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Monetary Policy and Stock Market Cycles in Iran

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ABSTRACT

The present study examines the impact of monetary policy on nominal and real stock returns in Iran during bull and bear stock market cycles. Estimating the models with a modified version of the Hamilton (1989) Markov-switching model and by employing the quarterly data spanning from 1991/92 to 2016/17, the results indicate that an expansionary monetary policy has a positive and statistically significant impact on stock returns only in bear regimes in line with the prediction of models with financial restrictions. By employing time-varying transition probability Markov-switching models the findings also indicate that an easy monetary policy increases the probability of remaining in a bull regime while reduces the probability of being trapped in a bear one.

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1- Introduction

Investigating the link between monetary policy and stock returns has been very important for monetary policymakers and financial market investors to employ appropriate monetary policy and make the right investment decisions. As stated by Bernanke and Kuttner (2005), financial market is an important channel of monetary policy transmission mechanism. Monetary policy affects its ultimate objectives indirectly via financial markets. Moreover, it has been of great interest to economists whether monetary policy has the same sort of effects in bull and bear stock market cycles. If monetary policy has asymmetric impacts, policy makers should consider stock market cycles[1] when implement monetary policy.

The objective of the present study is to investigate the reaction of stock returns to monetary policy and asymmetries over bull and bear cycles in Iran. Moreover, the impact of monetary policy on the switching probabilities between bull and bear regimes is also examined. Possible asymmetries are examined using Markov-switching (MS) models[2].

This study contributes to the existing literature in the following ways: First, most of the existing literature related to monetary policy asymmetries concentrate on the developed countries especially United State[3]. Due to difference in financial markets conditions and economic structures in Iran with that of advanced countries, the findings in developed economies is not exactly applicable for developing economies[4]. This study fills the gap in the literature by investigating

[1] Bull and bear stock market cycles
[2] We employ a modified version of Markov-switching modes developed by Hamilton (1989).
[3] See section 2.2 for a detailed review of empirical literature.
[4]Iran stock market faces some structural problems in the following areas compared to stock market in developed countries. (1) Major shareholders are state-owned or semi-state-owned such as banks, pension funds and other similar institutions. This may prevent small private investors to be able to compete with them. (2) It faces serious constraints in international communications largely influenced by political factors such as international sanctions and underdeveloped economic infrastructures. (3) The role of debt instruments and derivatives are

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asymmetric impacts of monetary policy in Iran. Second, this study investigates the asymmetric impacts of monetary policy on stock returns over bull and bear stock market conditions in Iran. In recent years, some papers has been published to explore asymmetries Iran. However, Most of the literature related to this issue are dealing with asymmetric effects on real output (see for instance, Sharifi Renani, Salehi, Ghobadi & Salehi, 2012; Gholami, Farzinvash & Ehsani, 2013; Jafari Samimi, Ehsani, Tehranchian & Ghaderi, 2014; Zare, 2015 and Komijani, Elahi & Salehi Rezveh, 2015). As far as we know, the only exception is Mousavi jahromi and Rostami (2015) who examined asymmetries[5] on stock price index in Iran. Third, this study employs fixed-transition probability (FTP-MS) and time-varying-transition-probability Markov-switching (TVTP-MS) models which are not explored in the related literature in Iran. In FTP models, the transition probabilities are static. In TVTP models, we assume the probability of switching between regimes to depend on monetary policy evolutions (Mousavi jahromi & Rostami, 2015).

The rest of paper is structured as follows. The next section reviews the theoretical and empirical literature. Econometric framework and the data are presented in Section 3. Section 4 reports the empirical results of the asymmetries and transition probabilities of switching between regimes. Finally, Section 4 concludes with some policy implications.

very limited in Iran stock market. (4) Share turnover as a measure of stock liquidity is very low. This measure is calculated by dividing the total number of shares traded over a period by the average number of shares outstanding for the period. This ratio is less than 0.2 for Iran but in some developed countries is around 2. (5) Very low rank in terms of market value relative to GDP. This ratio in Iran stock market is around 20% compared to around 80% in developed countries. (6) Floating stocks are much lower than developed countries. This ratio is around 20% in Iran compared to 70% to 90% in developed markets. (7) Low ratio of active shareholders to total population. This ratio is near 10% in Iran stock market compared to 50% in developed countries. (8) High percentage of dividends in Iran stock market. (9) Total value of share traded relative to GDP is low in in Iran stock market. (10) Iran stock market organizations does not have political and economic independence.

[5] Asymmetric effects of positive and negative monetary policy shocks.

2- Literature review

2-1- Theoretical literature

2-1-2- Monetary policy and stock returns

Mishkin (2007) describe the asset pricing channel[6] though which monetary policy affects the stock prices and returns (Mishkin, 2007). According to this channel:

$$Q_t = E_t\{\sum_{k=1}^{\infty} \frac{C_{t+k}}{(1+r_{t+k})^k}\} \quad (1)$$

Where Q_t is the current price of stock, C denotes its cash flows, r is the interest rate to discount the future and E_t is the expectations operator. From this simple model, monetary policy decisions (change in policy rate or money supply) can affect stock prices directly through discount rate $(1 + r_{t+k})^k$, and indirectly by influencing expectations of future cash flows. An increase in interest rate leads to lower expected future cash flow and hence lower stock prices[7].

2-1-3- Asymmetric effects of monetary policy

The theoretical framework for explaining the asymmetries over business cycles can be described by the models with financial restrictions. Recent financial theories of business cycle[8] describe how financial factors may enhance the effects of monetary policy. These models are based on "credit market imperfections" theories. According to these theories asymmetric information between lenders and borrowers prohibits efficient allocation of resources and leads to deadweight losses (agency costs) in optimal financial contracts. The

[6] According to this channel the price of a financial asset is equal to the discounted present value of expected future cash flows.

[7] Mishkin (1996) also elaborated two views through which monetary policy can influence stock prices: the monetarist view and the Keynesian view. From the monetarist view, expansionary monetary policies increase the optimum money balances and hence enhance the demand for equities and raising their prices. Keynesian argues that the fall in interest rates stemming from expansionary monetary policies making bonds less attractive than equities causing the price of equities to rise.

[8] These theories are developed by Bernanke and Gertler (1989) and Kiyotaki and Moore (1997).

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lender should impose agency costs to borrower to solve the moral hazard problem[9]. Moreover, the lender must impose a monitoring cost to the borrower to overcome asymmetric information. These costs reveal in "external finance premium". The balance sheet channel of money transmission mechanism stated by Bernanke and Gertler (1995) predict that the "external finance premium" is contrary to the borrower's net worth (Gertler, 1995).

The fact that borrower's net worth is likely to be procyclical implies that "external finance premium" increase during recessionary phases of business cycle and decrease during expansions. Thus, during recession the "external finance premium" will be relatively high which creates a financial propagation mechanism which intensify the interest rate effects of monetary policy by reducing the investment demand for constrained agents. The above discussion explains why monetary policy is more effective in recessions than expansions.

The models with financial restrictions also explain why monetary policy is more effective in bear cycles than bulls. According to these models, financial restrictions are more in bear cycles[10] because of lower net worth in these periods. The lower the net worth, the greater the external finance premium should be. Higher external finance premium create a financial propagation mechanism which amplify the interest rate effects of monetary policy (Garcia & Schaller, 2002; Chen, 2007).

2-2- Empirical literature

The impact of monetary policy on stock returns has been widely investigated in the last few years. The early literature in the 1960s to 1970s used money aggregate data to measure monetary policy.

[9] Moral hazard in this context refers to the notion that borrowers who need access to credit may be those who are least likely to be able to repay their debts.

[10] When there is asymmetric information in the financial market, borrowers behave like a financially constraint agent.

However, the empirical findings are different[11]. Since the influential paper by Bernanke & Blinder (1992), this relationship has been reexamined using the interest rate as measure of monetary policy (See for instance Thorbecke, 1997; Patelis, 1997; Conover, Jensen & Johnson, 1999).

Since then, two important contributions have been made to the related literature. The first one emphasizes on the unanticipated monetary policy shocks. Bernanke & Kuttner (2005) argued that stock market is not likely to react to anticipated monetary policy shocks. Accordingly, they extracted unanticipated monetary policy shocks from Federal funds futures by adopting the methodology suggested by Kuttner (2001). After controlling this issue the important finding is that stock returns only react to the unanticipated monetary policy shocks[12, 13].

The second contribution emphasizes on the endogeneity problem due to a bidirectional causality between monetary policy and stock prices. To circumvent the endogeneity problem a very high frequency dataset including daily and intraday dataset has been utilized which often has been referred to as the event study approach in the literature (see for instance Rigobon & Sack, 2004; Bernanke & kuttner 2005; Farka 2009; Chulia, Martens & Dijk, 2010 among others). However, as argued by Tsai (2011) a very high frequency event study

[11] For instance Keran (1971), Homa and Jaffee (1971) and Hamburner and Kochin (1972) found that monetary policy significantly affect stock returns. Cooper (1974), Pesando (1974), Rozeff (1974) and Rogalski and Vinso (1977) could not find significant relationship between these variables.

[12] In this research we do not follow this methodology for identification of the surprise component of monetary policy since unlike the developed economies, short term interest rate future contracts are not available in Iran.

[13] Refer to Bernanke and Kuttner, 2005; Chulia et al., 2010; Ehrmann and Fratzscher, 2004; Guo, 2004; Rigobon and Sack, 2004; Basistha and Kurov, 2008; Jansen and Tsai, 2010; Neely and Fawley, 2014 for a close review.

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approach cannot estimate the dynamic impact of monetary policy[14]. **Tabel 1** provides a summary of the related literature in some developed and developing countries.

Tabel 1. Summary of the Empirical Studies
Source: Research calculations

Authors	Sample countries	sample period	Methods	Findings
Laopodis (2013)	US	1970–1978, 1979–1987, 1987–2005,	VAR models	No relationship between the two variables.
Bouakez (2013)	US	1982:11–2007:11	a flexible SVAR model	Much weaker interaction than suggested by earlier studies.
Jansen & Zervou (2017)	US	June 1989-December 2007	the time-varying parameters model	Monetary policy surprise affects stock prices.
Ibrahim (2003)	Malaysia	Pre and post 1997 crisis	VAR models	Positive relation between monetary supply and stock price
Coleman & Agyire-Tettey (2008)	Ghana	1991-2005	Error correction models	Negative relation between interest rate and stock price
Suhaibu *et al.* (2017)	12 African countries	1979-2013	panel VAR model	Stock markets are positively affected by monetary policy
Zhang *et al.* (2017)	China	2005 - 2012	a non-linear VAR model	Significantly asymmetric effects of monetary policy over stock market cycles
Guo *et al.* (2013)	China	2005 - 2011	The MSVAR–EGARCH model	Significantly asymmetries in different time periods and market cycles
Sharma *et al.* (2019)	India	2003-2008 2008-2013 2013-2016	EGARCH model	Positive relation between monetary policy and stock price in period 3 (2013-2016) in India as compared to period 1 (2003-2008) and period 2 (2008-2013).
Nwakoby & Alajekwu (2016)	Nigeria	1986 –2013	The Johansen co-integration and the	Positive long-run relationship between variables. The granger causality analyses equally showed that this relationship runs from stock market to monetary policy

[14] This limitation and the unavailability of high frequency dataset in Iran motivate me to employ a lower frequency dataset (quarterly data) for investigating the dynamic impact of monetary policy on stock returns in Iran.

			granger causality test	implying that it is the stock market activities that influences the nature and direction of monetary policy to follow.
Fadaeinejad & Farahani (2017)	Iran	April 2003 to March 2015	Multiple regression models	Money supply negatively affect stock price index in Iran.
Bayat *et al.* (2016)	Iran	1995:1-2005:4	DSGE models	The reaction of central bank to deviations of total stock price index from its equilibrium reduces economic volatility and rises overall macroeconomic stability.
Nonejad *et al.* (2012)	Iran	1990 - 2008	VAR models	Monetary policy has a significant positive effect on real and nominal stock price index in Iran.
Ebrahimi & Shokri (2011)	Iran	1999:3-2009:3	Structural vector error correction (SVEC) models	Money supply shocks positively affect stock prices in Iran. However, the magnitude of the reaction of stock prices to shocks from variables such as oil prices, GDP and exchange rate is greater than the shocks from money supply.
Eslamloueyan & Zare (2007)	Iran	1993:3 - 2003:2	Auto regressive distributed lag (ARDL) models	Negative impact of money supply on stock price

Some empirical studies have investigated asymmetries of monetary policy[15]. Chen (2007) using MS models found that monetary policy is more effective in bear cycles. He also found that a contractionary monetary policy increases the probability of switching from the bull market to the bear market regime. Jansen & Tsai (2010) and Kurov (2010) examined the asymmetric response of stock returns to surprise component of monetary policy shocks over bull and bear cycles in an event study approach and found that monetary policy is more effective in bear cycles than bulls. They employed the method suggested by

[15] Lobo (2000), Bernanke and Kuttner (2005) and Chulia et al. (2010) found asymmetries connected to the direction of monetary policy shocks. Guo (2004), Andersen et al. (2007) and Basistha and Kurov(2008) studied the asymmetries over business cycle and showed that monetary policy is more effective in recessions than booms consistent with the prediction of models with financial restrictions.

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Kuttner (2001) to measure the surprise monetary policy shocks from the Federal Funds future data. Beatrice *et al*., (2013) using MS-VAR[16] models found that the monetary policy affects house price more strongly in bear regimes. Zare, Azali, Habibullah & Azman-Saini (2014) examined asymmetries in a panel of ASEAN5 countries by employing the PMG[17] method and found that monetary policy has stronger impact on real output in bear cycles than bulls.

In the case of Iran, the related literature are limited (see for instance, Sharifi Renani, Salehi, Ghobadi & Salehi, 2012; Gholami, Farzinvash & Ehsani, 2013; Jafari Samimi, Ehsani, Tehranchian & Ghaderi, 2014; Zare, 2015 and Komijani, Elahi & Salehi Rezveh, 2015, Zare, 2015). These studies examine the asymmetric impact of monetary policy on output and inflation. In the context of asymmetric effects of monetary policy on stock returns in Iran, the literature are even more limited. As far as we are aware, the only exception is Mousavi Jahromi & Rostami (2015) who examined the asymmetric effects of anticipated versus unanticipated monetary policy shocks and easy versus tight policy shocks on stock price index over the period 1991-2010. Due to the limited empirical studies in Iran, we examine the asymmetric impacts of monetary policy on stock returns over bull and bear stock market cycles in Iran.

3- Econometric framework

To examine asymmetries we employ MS[18] models developed by Hamilton (1989). Unlike linear models this approach is nonlinear and can handle asymmetries. Besides, the Hamilton algorithm endogenously determines bull and bear stock market cycles based on the data. In this study the Hamilton (1989) MS model is modified to allow monetary policy to affect stock returns. Moreover, the basic MS

[16] Markov-switching vector autoregressive
[17] Pooled mean group
[18] Markov-Switching

model is extended to a TVTP-MS[19] model to allow the probability of switching between regimes to depend on monetary policy.

1.1. Fixed transition probability MS model (FTP-MS model)

Let $R_t = 100 * \Delta\log(P_t)$, where $\log(P_t)$ is the logarithm of the nominal stock prices. Therefore, R_t is stock returns. Consider the following fixed transition probability MS Autoregressive ($FTP-MS-AR(q)$) model:

$$\varphi(L)R_t = \mu_{S_t} + \epsilon_t, \qquad \epsilon_t \sim i.i.d.N(0, \sigma^2_{S_t}), \tag{2}$$

Where, $\varphi(L) = 1 - L - L^2 - \cdots - L^k$. Term L denotes lag. μ_{S_t} and $\sigma^2_{S_t}$ are state-dependent mean and variance of R_t. Term S_t is a dummy variable (0 for bull or 1 for bear). The transition probability matrix is characterised by:

$$p = \begin{bmatrix} p^{00} & p^{01} \\ p^{10} & p^{11} \end{bmatrix} \tag{3}$$

where $p^{ij} = prob(S_t = j | S_{t-1} = i)$ with $\sum_{j=0}^{1} p^{ij} = 1$ for all i.

In other words, p^{10} is the probability of shift from state 1 to state 0 and is equal to $1 - p^{11}$. At first, it is supposed that transition probabilities are fixed over time with the following logit form:

$$p^{00} = \frac{\exp(\theta_0)}{1+\exp(\theta_0)} \tag{4}$$

$$p^{10} = \frac{\exp(\gamma_0)}{1+\exp(\gamma_0)} \tag{5}$$

The parameters θ_0 and γ_0 define the transition probabilities. Then, we allow transition probabilities to change over time to examine the impact of monetary policy on the probability of switching between

[19] Time-Varying-Transition-Probability Markov-Switching

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states. After estimating the parameters, we compute the filtered and smoothed probabilities for dating regimes[20].

3-2- A Modified MS Model

To examine asymmetries over bull and bear stock cycles we estimate a modified MS model as follows:

$$R_t = \mu_{S_t} + \sum_{j=0}^{q} \beta_{S_{t,j}} X_{t-j} + \delta_t Z_t + \epsilon_t \qquad (6)$$

$$\epsilon_t \sim i.i.d.N\left(0, \sigma_{S_t}^2\right)$$

Where X_{t-j} is monetary policy indicator at time $t-j$ measured using real M2 growth rate and changes in real interest rate. The asymmetric impacts of monetary policy can be examined by comparing the coefficients of X_{t-j} in different states. Z_t is a vector of relevant control variables[21]. These variables are important in explaining stock returns by affecting future cash flows.

3-3- Time-varying transition probability MS model (TVTP-MS)

To examine the impact of monetary policy on the probability of switching between alternative regimes we employ a TVTP-MS model. This model assumes that the transition probabilities change in response to the evolutions in monetary policy. The time-varying transition probability matrix can be specified as follows:

[20] Filtered probabilities are inferences about S_t conditional on information up to time t. The so-called filterd probabilities are given by:

$$p(S_t = j|\emptyset_t) = \sum_{i=0}^{1} \dots \sum_{k=0}^{1} p\,(S_t = j, S_{t-1} = i, \dots, S_{t-r} = k|\emptyset_t) \qquad j, i, \dots, k = 0,1 \qquad (7)$$

The smoothed probabilities are inferences about S_t by using all the information available in the sample. These probabilities provide information about the regime in which the series is most likely to have been at every point in the sample. So, they are very useful for dating regimes. In most applications, filtered and smoothed probabilities would lead to very similar conclusions.

[21] These variables include real GDP growth rate, inflation rate and exchange rate growth.

(7) $$p_t = \begin{bmatrix} p_t^{00}(\boldsymbol{Z_t}) & p_t^{01}(\boldsymbol{Z_t}) \\ p_t^{10}(\boldsymbol{Z_t}) & p_t^{11}(\boldsymbol{Z_t}) \end{bmatrix}$$

Where $p_t^{ij} = prob(S_t = j|S_{t-1} = i, \boldsymbol{Z_t})$, and $\boldsymbol{Z_t} = \{Z_t, Z_{t-1}, \dots\}$ is monetary policy. Therefore the probability of switching between alternative states is assumed to depend on monetary policy. Transition probabilities are as follows:

(8) $$p_t^{00}(\boldsymbol{Z_t}) = \frac{\exp(\theta_0 + \theta_1 \boldsymbol{Z_t})}{1 + \exp(\theta_0 + \theta_1 \boldsymbol{Z_t})}$$

(9) $$p_t^{11}(\boldsymbol{Z_t}) = \frac{\exp(\gamma_0 + \gamma_1 \boldsymbol{Z_t})}{1 + \exp(\gamma_0 + \gamma_1 \boldsymbol{Z_t})}$$

Clearly,

(10) $$\frac{\partial p_t^{00}}{\partial \boldsymbol{Z_t}} = \theta_1 p_t^{00}(1 - p_t^{00})$$

(11) $$\frac{\partial p_t^{11}}{\partial \boldsymbol{Z_t}} = \gamma_1 p_t^{11}(1 - p_t^{11})$$

Since $0 \leq p_t^{00}, p_t^{11} \leq 1$, the signs of $\frac{\partial p_t^{00}}{\partial \boldsymbol{Z_t}}$ and $\frac{\partial p_t^{11}}{\partial \boldsymbol{Z_t}}$ are determined by the signs of θ_1 and γ_1, respectively. Thus, the estimates of θ_1 and $\gamma_1$indicate the impact of monetary policy on the probability of switching between regimes.

3-4- The data

Our empirical application is based on the quarterly dataset of Iran stock market spanning from 1991/92 to 2016/17. We use total share price index to construct nominal and real stock returns. Nominal stock returns are computed from the logarithmic difference of total share price index. Then, the CPI inflation rate is deducted from nominal returns to compute real returns. Real returns are employed for the robustness check of empirical findings. Figure 1 represents the movements of the total share price index. Nominal and real returns are presented in figure 2. As is evident from figure 1 total share price index experiences upward trend to reach a peak in 2014Q1. Then, it is declined until last quarter of 2015 and then resumed its upward trend

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but still below its peak during the sample period. The summary statistics of the quarterly nominal and real return series are presented in **Tabel 2**. As depicted in the **Tabel 2**, Tehran stock exchange exhibit positive returns over the sample period. The nominal and real mean returns are 5.66% and 1.46% over the sample period, respectively. As reflected by the standard deviation, nominal and real returns display the same volatility. The market returns are positively skewed with more skewness in the case of nominal returns. Kurtosis statistics are lower than 3 indicate thinner tail than normal distribution. The Jarque-Bera test statistics for normality show normal distribution in both nominal and real returns.

Tabel 2. Descriptive Statistics of the Stock Market Returns
Source: Research calculations

	Nominal return	**Real return**
Mean	5.66	1.46
Median	6.20	1.46
Maximum	23.85	16.56
Minimum	-6.43	-12.97
Std. Dev.	8.60	8.55
Skewness	0.12	0.01
Kurtosis	2.00	1.84
Jarque-Bera	1.57	2.02
Probability	0.46	0.36

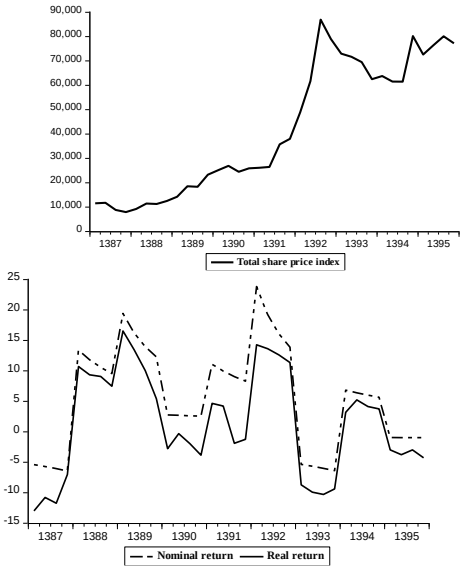

Figure 1. Total Share Price Index, Nominal and Real Returns
Source: Research calculations

We employ two measures of monetary policy: real M2 growth and changes in real interest rate. One year deposit rate is used as the suitable interest rate variable. The selection of appropriate measure of monetary policy is an important aspect of the analysis of monetary policy effects. Using money aggregates as measure of monetary policy has an identification problem since it reflects the endogenous responses of central banks to economic development and a variety of non-policy influences. Moreover, it may show demand for money (Morgan, 1993; Bernanke & Mihov, 1998; Kakes, 1998). Due to these deficiencies Bernanke & Blinder (1992) emphasized the role of interest rate as monetary policy indicator. Accordingly, we employ real interest rate as an alternative monetary policy indicator to check the robustness of the empirical findings.

Other variables considered in the study are as follows. Real output is represented by GDP at constant prices (2005=100). Exchange rate is spot Rial-USD exchange rate. The main source of the data is the

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economic time series database of the Central Bank of Iran through its official website (http://www.cbi.ir). The results of ADF and PP tests[22] are presented in **Tabel 3** The findings indicate that all the variables considered in the analysis are stationary.

Tabel 3. Unit Root Tests
Source: Research calculations

Variable	ADF	PP
Nominal returns	-3.760	-3.887
Real returns	-4.265	-4.402
Real M2 growth	-4.432	-11.811
Changes in real interest rate	-7.092	-5.029
Inflation rate	-3.336	-6.740
Real GDP growth	-11.118	-11.612
Exchange rate growth	-9.004	-9.174

NOTE: Critical values for ADF and PP are -3.49 (1%), −2.89 (5%), and −2.58 (10%). Lags in ADF are selected by Schwartz Bayesian information criterion (SC).

4- Empirical results

4-1- FTP-MS model

The finding of linear and MS models are depicted in Table 4. No AR lag in R_t is selected based on non-autocorrelated error terms. Based on the likelihood-ratio (LR) test the Marrkov-switching models perform better than linear models. The LR test statistic[23] is 76.92 for the nominal returns data and 59.98 for real returns data[24]. The LR statistic

[22] The augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) unit root tests
[23] LR test statistic is computed as $LR = 2LL\_M2 - 2LL\_M1$. Where LL_M2 is the LogLik of the Markov-switching model and LL_M1 is the LogLik of the linear model.
[24] Garcia (1998) tabulates critical values for the simple two-means, two-variances FTP-MS-AR(0) model under the null of no switching.

is much higher than the 99%-critical value (14.02). According to the findings depicted in Table 4, the MS models identify two regimes with different means and variances conventionally labelled as bull (regime 0) and bear (regime 1). Average expected durations of bull and bear regimes reported in Table 5 show that both regimes are highly persistent. They persists on average around 10 to 12 quarters. Figure 2 shows the smoothed probabilities of regime 0 (bull)[25]. As is evident from Figure 1, both nominal returns and real returns show consistent periods of bull and bear cycles.

Tabel 4. Linear and Ms Models
Source: Research calculations

	Nominal returns		Real returns	
	linear	**FTP-MS-AR(0)**	**linear**	**FTP-MS-AR(0)**
μ	5.097*** (0.818)		0.719 (0.792)	
μ_0		10.767*** (0.876)		6.240*** (0.977)
μ_1		-2.321*** (0.455)		-6.196*** (0.623)
σ	8.181		7.920	
σ_0		1.806*** (0.101)		1.766*** (0.107)
σ_1		1.003*** (0.119)		1.202*** (0.122)
θ_0		2.428*** (0.498)		2.299*** (0.527)
γ_0		-2.357*** (0.562)		-2.242*** (0.554)
p^{00}		0.919		0.909
p^{10}		0.081		0.091
logLik	-351.573	-313.112	-348.325	-318.336

NOTE: The numbers in parentheses are the standard errors.*** represents significant at 1% significance level.

[25] The smoothed probabilities of regime 0 (bull) are computed using the full-sample smoothing algorithm of Kim (1994). Simply taking 0.5 as the cut-off value, the periods with smoothed probabilities greater than 0.5 are more likely to be a bull regime.

Tabel 5. Average Expected Durations of Bull and Bear Regimes
Source: Research calculations

	Nominal returns	Real returns
bull	12.332 quarters	10.414 quarters
bear	11.559 quarters	10.967 quarters

Notes: Average expected durations for regime 0 (bull) and regime 1 (bear) are computed as $\frac{1}{1-p^{00}}$ and $\frac{1}{1-p11}$, respectively.

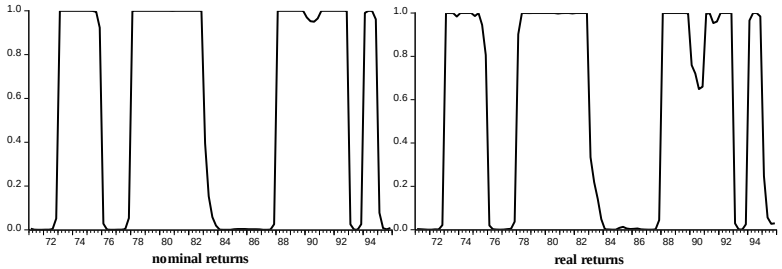

Figure 2. Smoothed Probabilities in Regime 0 (Bull)
Source: Research calculations

4-2- A modified MS model

The results of a modified MS model based on equation (8) are reported in Table 6. The coefficients β_0 and β_1 show the response of stock returns to monetary policy in bull and bear regimes, respectively. The results show that monetary policy significantly affect stock returns only in bear cycles. When we measure monetary policy by real M2, it has a positive impact on stock returns. However, when it is measured by real interest rate it has negatively affected stock returns. In other words, increase in real M2 rise stock returns while increase in real interest rate reduce returns[26]. The stronger impact of monetary policy on stock returns in bear market periods than bulls is in line with the prediction of models with financial restrictions. These findings are consistent with

[26] The empirical results from real returns data are very similar to what I obtained from nominal returns data, thus making my estimates robust.

the findings in Perez-Quiros & Timmermann(2000), Chen (2007), Kurov (2010), Jansen & Tsai (2010) & Beatrice *et al*., (2013).

Tabel 6. FTP-MS models
Source: Research calculations

	Nominal returns		Real returns	
	real M2 growth	Changes in real interest rate	real M2 growth	Changes in real interest rate
μ_0	8.150*** (1.578)	9.911*** (1.247)	8.150*** (1.577)	9.911*** (1.247)
μ_1	-5.218*** (1.199)	-3.062*** (0.859)	-5.218*** (1.199)	-3.062*** (0.859)
σ_0	1.726*** (0.105)	1.771*** (0.107)	1.726*** (0.105)	1.771*** (0.107)
σ_1	0.952*** (0.119)	0.874*** (0.122)	0.952*** (0.119)	0.874*** (0.122)
β_0	-0.158 (0.222)	-0.238 (0.276)	-0.158 (0.222)	-0.238 (0.2756)
β_1	0.293** (0.131)	-0.474*** (0.188)	0.293** (0.131)	-0.474*** (0.188)
θ_0	2.387*** (0.578)	2.377*** (0.578)	2.387*** (0.578)	2.377*** (0.578)
γ_0	-2.437*** (0.510)	-2.443*** (0.509)	-2.437*** (0.510)	-2.443*** (0.509)
p^{00}	0.916	0.915	0.916	0.915
p^{10}	0.084	0.085	0.084	0.085
Inflation rate	0.689*** (0.259)	0.218 (0.211)	-0.311 (0.259)	-0.782*** (0.211)
Real GDP growth	0.066 (0.049)	0.074* (0.046)	0.066 (0.049)	0.074* (0.046)
Growth rate of exchange rate	-0.122* (0.071)	-0.060 (0.069)	-0.122* (0.071)	-0.060 (0.069)
logLik	-305.769	-306.358	-305.769	-306.359

NOTE: Refer to notes of Table 4. Real M2 growth and Changes in real interest rate are monetary policy indicators.

4-3- TVTP-MS model

Does monetary policy affect the dynamics of switching between regimes? To answer this question, we estimate a TVTP-MS model as formulated in section 3.3. Table 7 presents the estimation results of θ_1 and γ_1 from equations (10) and (11). Clearly, it is found that $\hat{\theta}_1 > 0$ and $\hat{\gamma}_1 < 0$ in the case of employing real M2 as measure of monetary policy. Here, $\hat{\theta}_1 > 0$ means that an expansionary monetary policy raises the probability of remaining in a bull regime (ie., $p_t^{00}(Z_t)$).

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Furthermore, an expansionary monetary policy reduces the probability of switching from a bull regime to a bear one (ie., $p_t^{01}(Z_t) = 1 - p_t^{00}(Z_t)$). In addition, since we get $\hat{\gamma}_1 < 0$, thus an expansionary monetary policy decreases the probability of being trapped in a bear market (i.e., $p_t^{11}(Z_t)$) while it can increase the probability of switching from a bear market to bull one (ie., $p_t^{10}(Z_t) = 1 - p_t^{11}(Z_t)$).

In the case of employing real interest rate as measure of monetary policy it is found that $\hat{\theta}_1 < 0$ and $\hat{\gamma}_1 > 0$. Here, $\hat{\theta}_1 < 0$ means that negative changes in real interest rate (an expansionary monetary policy) raises the probability of remaining in a bull regime while reduces the probability of switching from a bull regime to a bear one. In addition, since we get $\hat{\gamma}_1 > 0$, thus negative changes in real interest rate (an expansionary monetary policy) decreases the probability of remaining in a bear market while it can increase the probability of switching from a bear market to bull one. The findings of a TVTP-MS model are consistent with the findings of Chen (2007) who employed the same methodology. Chen (2007) showed that a tight monetary policy shock increases the probability of switching from the bull market to a bear one while it reduces the probability of staying in the bull market. However, it raises the probability of being trapped in the bear market regime.

Tabel 7. TVTP-MS Models
Source: Research calculations

	Nominal returns		Real returns	
	real M2 growth	Changes in real interest rate	real M2 growth	Changes in real interest rate
μ_0	8.517*** (1.547)	9.913*** (1.261)	8.517*** (1.547)	9.913*** (1.261)
μ_1	-4.945*** (1.173)	-3.064*** (0.868)	-4.945*** (1.173)	-3.064*** (0.868)
σ_0	1.712*** (0.104)	1.770*** (0.108)	1.712*** (0.104)	1.770*** (0.108)
σ_1	0.942*** (0.118)	0.874*** (0.124)	0.942*** (0.118)	0.874*** (0.124)
θ_0	2.374*** (0.545)	2.514*** (0.544)	2.374*** (0.545)	2.514*** (0.544)

θ_1	0.155 (0.109)	-0.097 (0.150)	0.155 (0.109)	-0.097 (0.150)
γ_0	-2.409*** (0.689)	-2.392*** (0.590)	-2.409*** (0.689)	-2.392*** (0.590)
γ_1	-0.253* (0.145)	0.016 (0.274)	-0.253* (0.145)	0.016 (0.274)
logLik	-303.285	-306.128	-303.285	-306.128

NOTE: Refer to notes of Table 4. Real M2 growth and Changes in real interest rate are monetary policy indicators.

5- Conclusion

The present study empirically examine the impacts of monetary policy on stock returns during bull and bear markets in Iran by employing MS model developed by Hamilton (1989). According to models with financial restrictions, monetary policy may have stronger impact in bear cycles than bulls. Employing a quarterly dataset spanning from 1991/92 to 2016/17, the FTP-MS-AR(0) models find two regimes characterized as bull and bear cycles.

The results of a modified MS model indicate that monetary policy significantly affect stock returns only in bear cycles. More specifically, increase in real M2 rise stock returns while increase in real interest rate reduce returns for both nominal and real returns in bear regimes. These findings are in line with the prediction of the models with financial restrictions. Finally, Empirical results from estimating TVTP-MS models suggest that that an expansionary monetary policy raises the probability of remaining in a bull regime while reduces the probability of being trapped in a bear regime.

As a policy implication, monetary policy makers should consider stock market cycles in implementing monetary policies. Especially in bear market periods implementing an expansionary monetary policy may lessen the probability of remaining in bear markets and will raise the probability of switching from a bear regime to a bull one. Moreover, the stock market investors should consider that the impact of monetary policy on stock returns may depend on the phase of the stock market.

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Monetary Policy and Commodity Terms of Trade Shocks

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ABSTRACT

The commodity terms of trade shocks are important to explain the macroeconomic fluctuations of oil-exporting countries. Oil price shocks are the main source of terms of trade variability in oil-exporting countries. Given the significant effects of terms of trade fluctuations on domestic macroeconomic variables, understanding the transmission and propagation of terms of trade fluctuations is crucial in the design and conduct of macroeconomic policies in oil-exporting countries. An appropriate monetary policy can help to stabilize these shocks. This study evaluates three alternative monetary policy regimes' responses to commodity terms of trade shock and export sector productivity shock using a New Keynesian Dynamic Stochastic General Equilibrium (DSGE) model. The model is calibrated to the Iran economy. This study aims at investigating the dynamic effects of commodity terms of trade shocks and evaluating the performance and the stabilization properties of various simple monetary policy rules for oil-dependent economies. Three alternative monetary policy rules have been considered: CPI inflation targeting (CIT) rule, non-traded inflation targeting (NTIT) rule, and exchange rate targeting (ET) rule. The comparison of responses under different monetary policy regimes shows that CPI inflation targeting is superior to the NTIT and ET targeting when commodity terms of trade shock happen. For export productivity shock, the performance of the CIT rule is better than other examining monetary policy rules. Also, the real exchange rate, which is defined as a function of commodity terms of trade and productivity differentials, makes it possible to examine the role of export productivity shock on macroeconomic variations and test the existence of Balassa- Samuelson effect. Under the export sector productivity shock, exported output increases while non-traded output decreases, possibly reflecting the symptoms of the Dutch disease. On the other hand, the dynamic responses of selected macroeconomic variables suggest the presence of the Balassa-Samuelson effect where an increase in productivity in the traded sector appreciates the real exchange rate and increases the prices of non-tradable goods through wage equalizations. Overall, when the economy is experiencing commodity terms of trade shocks or exported productivity shocks, CPI inflation targeting is relatively better than exchange rate targeting and non-traded inflation targeting in macroeconomic stabilization.

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1- Introduction

The commodity terms of trade shocks are regarded as a major source of economic fluctuations. These shocks roughly account for half of the fluctuation in aggregate output (Kose & Riezman, 2001; Mendoza, 1995), and play a very important role in inducing business cycles in factors of production as they account for more than 86% of investment and 80% of lobar supply fluctuations (Kose & Riezman, 2001). Coudert et al. (2015) have found a positive relationship between the real exchange rate and the country`s terms of trade for whole commodity exporters, be they advanced, intermediate or low-income countries. Also, they have shown that improved terms of trade cause a Dutch disease problem on the long run if commodity exporter countries do not adequately redistribute rents across sectors. These shocks are more volatile in developing countries because primary commodities constitute a significant component of the exports in developing countries (Cashin, McDermott, & Pattillo, 2004; De Gregorio & Wolf, 1994) so, fluctuations in world commodity prices have the potential to explain a large share of movements in their terms of trade (Cashin, Céspedes, & Sahay, 2004).

Broda (2004) and Chia & Alba (2005) have examined the effects of terms of trade shocks on important macroeconomic variables under alternative exchange rate regimes and they found that flexible exchange rate regimes adjust real shocks more effectively than fixed regimes. This result is in favor of Friedman`s (1953) hypothesis. Devereux, lane & Xu (2004) and Hove, Touna Mama & Tchana Tchana (2015) have compared alternative monetary policy rules in emerging market economics that experience commodity terms of trade shocks. Hove et al. (2015) have found that commodity terms of trade shocks have less impact on most macroeconomic variables under CPI inflation targeting. However, Devereux et al. (2004) have shown the degree of exchange rate pass-through is very important for the assessment of monetary policy. Allegret & Bebkhodja (2015) investigate the dynamic effect of external shocks under alternative monetary rules in an oil economy using Bayesian approach, the DSGE

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model based on the features of the Algerian economy. They have found that the core inflation monetary rule performs relatively better to stabilize both output and inflation.

A large part of the variability of the terms of trade is associated with extreme movements in oil prices (Backus & Crucini, 2000) and commodity price volatilities influence both exchange rates and the terms of trade of commodity exporters (Bergholt, 2014). Iran has the fifth largest oil reserves and the second largest gas reserves in the world. Oil exports account for a high percentage of export earnings and finance a significant portion of government spending in This country. However, some researches have studied the macroeconomic performance of alternative monetary policy regimes in Iran. They often have evaluated the role of monetary policy in adjusting shocks, such as oil price shocks, oil income shocks and productivity shocks (see Rabee Hamedani & Pedram, (2013); Bahrami & Ghoreishi, (2011)). Although these shocks are important, it is necessary to analyze commodity terms of trade shocks in oil exporting economies like Iran.

In this paper, a multi-sector DSGE set-up based on Hove et al. (2015), Monacelli (2005) and Cashin et al. (2004) has been developed for the economy of Iran. This study aims at investigating the dynamic effects of commodity terms of trade shocks and evaluating the performance and the stabilization properties of various simple monetary policy rules for oil-dependent economies. Three alternative monetary policy rules have been considered: CPI inflation targeting (CIT) rule, non-traded inflation targeting (NTIT) rule and exchange rate targeting (ET) rule. The rest of the paper is organized as follows: section 2 lays out the model while section 3 describes the calibration of parameters and solution of the model. Section 4 analyzes the results. Section 5 is the conclusions and suggestions.

2- A small open economy model

In this study, the model has been developed based on Hove et al. (2015), Monacelli (2005) and Cashin et al. (2004) for the economy of Iran. This theoretical framework characterizes a small open oil

exporting economy by two domestic sectors: traded sector and non-traded sector. In non-traded sector, prices are sticky according to Calvo`s (1983). There is one external sector which is the rest of the world. Also, incomplete exchange rate pass-through is introduced via nominal rigidities on import prices. This model has developed to evaluate the response of different monetary policy regimes to commodity terms of trade shocks and export productivity shocks.

2-1- The consumer`s problem

Following Hove et al (2015), Representative household in the home country are assumed to maximize the following utility function:

$$U = E_0 \sum_{t=0}^{\infty} \beta^t \left(\frac{C_t^{1+\psi}}{1-\sigma} - \eta \frac{L_t^{1+\psi}}{1+\psi} \right) \quad (1)$$

Subject to the following budget constraint:

$$P_t C_t \leq W_t L_t + \prod_t + D_t - E_t(Q_{t+1} D_{t+1}) + T_t \quad (2)$$

E_0 denotes the conditional expectation on information available at date t=0, β is the inter temporal discount factor, with $0 < \beta < 1$. C_t denotes composite consumption in period t, L_t denotes labor supply. $\sigma > 0$ is the inverse of the elasticity of substitution between consumption and labor and $\psi > 0$ is the inverse of wage elasticity of labour.

In the budget constraint, W_t is the nominal wage, P_t is the consumer price index, and Π_t are real profits for the home consumer.D_t is the portfolio of assets. D_{t+1} is the nominal payoff of period $t+1$ of the portfolio held at the end of time t, $Q_{t+1}$is the stochastic discount factor, and T_t are lump-sum taxes.

The aggregate consumption index (C_t) is a composite of non-tradable (C_{Nt}) and tradable (C_{Tt}) goods witch takes the constant elasticity of substitution (CES) function of the form:

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(3) $$C_t = \left[\alpha^{\frac{1}{\rho}} C_{Nt}^{\frac{\rho-1}{\rho}} + (1-\alpha)^{\frac{1}{\rho}} C_{Tt}^{\frac{\rho-1}{\rho}}\right]^{\frac{\rho}{\rho-1}}$$

where ρ is elasticity of substitution between the tradable and non-tradable goods, and α is share of non-tradable goods in the consumption basket at home. In this context, the consumer price index that corresponds to the previous specification is given by:

(4) $$\mathrm{P_t} = \left(\alpha \mathrm{P_{Nt}^{1-\rho}} + (1-\alpha)\mathrm{P_{Tt}^{1-\rho}}\right)^{\frac{1}{1-\rho}}$$

where, all prices are for goods sold in the home country, in home currency for tradable and non-tradable goods.

Households allocate aggregate expenditure based on the following demand functions:

(5) $$C_{Nt} = \alpha \left(\frac{P_{Nt}}{P_t}\right)^{-\rho} C_t$$

(6) $$C_{Tt} = (1-\alpha) \left(\frac{P_{Tt}}{P_t}\right)^{-\rho} C_t$$

The demand for domestic non-tradable goods and imports is given by:

(7) $$Y_{Nt}^D = C_{Nt} + G_t$$

(8) $$Y_{Tt}^D = C_{Tt}$$

It is assumed that the government only demands domestically non-tradable goods, such that:

(9) $$G_t = G_{Nt}$$

Government spending is exogenously determined and exhibits persistent variation. In particular, it follows an AR(1) process in log-linearized terms:

(10) $$g_t = \rho_g g_{t-1} + \epsilon_{gt}$$

where g_t is the amount spent by the government and $\epsilon_{gt}$is distributed normally with mean 0 and variance σ_g^2.Lowercase letters are used to denote the log-linearized of their uppercase counterparts.

The first order conditions of the household`s optimization problem are given by:

(11) $$C_t^{\sigma}\eta L_t^{\psi} = \frac{W_t}{P_t}$$

(12) $$\beta R_t E_t\left(\left(\frac{C_{t+1}}{C_t}\right)^{-\sigma}\left(\frac{P_t}{P_{t+1}}\right)\right) = 1$$

2-2- Firms

2-2-2- Domestic firms

Following Hove et al (2015), There are two sectors in the domestic economy; the traded sector and non-traded sector. It is assumed that the domestic traded sector only produces oil which are all exported. Firms in the traded sector operate under perfect competition and use the following linear technology:

(13) $$Y_{Xt} = A_{Xt}L_{Xt}$$

where A_{Xt} is a productivity variable and L_{Xt} is labor in the commodity export sector. A_{Xt} follows an AR(1) process such that in logarithms, it is:

(14) $$\ln A_{Xt} = \rho_x \ln A_{Xt-1} + \epsilon_{Xt}$$

where $\epsilon_{Xt} \sim N(0.1)$ and ρ_x is the autocorrelation coefficient showing the persistence parameter of lobar productivity in the oil export sector. Cost minimization in the commodity export gives the following marginal cost:

(15) $$MC_{Xt}^{R} = \frac{W_t}{A_{Xt}P_{Xt}}$$

where MC_{Xt}^{R} is the real marginal cost in the oil export sector, W_t is the wage rate and P_{Xt} is the oil price. Firms in the non-traded sector face monopolistic competition and produce differentiated non-traded goods using the linear production technology:

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(16) $$Y_{Nt} = A_{Nt} L_{Nt}$$

where A_{Nt} is a productivity variable for non-traded goods and L_{Nt} is labor in the non-traded sector. A_{Nt} follows an AR(1) process such that in logarithms, it is:

(17) $$\ln A_{Nt} = \rho_N \ln A_{Nt-1} + \epsilon_{Nt}$$

where $\epsilon_{Nt} \sim N(0.1)$ and ρ_N is the autocorrelation coefficient showing the persistence parameter of lobar productivity in the non-traded sector. Cost minimization in the non-traded sector gives the following marginal cost:

(18) $$MC_{Nt}^{R} = \frac{W_t}{A_{Nt} P_{Nt}}$$

where MC_{Nt}^{R} is the real marginal cost in the non-traded sector and P_{Nt} is the price of non-traded goods. Because of perfect competition in the traded sector, the price of tradeable goods can be expressed as a function of wages and productivity only. Also the price of non-traded goods can be expressed as a function of wages, productivity and marginal costs:

(19) $$P_{Nt} = \frac{W_t}{A_{Nt}\, MC_{Nt}^{R}}$$

(20) $$P_{Xt} = \frac{W_t}{A_{Xt}}$$

Using E.q. (19) and (20), the price of non-traded goods can be written as function of the oil price and the relative productivities between tradable and non-tradable sectors.

(21) $$P_{Nt} = \frac{A_{Xt}}{A_{Nt} MC_{Nt}^{R}} P_{Xt}$$

2-2-3- Foreign firms

Following Cashin et al.(2004) and Hove et al.(2015), the foreign economy is assumed to be contained of three different sectors that is the non-tradable sector, intermediate sector, and final good sector. Firms in all sectors are perfectly competitive. Since the labor is movement across sectors, the wage is equated across sectors, firms in

non-tradable sector produce differentiated goods under a linear production function that is given by:

(22) $$Y_{Nt}^{*} = A_{Nt}^{*} L_{Nt}^{*}$$

where A_{Nt}^{*} is a productivity variable for non-traded goods and L_{Nt}^{*} is labor in the foreign non-traded sector. A_{Nt}^{*} follows an AR(1) process such that in logarithms, it is:

(23) $$\ln A_{Nt}^{*} = \rho_{N_t^{*}} \ln A_{N_{t-1}}^{*} + \epsilon_{N_t}^{*}$$

where $\epsilon_{N_t}^{*} \sim N(0.1)$. Firms in the foreign intermediate sector also operate under a linear production function:

(24) $$Y_{It}^{*} = A_{I}^{*} L_{It}^{*}$$

where A_{I}^{*} is a productivity variable for intermediate goods and L_{It}^{*} is labor in the foreign intermediate sector. A_{I}^{*} follows an AR(1) process such that in logarithms, it is:

(25) $$\ln A_{I_t}^{*} = \rho_{A_{It}^{*}} \ln A_{I_{t-1}^{*}} + \epsilon_{I_t}^{*}$$

where $\epsilon_{I_t}^{*} \sim N(0.1)$. As before, the price of foreign non-traded goods is defined as:

(26) $$P_{Nt}^{*} = \frac{A_{It}^{*}}{A_{Nt}^{*}} P_{It}^{*}$$

where P_{It}^{*} is the price of intermediate inputs. There is a continuum of final good variety producers. Firms in foreign traded sector produce traded final goods using oil which is exported by domestic economy (Y_{Xt}^{*}) and foreign intermediate good produced in the rest of the world (Y_{It}^{*}) through the following technology:

(27) $$Y_{Tt}^{*} = \vartheta (Y_{It}^{*})^{v} (Y_{Xt}^{*})^{1-v}$$

the price of foreign traded goods is defined as:

(28) $$\mathrm{P}_{\mathrm{Tt}}^{*} = (P_{It}^{*})^{\mathrm{v}} (\mathrm{P}_{\mathrm{Xt}}^{*})^{1-\mathrm{v}}$$

Foreign consumer price index is:

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(29) $$P_t^* = P_{Nt}^{*\,\alpha^*} \mathrm{P}_{\mathrm{Tt}}^{*\,1-\alpha^*}$$

2-3- Pass through and deviations from PPP

Based on empirical evidence such as Shajari et al (2015), pass through is assumed to be incomplete in model. Following Monacelli (2005), under the assumption of incomplete pass-through, the Law Of One Price (LOP) does not hold. This means that the price of any imported goods in the market of small open economy is not equal to price of the identical good in the world market in terms of domestic currency. In other words, the economy is identified by deviation of the world price from the domestic currency price of imports as follows:

(30) $$\mathrm{P}_{\mathrm{Tt}} \neq \frac{\mathrm{P}_{\mathrm{Tt}}^*}{\varepsilon_{\mathrm{t}}}$$

where ε_t is the nominal exchange rate, P_{Tt}^* is price of foreign country in the terms of its own currency. From above expression the LOP gap is defined as follows in log-linearized form:

(31) $$\psi_t = p_{Tt}^* - e_t - p_{Tt}$$

2-4- Real exchange rate, commodity terms of trade and Pass through

As Hove et al (2015), Real exchange rate is defined as the ratio of domestic prices in foreign currency to the foreign prices:

(32) $$\mathbb{Q}_{\mathrm{t}} = \frac{\varepsilon_{\mathrm{t}} \mathrm{P}_{\mathrm{t}}}{\mathrm{P}_{\mathrm{t}}^*}$$

The Law Of One Price is assumed to hold for exports such that:

(33) $$P_{Xt} = \frac{P_{Xt}^*}{\varepsilon_t}$$

Following Hove et al (2015) and monacelli (2005), From equation (32) and after some algebra, the following version of the real exchange rate can be derived:

(34) $$\mathbb{Q}_t = \left(\frac{A_{Xt}}{A_{It}^*}\frac{A_{Nt}^*}{A_{Nt}}\frac{P_{Xt}^*}{P_{It}^*}\right)^{\alpha}\left(\frac{1}{MC_{Nt}^R}\right)^{\alpha}\left(\frac{1}{\psi_t}\right)^{1-\alpha}$$

Commodity terms of trade is defined as the relative price of commodity exported in terms of intermediate foreign inputs.

(35) $$F_t = \frac{P^*_{Xt}}{P^*_{It}}$$

Substituting equation (35) into the real exchange rate equation gives:

(36) $$\mathbb{Q}_t = \left(\frac{A_{Xt}}{A^*_{It}}\frac{A^*_{Nt}}{A_{Nt}}F_t\right)^{\alpha}\left(\frac{1}{MC^R_{Nt}}\right)^{\alpha}\left(\frac{1}{\psi_t}\right)^{1-\alpha}$$

This is a version of real exchange rate which is function of productivity differential between the export and import sectors, productivity differential between domestic and foreign non-traded sectors, terms of trade, LOP gap and marginal costs.

2-5- Incomplete pass through and imports pricing

As Monacelli (2005), imported good firms follow Calvo (1983) staggered price setting where they adjust their prices only with some probability. That is at period t, $1-\theta_\psi$ firms set prices optimally and θ_ψ keep prices unchanged, where $\theta_\psi \in (0.1)$ is the degree of nominal rigidity.

The import price index is defined as follows:

(37) $$P_{Tt} = \left\{\left(1-\theta_\psi\right)P_{Tt}^{new\,1-\varepsilon} + \theta_\psi P_{Tt-1}{}^{1-\varepsilon}\right\}^{\frac{1}{1-\varepsilon}}$$

where P_{Tt}^{new} is price level of an optimizing firm. By log-linearizing equation (37) and Further computations lead to an aggregate supply curve equation for the import goods where$\lambda_\Psi = \frac{(1-\theta_\psi)(1-\theta_\psi\beta)}{\theta_\psi}$:

(38) $$\Pi_{Tt} = \beta E_t \Pi_{Tt+1} + \lambda_{\psi t}\psi_{Tt}$$

2-6- International risk sharing and uncovered interest parity

As Gali and Monacelli (2005) complete securities markets are assumed, so a first order condition analogous to (12) must also hold for the representative household in any other country:

(39) $$\beta E_t\left(\frac{C_{t+1}}{C_t}\right)^{-\sigma}\left(\frac{P_t}{P_{t+1}}\right) = \beta E_t\left(\frac{C^*_{t+1}}{C^*_t}\right)^{-\sigma}\left(\frac{\varepsilon_t P^*_t}{\varepsilon_{t+1}P^*_{t+1}}\right)$$

Under the assumption of complete international markets, the uncovered interest parity condition can be derived:

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(40) $$E_t Q_{T+1}\left(R_t - R_t^* \frac{\varepsilon_{t+1}}{\varepsilon_t}\right) = 0$$

2-7- Domestic price setting

As Hove et al (2015) non-traded good firms follow Calvo`s (1983) staggered price setting where they adjust their prices only with some probability. That is at period t, $1-\theta_N$ firms set prices optimally and θ_N keep prices unchanged, where $\theta_N \in (0.1)$ is the degree of nominal rigidity. The aggregate price level of domestically produced non-traded goods (P_{Nt}) evolves according to:

(41) $$P_{Nt} = \theta_N P_{Nt-1} + (1-\theta_N)P_{Nt}^*$$

where P_{Nt}^* is an index for the prices newly set in period t.

(42) $$\pi_{Nt} = \lambda_N mc_{Nt} + \beta E_t\{\pi_{Nt+1}\}$$

where $\lambda_N = \frac{(1-\theta_N)(1-\beta\theta_N)}{\theta_N}$.

2-8- Monetary policy rules

Monetary policy is conducted with generalized Taylor rule.

(43) $$R_t = R_{t-1}^{\rho_r}\left\{\left(\frac{Y_t}{\overline{Y}}\right)^{\omega_1}\left(\frac{\Pi_t}{\overline{\Pi}}\right)^{\omega_2}\left(\frac{\Pi_{Nt}}{\overline{\Pi_N}}\right)^{\omega_3}\left(\frac{\varepsilon_t/\varepsilon_{t-1}}{\overline{\varepsilon}}\right)^{\omega_4}\right\}^{1-\rho_r}$$

2-9- Equilibrium

The good market clearing condition in domestic economy requires for all t that domestic output equals a weighted average of traded and non-traded output:

(44) $$y_t = \alpha y_{Nt} + (1-\alpha)y_{Xt}$$

That domestic non-traded output consists of private consumption and government spending:

(45) $$y_{Nt} = y_{Nt}^D = c_{Nt} + g_t$$

And the domestic traded output is equal to consumption of traded goods:

(46) $$y_{Tt} = y_{Tt}^{D} = c_{Tt}$$

Also, the market clearing condition in foreign economy is a weighted average of traded and non-traded output:

(47) $$y_t^* = \alpha^* y_{Nt}^* + (1-\alpha^*) y_{Tt^*}$$

(48) $$r_t^* = \rho_r r_{t-1}^* + \epsilon_{t.r^*}$$

3- Calibration and solution

The model is solved numerically and the parameter choices for the model are summarized in Table 1. The model is calibrated to match the key features of the Iran economy using data for period 1991: Q1 to 2017: Q1. The series of Oil production and Non-oil production are obtained from the "Statistical Centre of Iran" The series of Interest rate and oil price are obtained from the "Central Bank of Iran". The series of production in foreign intermediate sector and foreign intermediate good price are obtained from the "Archival Federal Reserve Economic Data"[1]. Other parameters were obtained from previous studies on the Iran economy and business cycle literature in the world. The benchmark parameter choices for the model are described in Table 1. Following Fotros, Tvakolian and Maabodi (2014), Elasticity of substitution between traded and non-traded goods ρ is set at 3.4. Following Tavakolian and Afzali Abarghoie (2016), the subjective discount factor β and the share of non-traded goods in consumption α are set as 0.96 and 0.8, respectively. The inverse of the elasticity of substitution between consumption and labor σ is set at 1.57, Following Komijani and Tavakolian (2012). As Manzoor and Taghipour (2015) stickiness parameter in the non-traded sector θ_N, stickiness parameter in the import sector θ_Ψ and Elasticity of substitution between traded and non-traded goods in foreign ρ^* are set as 0.2488, 0.2, 3.5 respectively. Following Rabanal &Tuesta (2013) persistence parameter for foreign interest rate ρ_r^* and persistence parameter of lobar productivity in foreign non-traded sector ρ_{Nt}^* are set as 0.88 and 0.75 respectively. Following Hove et al. (2015), share of non-traded goods in

[1] The date of US is considered as an alternative for foreign sector data

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consumption in foreign country $\boldsymbol{\alpha}^*$ is set at 0.8. AR(1) processes are fitted for interest rate in Iran, oil price, lobar productivity in intermediate sector and intermediate good price in U.S. (as proxy for world) using quarterly, HP-filtered data over the sample period between 1991:Q1 to 2017:Q1, Which are estimated as follows:

$$p_{xt}^* = 0.69965 p_{xt-1}^* + \varepsilon_{xt}^* \quad (49)$$

$$a_{It}^* = 0.870763 a_{It-1}^* + \varepsilon_{It} \quad (50)$$

$$r_t = 0.702393 r_{t-1} + \varepsilon_{rt} \quad (51)$$

Tabel 1. Calibration of the model
Source: Research results

Parameter	Definition and Description	Value
$\boldsymbol{\alpha}$	share of non-traded goods in consumption	0.8
$\boldsymbol{\rho}$	Elasticity of substitution between traded and non-traded goods	3.4
$\boldsymbol{\beta}$	subjective discount factor	0.96
$\boldsymbol{\theta_N}$	stickiness parameter in the non-traded sector	0.2488
$\boldsymbol{\theta_\Psi}$	stickiness parameter in the import sector	0.2
$\boldsymbol{\sigma}$	inverse of the elasticity of substitution between consumption and labor	1.57
$\boldsymbol{\rho_r}$	smoothing parameter for Taylor rule	0.7
$\boldsymbol{\rho_r^*}$	persistence parameter for foreign interest rate	0.88
$\boldsymbol{\rho_{A_I}^*}$	persistence parameter of lobar productivity in intermediate sector	0.8
$\boldsymbol{\rho_{xt}^*}$	persistence parameter of oil price	0.6
$\boldsymbol{\alpha^*}$	share of non-traded goods in consumption in foreign country	0.8
$\boldsymbol{\rho^*}$	Elasticity of substitution between traded and non-traded goods in foreign	3.5
$\boldsymbol{\rho_{Nt}^*}$	persistence parameter of lobar productivity in foreign non-traded sector	0.75

4- Results

This section analyzes the dynamic properties of the models when the economy is exposed to the commodity terms of trade shocks and productivity shocks in the export sector under the following alternative monetary policy rules. Following Hove et al. (2015), these monetary policy rules are assessed based on the degree to which they minimize the volatility of selected macroeconomic variables as reflected by their impulse response functions.

4-1- Impulse response analysis

4-1-2- Commodity terms of trade shocks

Figure 1 presents impulse responses of selected macroeconomic variables to the commodity terms of trade shock that have received the most attention in the literature. The figure shows that the commodity terms of trade shock decreases production in traded sector under three alternative monetary policies. However, NTIT rule exhibits the largest fall. An increase in terms of trade that is an increase in the relative price of oil in terms of foreign intermediate goods declines foreign output in response to higher oil price as an input to production becomes costlier. So, global oil demand decreases which results in a deduction oil production. Although, reducing demand for oil may be due to the fact that rising oil prices make shale oil more affordable. The income effect of commodity terms of trade shock also increases production in non-traded sector, with the strongest response being experienced under NTIT rule. The possible explanation is that oil income expending increases the demand for traded and non-traded sectors. Since the price of traded sector is determined in international markets, extra demand for traded goods is provided with extra import. So prices in non-traded sector increase more than prices in traded sector, which move resources from traded sector to non-traded sector. Finally, the output and labor supply in non-traded sector increase and this leads to an increase in employment aggregate. Total output as weight average of traded and non-traded output increases in all regimes, which is in line with those reported by Hove et al. (2015). The largest volatilities in total output are under NTIT and the smallest is under CIT. The commodity terms of trade shock generate a wealth effect which increases the demand and prices of imported and non-traded goods. Higher prices cause consumption deduction under CIT and NTIT rules, while the increase in domestic prices leads to an increase in imported consumption and thus increases consumption aggregate under ET rule. The largest volatility in consumption is under CIT and the smallest is under ET. Although the movement of production resources to the non-traded sector acts to rise

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in non-traded production, the demand is higher than production so excess demand leads a rise of inflation in this sector under three alternative monetary policy rules. Most fluctuations of non-traded inflation occur under the NTIT rule and the least fluctuations happen under the CIT rule. Since based on calibration, 80% of CPI inflation is formed by non-traded inflation, the increase in non-traded inflation induces an appreciation of the CPI inflation and CPI inflation follows a pattern of non-traded inflation. The commodity terms of trade shock provides an initial decline of real exchange rate in all regimes. The immediate response of real exchange rate is larger under NTIT and ET rules but smaller under CIT rule. In addition, the commodity terms of trade shock triggers to decrease oil incomes and exchange reserves of the central bank. As a result, the nominal exchange rate depreciates under three alternative regimes. In reaction to inflation and production, the nominal interest rate increases as contractive monetary policy. Increasing interest rate reduces investment, output and inflation. Finally, they return to equilibrium. Generally, the dynamic adjustment of most variables shows that CIT rule is superior to NTIT and ET rules because it generally exhibits small responses of most variables in terms of trade shock.

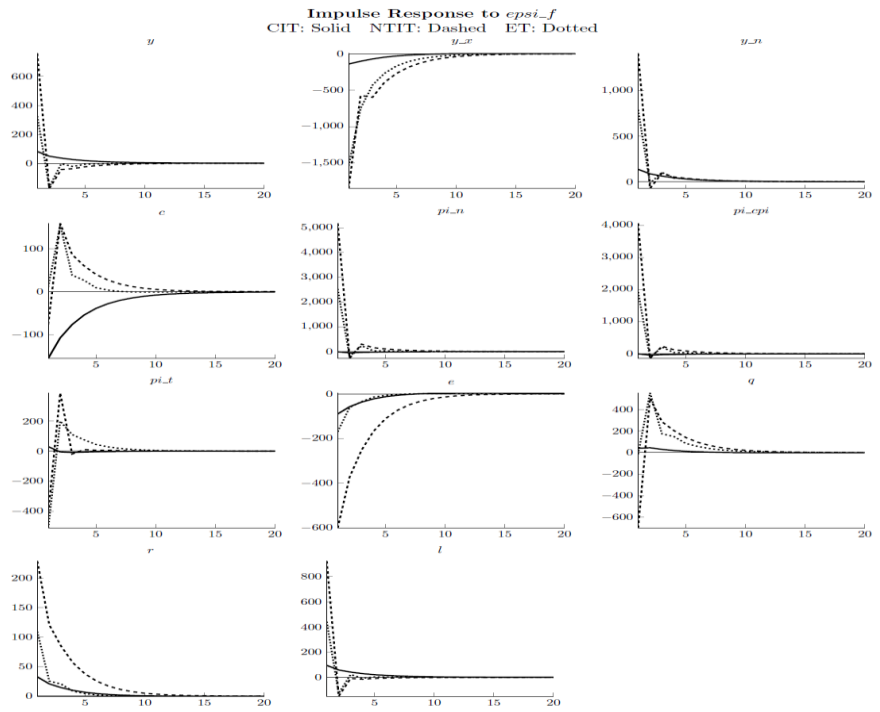

Figure 1. Impulse responses to commodity terms of trade shock
Source: Research results

4-1-3- Export productivity shocks

Figure 2 presents impulse responses to one standard deviation positive shock to export productivity. Based on research findings, the export productivity shock increases traded output under three alternative monetary policy rules. the export productivity shock decreases non-traded output and employment and increases consumption under three alternative rules. This case can be the result of the resources movement to the booming oil export sector, which can be the symptoms of the Dutch disease. An increase in consumption of imported good also leads to appreciates aggregate consumption and decreases employment. A Positive shock to export productivity improves productivity in non-

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traded sector, which leads to a fall in real marginal cost in non-traded sector. Based on this model, non-traded inflation is a function of next period`s expected inflation and real marginal cost in this sector, so real marginal cost deduction acts to fall non-traded inflation and CPI inflation. export sector productivity shock improvement and the consequent expansion in exported output induces an appreciation in export earnings that leads to increase nominal exchange rate. The export productivity shock appreciates real exchange rate under all rules, which shows the presence of the Balassa Samuelson effect. An increase in productivity in the commodity sector will tend to increase wages, which translate into an increase in the price of the non-traded good. As the relative price of the primary commodity is exogenously determined, the final effect will be an appreciation of the real exchange rate (Cashin, Céspedes, et al., 2004). Overall, the dynamic adjustment of most variables shows that CIT rule is superior to NTIT and ET rules because most of the selected variables are more stable under CIT rule. The good performance of inflation targeting is enhanced by its flexibility, credibility and the presence of flexible exchange rates which help to insulate the economy from shocks. Results of this study confirm Fridman`s (1953) discussion about merit of flexible exchange rate regime to nominal exchange rate regime under real shocks. Although, the efficient policy rule is dependent to kind of shock that hit the economy (Hove et al. (2015)), but a large number of empirical studies have found that CPI inflation targeting as superior policy rule under different shocks (Concalves and Salles (2008), Ball (1998), Svensoon (2000), Hove et al. (2015)).

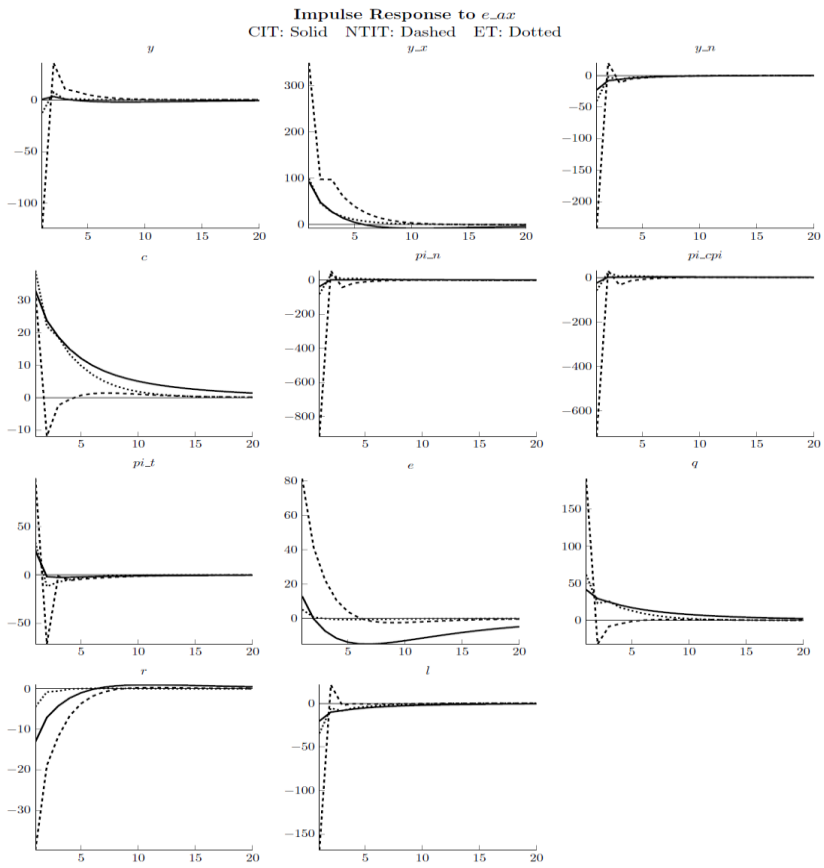

Figure 2. Impulse responses to an export sector productivity shock
Source: Research results

4-2- Volatility analysis of three alternative monetary policy rules

Tabel 2 compares the volatility of selected macroeconomic variables associated with alternative monetary policy rules. The results show that total output, non-traded output, exported output, labor supply, Real exchange rate, nominal exchange rate, CPI-inflation, non-traded inflation and interest rate induce the lowest volatility under CIT and highest under NTIT, this is consistent with Santacreu (2005), Devereux

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et al. (2006) and Hove et al. (2015) findings. Furthermore, consumption induces the lowest volatility under ET rule and highest under CIT rule. Generally, the volatility analysis confirms findings that were already evident from impulse responses, which CPI-inflation targeting outperforms other considered regimes.

Tabel 2. Standard Deviation of Macroeconomic variables
Source: Research results

Variable	**CIT**	**NTIT**	**ET**
total output	0.0538	0.3905	0.1823
non-traded output	0.0920	0.7091	0.3999
exported output	0.1006	1.0502	0.9001
labor supply	0.0634	0.4670	0.2299
Consumption	0.1092	0.1062	0.0809
real exchange rate	0.0359	0.4764	0.3046
nominal exchange rate	0.0587	0.3924	0.0921
non-traded inflation	0.0357	2.6054	1.2740
CPI-inflation	0.0294	2.0418	0.9683
interest rate	0.0216	0.1410	0.0571

Note: CIT is CPI inflation targeting, NTIT is non-traded inflation targeting and ET is exchange rate targeting. Bold values indicate the regime under which a volatility is lower.

4-3- Comparison of simulated data moments and real data moments

The moments of the calibrated model variables are compared with the moments of the identical variables in the real world. The degree of proximity to them is a good measure for fitting the model. **Tabel 3** compares the moments of some variables that shows the relative success of the model in simulating the realities of Iran's economy.

Tabel 3. Comparison of simulated data moments and real data moments
Source: Research results

Variable	The standard deviation of real data	The standard deviation of simulated data
Oil production	0.141527	0.1318
Non-oil production	0.14386	0.0927
Interest rate	0.079584	0.0295

5- Conclusions and suggestions

This essay focuses on the interaction of two characteristics of an oil exporting economy (oil dependence and vulnerability to terms of trade shocks) and their interactions with monetary policy and

macroeconomic dynamics. the essay contributes to the literature by incorporating the oil sector and focusing on the commodity terms of trade shock in a multi-sector DSGE model, where incomplete exchange rate pass through is introduced via nominal rigidities on import prices. The analysis of the impulse response functions has shown that the CIT rule has had better performance than NTIT and ET rules in stabilizing the economy when it experiences the commodity terms of trade shocks or exported productivity shocks. So, the results generally suggest that the central bank can reduce macroeconomic volatility by targeting CPI inflation. performance of inflation targeting is enhanced by its flexibility, credibility and the presence of flexible exchange rates which help to insulate the economy from shocks. However, the increased flexibility of exchange rates in inflation targeting countries comes at the cost of higher exchange rate flexibility. This implies that inflation targeting in oil exporting economies need to pay attention to exchange rate fluctuations induced by commodity terms of trade shocks. Additionally, productivity shocks in export sector might provide problem of Dutch disease. improving this issue, policy makers should expend oil income for investment in non-traded sector instead of import of consuming goods, which are often cheap alternatives for domestic goods. It would be useful in future researches to examine how factors such as central bank independence, fiscal discipline and financial sector development do explain inflation target deviations from the target bands. Another interesting extension would be the incorporation of uncertainty of the commodity terms of trade shocks in the model. Uncertainty about the size and duration of the commodity terms of trade shock may affect the results since monetary policy responses may depend on whether the shock is temporary or permanent.

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Non-linear Response of Inflation: A Real Effective Exchange Rate in Iran

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ABSTRACT

Exchange rate is a variable transferring international economic shocks to domestic economy. In countries like Iran who are experiencing a high inflation and whose GDP as well as consumption expenditures are mostly dependent on imports and foreign capital flows, exchange rate changes and its effects needs to be carefully monitored by policy makers and economic researchers. The purpose of the present paper is to measure a nonlinear model estimating the response of inflation to Real Effective Exchange Rate (REER) in Iran. The finding based on the time series data for the period 1971-2017 and a Threshold Regression (TR) model indicates that a Real Effective Exchange Rate (REER) of 6160.27 Rials has been applied as a threshold value. In other words, based on the above threshold value, the estimated model shows exchange rate coefficient has increased somewhat from the first to the second regime.

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1- Introduction

The rate of inflation, together with other macroeconomic variables such as economic growth rates, is undoubtedly one of the most important indicators of the economic performance of a country. One of the reasons for the importance of inflation is the wide range of this variable's effectiveness and influences. Indeed, inflation affects some of the most important key economic variables, such as unemployment, foreign trade, income distribution, savings, investment and economic well-being. No wonder a significant part of the economic literature is devoted to investigating factors that affect inflation.

In an open economy in which goods and services and capital have a two-way flow, Exchange Rate (hereafter so called ER) is a strategic variable. In such conditions, fluctuations of economic variables are transmitted between national economies. Hence, monetary and financial shocks are not enclosed within the boundaries of the domestic economy. ER can play the role of a "transitional variable" as well. Here, ER, in fact, transfers the effect of international economy shocks to the national economy variables. Hence, the study of the effect of ER and its fluctuations have always been special attraction for economists. Considering the importance of inflation in theoretical discussions and high inflation rate in some developing countries, the effect of ER on inflation has attracted the economists interested in monetary issues and international economics.

Although studies have mostly focused on measuring the extent of ER effect on price levels, we believe that investigating the possible existence of one or more thresholds in exchange rate effect is important, because the reaction of monetary policymakers may be somehow dependent on the extent of ER effect with respect to one (or more) threshold value(s). For instance, policymakers might not take care of ER fluctuations below a certain level, but as soon as it crosses such a level, they believe it damages to the economy and the welfare of the country, thus triggering some intervention in the currency market.

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Iran economy has experienced high, double-digit inflation rates since 1980s. Therefore, reducing and controlling inflation is one of the goals of policy makers and economic planners. From 1989 to 2020, the first to sixth development plans were designed and implemented to achieve important goals such as economic growth and reducing inflation. **Tabel 1** shows the approved values and performance of inflation and exchange rate growth in six development programs.

Tabel 1. Inflation Rate and Exchange Rate Growth in the Programs of Economic Development (1989-2021) (Percent)
Source: Central Bank of Iran

	Inflation Rate		Exchange Rate Growth
	Target	Performance Average	Performance Average
1st Development Plan (1989-1993)*	14.4	21.60	19.17
2nd Development Plan (1995-1999)	12.4	25.62	27.96
3rd Development Plan (2000-2004)	15.9	14.12	1.82
4th Development Plan (2005-2009)**	9.9	14.88	3.94
5th Development Plan (2011-2015)***	9.9	20.53	15.81
6th Development Plan (2016-2021)	8.8	29.6	91.65

Note 1: *Inflation rate and exchange rate growth of 1994 has calculated in the 1st Development Plan.
Note 2: **Inflation rate and exchange rate growth of 2010 has calculated in the 2nd Development Plan.
Note 3: ***Inflation rate and exchange rate growth of 2016 has calculated in the 3th Development Plan.

As can be seen in Tables above, there is a significant difference between inflation targets and performance during the five-year development plans. ER seems to be one of the most important determinants of this deviation. As the average ER growth increases, so does the average inflation rate. In the present study, we seek to answer this question, which is to what extent has the rise in ER shifted to inflation?

The present paper is organized in five sections, and in the second section, a review of the literature on the subject, including the principles of the theory and literature review, is addressed. In the third section, the research method is introduced. In the fourth section, the results of the model estimation are presented and the final section is dedicated to the conclusion and presentation of the proposal.

2- Literature Review

The exchange rate, as a measure of the value of a country's national currency against the currencies of other countries, reflects the economic situation of that country compared to other countries. Assuming the complete convertibility of currencies in a country, the exchange rate is an important indicator that has a great impact on all economic areas (Mahdiloo & Asgharpur, 2020).ER movements to domestic price are one of the ways through which inflation and business cycles are transmitted among countries (Aron, Creamer, Muellbauer & Rankin, 2014). Due to the dependence of domestic products and consumptions on import, ER is one of the determinants of raw materials price, intermediate goods, capital equipment and other final good prices. This way, variations in ER through the prices of imported goods open their way into the prices of domestic output and imported goods (Sharifi & Nabavi-Larimi, 2015).

A common method for studying the dynamic behavior of economic variables is using various time series models. Among time series methods, linear patterns, such as Autoregressive model, Moving Average (MA), or combination of these models (Autoregressive Moving Average (ARMA) are more popular. Although these approaches were widely used for many years to examine the effects of ER on inflation, there were significant reasons why economists were interested in the nonlinear analysis of inflationary response to ER. A part can be attributed to the nonlinear nature of ER trend, Lucas's critique (1976), the heterogeneous firms hypothesis, spillover effects

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of ER fluctuations, independent changes in the decision space, and Taylor's (2000) hypothesis.

A reason for the non-linear response of inflation is the non-linear nature of ER trend. In fact, geometrically, among all time paths of ER, the probability of a linear path between the two time points is very weak. The effect of all determinants of ER is displayed in its changes. Here are two important points to note. First, the cross-effects of ER determinants can influence the impact of each determinant. Second, the importance of currency, especially in developing countries, and its key role between the foreign exchange and financial markets, has made exchange rate an intelligent variable, which corrects mistakes at the next rate through learning process. Hence, the course of ER over time is expected to be nonlinear (Pérez Forero & Vega, 2015; Jašová, Moessner & Takáts, 2016; Forbes, Hjortsoe & Nenova, 2018).

Lucas (1976) challenged the stability of the coefficients of econometric models. He clearly showed that consumer preferences and technical conditions of production in firms were not fixed over time. According to Lucas's critique, consumers, producers and investors transmit the experience of ER changes through error correction mechanisms and in the context of market clearing to their predictions and future choices in pricing and trade and financial transactions. Hence, price level response as the consequence of consumer preferences, firms and investors in the course of ER changes will not be the same (Lucas, 1976).

Taylor (2000) showed that the response of inflation rate to ER fluctuations at various levels of inflation rate is not the same. Taylor's findings showed that in low rates of inflation, the Exchange Rate Pass-Through (hereafter so called ERPT) is low, and in high rates of inflation, ERPT to inflation is more (Taylor, 2000).

Nonlinear time series models have grown rapidly in the last two decades. In nonlinear models, pattern parameters are a function of variable or different regimes, and thus change over time. Of course,

nonlinear models are not ideal ones and have their own limitations, including the fact that estimating nonlinear patterns is relatively more difficult compared to linear labor patterns, and most nonlinear patterns are designed to describe a particular case of behavior of variables.

Nonlinear behavior in ER effect on inflation can provide false estimates of ER coefficient when the econometric model is estimated linearly. In such a circumstance, we can accommodate cases when the inflation condition and its rate affect economic factors in response to an ER shock. Indeed, due to a stable and low inflation, domestic prices may not respond to an ER shock. However, they may respond wildly to a similar shock when inflation is above some significant threshold (Aleem & Lahiani, 2014).

Da Silva Correa & Minella (2010) investigated the existence of nonlinear process of ERPT to inflation in Brazil. It was concluded that when the economy grows faster, ER devaluates above a threshold level and when ER fluctuations are lower, the pass-through rate in short-term is higher (Da Silva Correa & Minella, 2010). Shintani, et al., (2013) examined the relation between ER and inflation by estimating a nonlinear model. They showed that the dynamic of ER effect on inflation can be well estimated by a STAR model (Shintani, Terada-Hagiwara & Yabu, 2013). Pérez Forero & Vega (2015) examined the non-linear response of prices to ER shocks in Peru. To this end, they used the SVAR model and Impulse-Responses Functions to examine prices after ER shocks. The results provided a remarkable asymmetry in the response of CPI to ER shocks (Pérez Forero & Vega, 2015). Turner & Wood (2016) provided theoretical reasons for a nonlinear ERPT to import and export prices. Theoretical reasons are based on the menu-costs approach, in which small absolute changes in ER may not excite price changes, because the costs of doing so are more than additional benefits begotten by firms engaged in international trade (Turner & Wood, 2016). Marodin & Portugal (2018) based on Markov-Switching Semi-Structural New Keynesian model examined the nonlinearity of ERPT in Brazil during 2000-2015. In this survey,

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evidence was obtained from two different regimes for ERPT to inflation in Brazil during period under review (Marodin & Portugal, 2018).

Ben Cheikh, et al., (2018) examined the nonlinear dynamics in ERPT to inflation in 10 european economies. According to the research findings, ERPT to inflation responds to economic activities in a non-linear manner, meaning that ERPT over economic development periods is higher than recession (Ben Cheikh, Ben Zaied & Bouzgarrou, 2018). Musti & Siddiki (2018) tested the nonlinearitiy and asymmetry in the ERPT to Consumer Price Index in Nigeria. According to them, standard literature assumes the linearity and symmetry of ERPT to Consumer Price Index in a developing country, despite the importance and presence of potential asymmetry and nonlinearity as exemplified by various factors such as menu costs, capacity constraints and market share goals (Musti & Siddiki, 2018).

Caselli & Roitman (2019) presented evidence of nonlinearity and asymmetry in the transition of ER volatilities to prices from 27 emerging markets. They found documents of asymmetry in ER transmission over periods of ER appreciation compared to periods of ER depreciation. A threshold that could lead to nonlinearity emerged (ER decline of more than 24%) (Caselli & Roitman, 2019). Colavecchio & Rubene (2020) examined the probablity of non-linear transition of ER changes to imported prices and CPI in 19 european economies. They found that CPI and imported prices in the target countries respond significantly to ER fluctuations after a year, and the response is greater when ER changes are relatively large (Colavecchio & Rubene, 2020). Anderl & Caporale (2021) tried to explicate the Real Exchange Rate (RER) volatilities using two models of linear ARDL and Nonlinear ARDL (NARDL) for United Kingdom, Canada, Australia, New Zealand and Sweden. The results showed that due to the existence of asymmetry in the long and short term, the nonlinear model is more appropriate. Also, inflationary expectations perform an important role in this case (Anderl & Caporale, 2021).

Bilgili et al. (2021) using the Markov-Switching model, examined the pass-through effect in Turkey, and they found that there exists a nonlinear relation between ER and CPI (Bilgili, Ünlü, Gençoğlu & Kuşkaya, 2021). Moradi et al. (2021), using the NARDL method during 1986-2017, found that the degree of ERPT to CPI in short and long term in Iran is incomplete and asymmetric (Moradi, Anvari & Arman 2021).

In this study, we are empirically reviewing the effect of Real Effective Exchange Rate (hereafter so called REER) on inflation in Iran and also the possibility of existence of one or more thresholds by using a Threshold Regression (TR) method. In Iran, a threshold regression has been mainly used on issues of economic growth, based on the theory of purchasing power parity, etc. In this study, on the other hand, we aim at keeping an eye on the critical level for ER while investigating the extent of ER effect on inflation in Iran and, therefore, unlike conventional econometric methods, a threshold regression turns out to be fully appropriate.

3- Methodology

In the present study, all data and information are gathered through library methods. Also, with using yearly data of official ER of Iran, price index and ER of Iran's major trade partners, REER during 1971-2017 was calculated as follows:

Real Effective Exchange Rate (REER) = Σ[Exchange Rate of Iran's Major Trade Partners (In terms of Rials)×Consumer Price Index of Iran's Major Trade Partners×Share of Currencies of Iran's Major Trade Partners in SDR]/ Iran's Consumer Price Index

In nonlinear models, the response of one variable to changes in other variables is examined nonlinearly. In this regard, threshold regression model can be used as a nonlinear model. Research of Calvo & Reinhart (2002), Mihaljek & Klau (2008), Kohlscheen (2010), Bussiere (2013), Shintani, et al., (2013), Alvarez, Lippi & Passadore

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(2016), and Marodin & Portugal (2018) indicates the extensive usage of threshold models in experimental economics. Linearity is a basic premise many people who use linear models, unless there is convincing evidence to prove it nonlinear.

To investigate the threshold effects of ER on inflation, the following Posedel & Tica (2009) model is used:

$$\pi_t = I_{t-d}\left[\alpha_1 + \sum_{i=0}^{k}\beta_{1i}e_{t-i}\right] + (1-I_{t-d})\left[\alpha_2 + \sum_{i=0}^{k}\beta_{2i}e_{t-i}\right] + \varepsilon_t$$

(1)
$$e_{t-i} \geq \tau \quad if \quad I_{t-d} = 1$$
$$e_{t-i} < \tau \quad if \quad I_{t-d} = 0$$

where inflation π_t is a function of REER. Variable I_t is a dummy variable. $I_t = 0$ if REER (e_t) is smaller than threshold (τ); also, $I_t = 1$ if REER (e_t) is equal or bigger than the threshold (τ). To estimate the desired threshold model, STATA software was used.

In an experiment on the effect of ER on inflation in Iran, first, Lagrange Multiplier is applied to nonlinearity test. Afterwards, the suggested model (1) is estimated by a threshold regression. The required information has been extracted from the Central Bank of Iran portal and World Development Indicator (WDI) database.

4- Results

4-1- Stationary Test

Since in macroeconomic analysis, as usual, time series are non-stationary and their non-stationarity provides the possibility of a spurious regression in experimental studies, we are first of all testing the stationarity of variables by using the KPSS[1] test. As shown in **Tabel 2**, inflation and REER are stationary in level.

[1] Kwiatkowski-Phillips-Schmidt-Shin

Tabel 2. Stationary Test Results
Source: Author's computation

Variable		Level		Results
		Intercept	Trend and Intercept	
Inflation Rate	Lagrange Multiplier-Statistic	0.193	0.146	I(0)
	Critical Values: 1% Level	0.739	0.216	
Real Effective Exchange Rate (REER)	Lagrange Multiplier-Statistic	0.556	0.104	I(0)
	Critical Values: 1% Level	0.739	0.216	

4-2- Threshold Regression

The research model is specified as follows:

(2) $$\pi_t = \alpha e_t + \varepsilon_t$$

Where, π_t is inflation rate for period t and e_t is REER.

In the study of Durlauf-Johnsone (1995), it was proved that the error term ε_t in a structure such as equation (2) has heteroskedasticity, and therefore they presented their results in the form of corrected standard errors to heteroskedasticity. In this study, their approach is followed, and under a modified heteroskedasticity process, the nuisance coefficient η^2 is applied using Epanechnikov kernel with a continuous bandwidth.

In this research, Lagrange Multiplier (LM) test is used to test the existence of a threshold. Using 5000 times repetition of Bootstrap process, the P-value for threshold model, using REER as threshold variable, is significant at 0.0346.

Tabel 3. Lagrange Multiplier Test Results
Source: Author's computation

Test of null of no threshold against alternative	
Threshold estimate	6160.27
LM-test for no threshold	8.22
Bootstrap P-Value	0.0346
Critical value 95%	7.69

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Based on the information in **Tabel 3** and considering that the value of Lagrange Multiplier test (8.22) is bigger than the critical value in confidenc level 95% (7.69), the null hypothesis is rejected. Therefore, the research model is nonlinear. **Figure 1** shows the result of this test for Lagrange Multiplier test, which in fact indicates the values of F (Gamma) test to examine existence or non-existence of a threshold. The critical value of 95% is equal to the P-value at that point, which here is equal to 7.69 and is plotted on a continuous line. According to the evidence obtained in **Tabel 3**, it can be observed that the effectiveness structure of REER on inflation in the examined period is nonlinear and follows the threshold regression process.

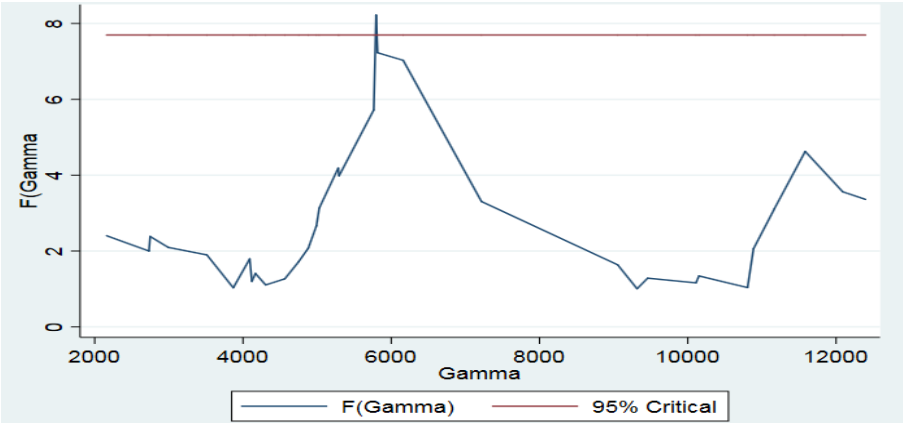

Figure 1. F Test to Reject the Existence of a Threshod
Source: Author's computation

To determine the number of thresholds in this study, the likelihood ratio test presented by Hansen (1999) was used. In this test, the following two hypotheses were tested:

A) Linear model versus a threshold model

B) One-threshold model versus two-threshold model

Tabel 4. Specifying the Threshold Number
Source: Author's computation

Hypotheses	Test Statics	Critical Value	Result
Hypothesis A	24.14	13.98	The null hypothesis is rejected
Hypothesis B	7.20	15.72	The null hypothesis is not rejected

The results of the first hypothesis indicate that the test statistics amount is bigger than the critical value. As a result, the null hypothesis of the linear model is rejected. Results of the second hypothesis also indicate that the null hypothesis is confirmed. Therefore, the model has only one threshold.

Figure 2 shows the normalized likelihood ratio $LR_n(\tau)$ as a function of the threshold variable. Estimation of Ordinary Least Squares (OLS) of τ is the value at which this figure is minimized, and is achieved at REER $\hat{\tau} = 6160.27$ The critical value of 95% is equal to the P-value at that point, which here is equal to 7.35 and is plotted on a continuous line.

Results indicate that there exists logical evidence for model specification with two regimes, and there is also comparative confidence for threshold value.

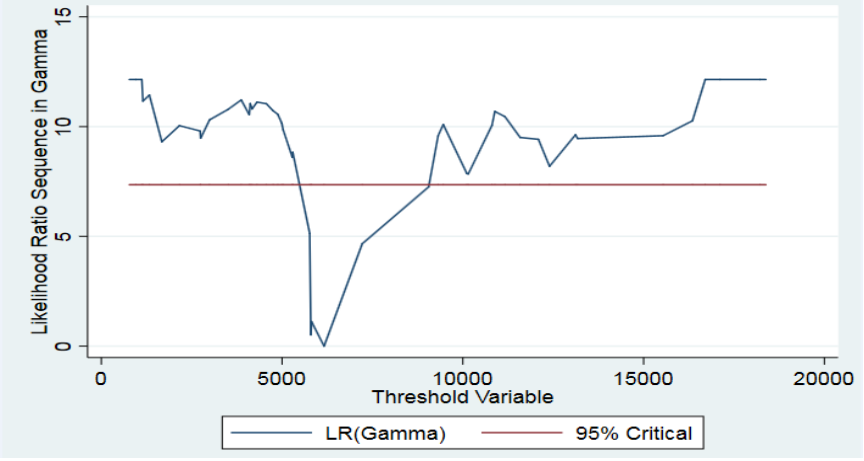

Figure 2. Confidence Interval Construction for Threshold
Source: Author's computation

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Tabel 5. The Estimation Results of Inflation Rate Threshold Model
Source: Author's computation

Variable	$q \leq 6160.27$	$q > 6160.27$
Intercept	22.50	36.43
Real Effective Exchange Rate (REER)	0.0013	0.0017
	R-squared: 0.66	R-squared: 0.57

According to **Tabel 5**, the estimated threshold for REER is 6160.27 Rials. According to **Tabel 5** and **Figure 2**, only one threshold was observed in impact process of ER on inflation. Also, considering that the effect coefficient of ER on the inflation has increased in the second regime compared to the first, rising from 0.0013 to 0.0017, it can be concluded that the extent of ER effectiveness on inflation has increased during the time.

The data seems to clearly point out that, according to threshold regression process, the effect of ER on inflation in Iran is nonlinear. This might happen because of the existence of high inflationary expectations in Iran, which intensifies into inflation when ER goes beyond a certain threshold level.

5- Conclusions

Besides some macroeconomic variables, such as economic growth rates, inflation rate makes one of the most important indicators of the assessed economic performance of a country. Inflation affects some of the most important key economic variables, such as unemployment, foreign trade, income distribution, savings, investment, and economic well-being. For such a reason, investigating the factors affecting inflation is allocated to a significant part of the economical scientific literature. There are several causes for inflation in macroeconomics, one of the most important connections to the outside world and the experience of external shocks. In this context, an important role is played by the effect of ER volatilities on domestic prices.

Although studies have mostly concentrated on measuring the extent of ER effect on price levels, we believe that investigating the

possible existence of one or more thresholds in ER effect is important, because the reaction of monetary policymakers may be somehow dependent on the extent of ER effect with respect to one (or more) threshold value(s). For instance, policymakers might not take care of ER fluctuations below a certain level, but as soon as it crosses such a level, they believe it damages the economy and the country welfare, thus triggering some intervention in the currency market.

Iran's economy, especially after the Islamic Revolution, has experienced imposed war and unconventional sanctions with free trade basics, REER having had significant increases. Looking at the statistical data related to the general level of prices, it is clear that, during the years 1971-2017, the CPI increased about 1250 times. Hence, it seems that there is a close relation between ER and changes in the general level of prices in Iran. Therefore, in this research, the effect of REER on inflation in Iran was experimentally tested by using the threshold regression method.

The present study showed that the impact structure of REER on inflation in the period under review is non-linear, and that it follows the threshold regression process. Also, the threshold regression model results showed that there is only a threshold in the period under review. The threshold value has been estimated at the level of REER of 6160.27 Rials and, according to the increase of REER coefficient to 0.0017 in the second regime with respect to 0.0013 in the first one, it can be concluded that the extent of ER effect on inflation has increased during time.

Considering the fact that preserving the value of national currency is one of the most important tasks of central banks, to control inflation it seems necessary to give due attention to ER and its threshold impacts when planning, designing and implementaing monetary and exchange policies. The results of this study suggests a policy guideline, namely, to limit the damaging effects of inflation on the economy and household welfare. Monetary policy makers in Iran must restrain foreign exchange shocks. In this regard, it is recommended to take the

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appropriate policies to prevent ER fluctuations in the market and its stabilization, among which we can mention controlling liquidity, fiscal and monetary discipline. Reducing the intensity of ER fluctuations can prevent raising prices of imported goods, and help stabilizing the domestic price level.

It is significant that the impact of low transition of ER to CPI contains an important point for domestic monetary policymakers. Indeed, the effect of lower transmission of ER provides more freedom to pursue an independent monetary policy, in particular, via inflation targeting system.

Finally, due to difference in the impact of ER on inflation on the two sides of threshold, policymakers should focus more on the threshold itself.

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Analysis of the Effect of EXIM Bank Efficiency on Non-Oil Export

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ABSTRACT

Banks are considered as vital circulatory system of finance and financial institutions that collect assets from various sources and allocate them to sectors that need market liquidity. Hence, banks are the vital arteries of any country. To evaluate the efficiency of the Export Development Bank of Iran, the cost efficiency of different branches was evaluated using estimation of Stochastic Frontier Model (SFA). Various inputs were fitted in the model and finally non-operating and operating incomes, as outputs, and overdue loan, default and Exim Bank capital, as bank's inputs, were identified. Accordingly, 27 branches of the Export Development Bank of Iran with continuous activity over the past three years were selected as a sample and their monthly cost efficiency was estimated. In the second step, the cost-effectiveness form of the bank was selected. The most common forms of Stochastic Frontier Model (including Cobb Douglass and Translog) were estimated using Frontier 4 software and the optimal form of the cost efficiency function was selected using statistical tests. Research results show that the nominal exchange rate and oil prices have a negative effect on gross national product and the bank's cost efficiency has a positive effect on non-oil exports. According to the research results, the bank's cost efficiency has increased in the period under review. It is suggested that in the medium term, the Export Development Bank prioritizes the closure of loss-making branches, increasing the bank's capital, attracting deposits, and reducing fixed assets and operating costs to improve the bank's cost efficiency.

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1- Introduction

In the present era, banking is one of the most important sectors of the economy, which has led to the expansion of markets and the growth and prosperity of economies in organizing and directing receipts and payments, facilitating trade and commerce. Banks can play a very constructive role in the economy by equipping savings and allocating them to various businesses. Export Development Bank of Iran, as the only Exim Bank of the country, can increase its efficiency by paying low-cost loans to export companies and providing the required working capital, as well as financing investment projects and development projects to increase export capacity. and their competitiveness in global markets will help a lot.

Putting emphasis on the development of non-oil exports as an important strategy is one of the ways to achieve continuous economic growth, which has always been emphasized as one of the central strategies of our country's economy. This policy, in addition to taking the country's economy out of the mono-product mode, leads to improving the balance of foreign exchange payments and increasing the strength and comparative advantage of our country in global markets. Paying attention only to the domestic market (import substitution policy) and lack of motivation for global marketing (export development) due to the support of inefficient domestic industries are the main factors limiting non-oil exports in recent years. Allocation of credit lines to foreign buyers is considered one of the most effective ways to finance exports and increase non-oil exports of countries. These types of loans are provided to foreign buyers to buy consumer goods or capital of the country. Given the easy repayment terms of such loans, the allocation of these credits increases the incentive for foreign buyers to purchase domestic products.

While bank functions can be complex and various, a bank is operationally defined as an institute whose current actions are mainly limited to giving loans to and taking deposits from people. It also

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plays an important role in the allocation of economic capital. A financial system with a developed level of efficiency can considerably facilitate allocation of appropriate sources to household consumptions as well as appropriate physical capital to productive sections in society. Thus, it is highly expected that efficient and profitable banks pave the way for the construction of an influencing financial system. In other words, the efficiency of the banks can lead to economic growth and development in their home country. The potential of banks to hold a highly efficient function determines their sustainability. In Iran, the banking industry plays a pivotal role in providing financial resources due to the lack of a capital market. That is why any shortage in the structure and function of banks might have an adverse effect on other sections. Thus, gaining deep insights into the policies of the banks in Iran seems essential (Tarkhani, Nazari & Niloofar, 2020).

The banking industry is one of the most important sectors in any economic system, because financial development and in particular the banking system lead to economic growth. The role of the banking system in financing the economy requires that the industry operate efficiently and effectively. The efficiency of the banking system means that it is able to provide services that lead to financing at a lower cost. Efficiency is an important concept in economics that represents a measure of success in resource allocation. In general, due to differences in equipment and allocation of resources, various restrictions in laws and regulations (ceiling of short-term and long-term facilities, etc.) and the cost of contracts between banks and the public (fees) cause differences in efficiency and performance of various banks because with the help of the efficiency appraisal process, we will be able to obtain useful information on how to do things effectively in the direction of the set goals (Amiri, 2018).

The mission of Exim Bank is to help exporters to meet government-supported competition from other countries and to correct market imperfections so that commercial export financing can

take place. The bank considers assistance in the export financing of goods and services when there is a reasonable assurance of repayment (OECD, 2010). Export Development Bank of Iran (EDBI) and other financial systems have been investing a vast amount of money in countries around the world that are still struggling with crisis, loss and bankruptcy the occurrence of negative shocks, especially during the epidemic of financial problems in banks, leading to a decline in exports by companies that export their products to global markets (Amiti & Weinstein, 2011; Paravisini, Septier, Moretton, Nigay, Arvisenet, Guichard & Dacremont, 2014; Del Prete & Federico, 2014).

Decreasing the exchange rate, which in turn reduces the value of foreign exchange cash assets and creates the risk of exchange rate fluctuations, on the other hand reduces the export earnings for a customer receiving the facility, reduces his expected income and thus reduces the repayment power and thus Credit risk is created. On the other hand, this will reduce the inflow of funds to the bank and create liquidity risk. In this case, the existence of one of the risks causes the emergence and strengthening of other risks and the set of risks affects the profitability and efficiency of the bank (Sarmiento, M, & Galan, 2017).

Amiri (2018) in a study entitled Evaluating the Efficiency of Selected Banks in Iran and its Relationship with Intra bank and Macroeconomic Variables showed that, on average, the efficiency of state-owned banks is 38%, the efficiency of private banks is 31% and the efficiency of privatized state-owned banks is 33%. According to the research results, the uncertainty of exchange rate fluctuations and inflation has a negative effect on the efficiency of Iranian banks. Exchange rate fluctuations also have a negative and significant relationship with the efficiency of Iranian banks. Ramazanian, yakideh & Akhavan Deilami (2019) in a study entitled Banking Management Efficiency Using DEA technique showed that collective network models have a lower number of efficiency units compared to

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the collective model they are simple. In addition, the efficiency obtained in the collective network model compared to the collective model Simple provides managers with a more accurate value that can identify the inefficiency of each Eliminate its weaknesses. Vahabi, Baradaran, Kazemzadeh & Rastegar (2021) conducted a three-level study evaluating the efficiency of bank branches using the Bootstrap Envelopment Analysis method. the results of this study show that at the third stage (profitability efficiency), due to large volume of non-performing loans (which are considered as undesirable inputs) or due to low volume of interest received on facilities and/ Or for both reasons, the efficiency of branches under review is lower than the other two stages. Also, none of the studied branches have been able to be efficient in all three stages. Furthermore, by comparing overall efficiency scores and modified overall efficiency scores, it can be seen that by modifying overall performance scores obtained from data envelopment analysis method, the overall efficiency of all branches is examined at a lower level. It should be noted that efficient branches are those whose efficiency is equal to one in terms of standard data envelopment analysis method, and if a branch with the highest modified efficiency is considered as an efficient branch, it means that bootstrap method is accepted as a method for ranking branches in terms of performance, while bootstrap method is not a valid method for ranking and only corrects the bias of standard data envelopment analysis method results.

According to European Central Bank (ECB, 2010), bank performance is described as the bank's capacity to generate sustainable profits. Bikker (2010) indicated the main drivers of bank performance as costs, efficiency, profits and market structure. Sherman and Gold (1985) conducted the first study of banking units using data envelopment analysis on 14 branches of US savings banks. The results of the calculation of production efficiency showed that only 6 branches had 100 efficiency (42% of the sample) and the reasons for inefficiency of other branches were poor management, size of branches, number of employees and operating costs.

Nowadays, due to liberalization of global trade, instability of foreign exchange income from oil exports, recent recession in global markets, the tendency to non- oil export development is doubled. Some export facilitations such as banks, are one of the most important factors in export development area for each country. In these situations, lack of an accurate (proper) financing infrastructure is an obstacle of trade. Limited access to financing resources and high costs, lack of insurances or guarantees, potentially have deterrent effect on trade and export, especially small and medium companies (SMEs), so the supporting and facilitating institutions to facilitate foreign trade are necessary. In such a situation, the existence of an efficiency evaluation system and using the result to improve future performance, which makes balance between risks and profits, is necessary.

Exim Bank of Iran is a governmental financial institution that is responsible for financing exports and export activities of Iranian companies. In general, Exim Bank provides financial and non-financial services in the domestic and international market to the country's export companies. There are more than 112 Exim Banks in the world, which are mainly governmental institutions and their main task is to develop the export of their national products in today's competitive world markets. Exim Banks are not competitors of the private sector. The risk of providing services to the private sector in that part of the ballast or the private sector is not able to meet the needs of that part of the market, so more than 70% of the world's Exim Bank customers are small and medium-sized businesses SMEs because businesses Small and medium-sized enterprises do not have sufficient resources and ability to enter international markets, and Exim Banks help to develop employment in their country by financing these industries.

Given the essential role of the banking system in the economies of countries, the government has always considered the efficiency of the banking industry and having efficient networks of

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branches is one of the main strategies in the strategy of efficiency improvement programs at the level of an Iranian export bank. Accordingly, the present study examined the cost-effectiveness of 27 branches of the Export Development Bank of Iran through stochastic border analysis. It is oil. Finally, the effect of bank cost efficiency on exports of non-oil products was estimated. After estimating the cost efficiency of branches, the effect of the average cost efficiency of branches (as bank cost efficiency) on non-oil exports was investigated.

The contribution of this research is in increasing the use of the findings of the efficiency model of Exim Bank in modeling macroeconomics in the country. This article shows which variables play a vital role in bank efficiency that indirectly affect non-oil exports. So far, no research has been done with this title, which is in fact an innovation of this research.

2- Theory of Efficiency by Parametric and Nonparametric Models

Seven criteria for evaluating firm performance are effectiveness, efficiency, productivity, quality, profitability and Profitability, quality of working life and creativity and innovation. The ratio of the amount of resources that are projected to achieve goals, objectives and activities Be used in proportion to the amount of resources actually used between productivity and the ratio or relationship between The amount of output produced by the firm using a certain amount of inputs is called productivity. Thus, improving the level of productivity is the result of producing more output using a fixed amount of input or producing a fixed amount of output using less input.

Usually, the purpose of examining productivity is to compare the conditions of a firm in several periods. In one or more periods, the firm uses less input to produce a certain amount of residue unless otherwise specified, that is, the production of the maximum amount of output with a certain amount of input is specified. This definition

is also related to the concept of efficiency, and therefore the firm that invests the least amount, by producing a certain amount of output and assuming the stability of other conditions, is considered the most efficient enterprise (Amiryusefi & Hafezi, 2006).

Bank efficiency studies are abundant by now. Nevertheless, Exim Bank efficiency and effective variables in their efficiency have not been studied yet. Besides, nobody research the result of efficiency this kind of banks in economy in spite of the fact that Exim Bank establish to operate government's macroeconomic aims in each country specially in export portion. Nevertheless, we have selected parametric model to assess Exim Bank efficiency model according to literature review of parametric and non-parametric models. Farrell (1957) suggests a non-parametric approach to measure technical efficiency by a linear programming method designated as Data Envelopment Analysis (DEA).Though widely used, DEA suffers numerous shortcomings such as sensitivity to random deviations, outliers, and data errors. Emrouznejad and Yang state that the banking field is the second application field that uses the DEA methodology in and Kaffash and Marra review DEA methods and its applications in financial services (Kaffash & Marra, 2016).

In the DEA method, introduced by Charens, Cooper, and Rhodes (CCR) in 1978, an efficient boundary curve is first created through a series of points determined by linear programming, and then characterized by an optimization process. Where the firm is located at this boundary, eventually the for-profit and non-for-profit firms are separated from each other. The most important advantage of this method is that it does not need to impose any specific subordinate form on the data and therefore due to this flexibility, it has gained a great reputation among researchers. Nevertheless, the calculated boundary function considers the existence of efficient boundary factors to be due to the inefficiency of the units and places it as inefficient - then Bunker, Charans, and Cooper in 1984 removed the assumption of constant relative-to-scale returns from this method.

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Therefore, this method is becoming more and more important (Hosseini & Souri, 2007).

Three methods of Stochastic Frontier Analysis (SFA), Distribution Free Analysis (DFA) and Thick Frontier Analysis (TFA) are different types of parametric methods. The differences in the functional form as well as the distribution of the error sentence in these three methods will make them different from each other (Ilieva, 2003). This method is a subordinate form and an error sentence Considers ink for production, cost or profit. One component including error, random error

Bilateral has a normal distribution with normal characteristics. This means that if the firm's performance is less than border production, part of it is due to lack of technical efficiency and the other part is due to accidental factor (Coelli, Prasada & Rao, 1998). The Distribution Free Analysis method, developed by Schmidt and Sickles (1984) and Berger (1993), defines a definite derivative form for the cost-benefit boundary and assumes that random error statements of the normal distribution with mean zero and variance They follow certain. Nevertheless, it does not impose any kind of distributive assumption on one-way error statements (inefficiencies). Berger & Humphrey (1997) The Thick Frontier Analysis (TFA) method assumes a definite form of subordination, but none assumes a distribution for inefficiencies or random errors (Berger & Humphrey, 1997).

Since the introduction of the Stochastic Frontier Analysis in 1977, considerable research has been conducted. By Battese & Coelli (1992), in order to expand the application of the basic frontier production model. Most Frontier Production Models do not explicitly form a pattern for the effects of inefficiency. Practical articles that explain the effects of inefficiency.

Aigner, Lovell & Schmidt (1977), Meeusen & Broeck (1977) proposed a parametric approach to measure technical efficiency:

Stochastic Frontier Analysis (SFA). In the field of estimating the efficiency of the banking industry, a number of studies have been conducted outside and inside Iran, including the studies of Srairi, (2009), Lensink, Meesters & Naaborg (2008), Staikouras, Mamatzakis, Koutsomanoli & Filippaki (2008), Fu & Heffernan (2007), Ahmad Mokhtar et al. (2006), Coelli, Prasada Rao & Battese (2000).

Sufian, Kamarudin & Nassir (2016) measured the Malaysian banking sector with a two-stage approach. The results show that the efficiency of the Malaysian banking sector has increased. Cost, allocation and technical efficiency in conventional and partner banks in Turkey. Batir, Volkman & Gungor (2017) investigated the cost, allocation and technical efficiency of conventional and joint venture banks in Turkey using the Data Envelopment Analysis (DEA) method. The results show that the efficiency of partner banks is higher than the efficiency of conventional banks.

Arabmazar, Varahrami & Hosseini (2019) in a study entitled evaluating the efficiency of banks using the DEA method uses a one-step production model, examining the efficiency of 18 banks in Iran, concluded that except for three banks, other banks performed less than the efficiency level, the efficiency of some banks is very poor and the banks that have a higher ratio of overdue receivables are mostly lower efficiency.(Arab Mazar et al, 2019).

Vahabi et al. (2021) conducted a three-level study evaluating the efficiency of bank branches using the Bootstrap Envelopment Analysis method. the results of this study show that at the third stage ("profitability efficiency"), due to large volume of non-performing loans (which are considered as undesirable inputs) or due to low volume of interest received on facilities and/ Or for both reasons, the efficiency of branches under review is lower than the other two stages. Also, none of the studied branches have been able to be efficient in all three stages. Furthermore, by comparing overall efficiency scores and modified overall efficiency scores, it can be

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seen that by modifying overall performance scores obtained from data envelopment analysis method, the overall efficiency of all branches is examined at a lower level. It should be noted that efficient branches are those whose efficiency is equal to one in terms of standard data envelopment analysis method, and if a branch with the highest modified efficiency is considered as an efficient branch, it means that bootstrap method is accepted as a method for ranking branches in terms of performance, while bootstrap method is not a valid method for ranking and only corrects the bias of standard data envelopment analysis method results.

Tabel 1. presents a number of efficiency studies
Source: Literature review

Author (publication date)	Inputs	Outputs
Aggelopoulos, Georgopoulos & Siriopoulos (2010)	Personnel expenses, Operational expenses, Loan loss impairments	Net interest income, Non-interest (fee) income (t)
Athanassopoulos (1997) 68 branches of a Greek commercial bank	number of employees, number of ATMs, number of computers	number of deposit accounts, number of credit and debit transactions,
Giokas (2008a)	personnel expenses, other operating expenses	value of deposits and loans, fee, income
Giokas (2008b)44 branches of a Greek commercial	personnel expenses, other operating expenses	value of deposits and loans , fee, income
Oral & Yolalan (1990)	personnel expenses, interest expenses, depreciation	interest income, fee income
Parkan (1987)	number of employees, other operating expenses , number of terminals	number of credit and debit transactions, number of loan applications
Vassiloglou & Giokas (1990)	number of employees, number of computers, operational costs	number of credit and debit transactions
Wu, Yang & Liang (2006)	number of employees, operational expenses	value of deposits and loans, fee income

Barnaba Chol, Kalunda Nthambib & Kamauc (2017) in a study entitled Ownership Structure, Bank Stability and the Financial efficiency of Commercial Banks in South Sudan concluded there was a statistically significant moderating effect of ownership structure on the financial efficiency of commercial banks in South Sudan. This

study recommends that the government should adopt better measures to safeguard public-owned commercial banks to improve their efficiency and performance.

Ndoka, Islami & Shimaand (2017) in their research on the effect of liquidity risk management on the efficiency of Albanian tread Banks (2005-2015) provided a contribution to the identification of liquidity risk factors that affect more the profitability of the Albania Banks and the finding of a scientific solution in order to manage this risk in a more efficient way. The recommendations derived from this study will help young researchers of academic area and professional field. In addition, this paper will create new discussions on risk management instruments used in the Albanian banking system.

3- Methodology

The following steps have been taken in the research for fulfilling the research objectives:

In the first step, in order to evaluate bank's efficiency, the cost efficiency of various branches was measured using Stochastic Frontier Model Function. Accordingly, 27 branches (Branches: Keshavarz Boulevard (Tehran), Argentina (Tehran), Tajrish (Tehran), Central Branch (Tehran), Mirdamad (Tehran), Mashhad, Bojnourd, Arak, Ardabil, Urmia, Isfahan, Rasht, Tabriz, Shiraz, Bandar Abbas, Kish, Qeshm, Zahedan, Bushehr, Ahvaz, Chabahar, Qazvin, Zanjan, Sanandaj, Sari, Qom and Karaj) with continuous activity during the past three years were selected as sample and their monthly efficiency was estimated. For measuring Exim Bank efficiency, bank's expenses were considered as a function of input and output variables and then estimated using Frontier 4 software. Various inputs were fitted in the model and finally non-operating and operating incomes, as outputs, and overdue loan, default and Exim Bank capital, as bank's inputs, were identified.

When the function and its variables were determined, in the

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second step, the form of bank's cost function was selected. The most common forms of Stochastic Frontier Model Function (including Cobb Douglass and Translog Functions) were estimated using Frontier 4 and the optimal form of cost function was selected using statistical tests. After choosing the form of cost function, since the software offers two estimations for the function, attempts were made to select the optimal estimation between MLE and OLS. Next, variability of the model's inefficiency in terms of tested time and inefficiency (efficiency) of various branches were measured. In the third step, the overall efficiency of the bank was calculated using the function and the effect of the Export Development Bank's efficiency on non-oil export in a 36 month period (2016-2019) was determined using an econometric model and Eviews software.

4- Bank efficiency using SFA model

As mentioned above, econometric estimation of cost function requires selection of function form. The model was estimated in Cob Douglass and Translog models and research model was selected. In addition, the model was estimated with different inputs and outputs. Only the final function form is entered here. General form of Cob Douglass and Translog functions are respectively as follows:

(1)
$$\ln(TC) = \alpha_0 + \sum_{i=1}^{2} \alpha_i \ln(Q_i) + \sum_{j=1}^{2} \beta_j \ln(P_j) + u_{it} + v_{it},$$
$$i = 1, 2, \ldots, t = 1, 2, \ldots$$

$$\ln(TC) = \alpha_0 + \sum_{i=1}^{2} \alpha_i \ln(Q_i) + \sum_{j=1}^{2} \beta_j \ln(P_J) + \sum_{i=1}^{2} \alpha_{ii} (\ln Q_i)^2 + \sum_{i=1}^{2} \beta_{jj} (\ln P_j)^2 + \sum_{i=1}^{2} \sum_{j=1}^{2} \gamma_{ij} (\ln Q_i)(\ln P_J) + u_{it} + \upsilon_{it}$$
$$, i = 1, 2, \ldots, t = 1, 2 \ldots,$$

TC_{it} is the total cost of i[th] bank, Q_{it} is output, P_{jit} is input price, U_{it} is random error and U_{it} is cost inefficiency.

The following test can be used to select between Cob Douglass and Translog functions. If multiplication of all the coefficients of model variable squares by variable coefficients results is zero, Cob Douglass is preferred; otherwise, Translog will be selected.

$$\begin{cases} H_0 : \beta_{ii} = \beta_{jj} = \beta_{ij} = 0 \\ H_1 : \beta_{ii} \neq \beta_{jj} \neq \beta_{ij} \neq 0 \end{cases} \quad (2)$$

Hypotheses related to Stochastic Frontier Model were tested using the following likelihood test:

$$\lambda = -2\{\log[L(H_0)/L(H_1)]\} = -2\{\log L(H_0) - \log L(H_1)\}$$ In which λ is the statistic of $L(H_0)$ and $L(H_1)$ MLE proportionate with the limits imposed by H_0 and H_1 hypotheses.

λ in limits terms has X^2 distribution with degree of freedom as for number of limits. If H_0 is true, the statistic of the above test will be smaller than the value of; X^2 otherwise, H_0 is rejected (**Tabel** 2).

Since log likelihood values for Cob Douglass and Translog functions are 138.8 and 102.8 respectively, thus:

$$\lambda = -2_*(138.8 - 102.8) = -2(36) = -72$$

Tabel 2. Hypothesis test
Source: Research calculations

Decision	Critical value	λ	Null hypothesis
H_0 confirmation	3.84	-80	H_0

Therefore, based on the results, since the value of λ is less than the critical amount of X^2 test, H_0 is confirmed and H_1 is rejected. In other words, Cob Douglass is preferred to Translog.

After model type selection, either Maximum Likelihood

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Estimation (MLE) or Ordinary least Squares (OLS) was to be selected.

Along with this purpose, we tested the following hypothesis:

(3) $$\begin{cases} H_0 : \gamma = 0 \\ H_1 : \gamma \neq 0 \end{cases}$$

λ of Cob Douglass model is 0.17, but t statistic of it shows that it is significant ($p<0.05$). Thus, it can be concluded that inefficiency parameter in the model is significant. Thus, MLE is preferred to OLS.

If in the estimated model η=0 and μ=0, i.e. inefficiency is a time-dependent variable, inefficiency distribution (U1) will be semi-normal.

In order to test the above hypothesis, such as function type selection hypothesis, the following likelihood test was used:

(4) $$\lambda = -2\{\log[L(H_0)/L(H_1)]\} = -2\{\log L(H_0) - \log L(H_1)]\}$$

In which λ is the statistic of $L(H_0)$ and $L(H_1)$ MLE proportionate with the limits imposed by H_0 and H_1 hypotheses.

λ n limits terms has X^2 distribution with degree of freedom as for number of limits. If H_0 is true, the statistic of the above test will be smaller than the value of X^2; otherwise, H_0 is rejected (**Tabel 3**).

In order words, the estimated model has a time-dependent inefficiency.

Finally, concerning the above tests, final form of the function is as follows:

H_0 and H_1 hypotheses will be as follows:

$$\begin{cases} H_0 : \mu = 0, \eta \neq 0 \rightarrow \log likelihood = 141.6 \\ H_1 : \mu \neq \eta \neq 0 \rightarrow \log likelihood = 138.8 \end{cases} \quad (5)$$

Tabel 3. Time-Dependent Inefficiency Hypothesis Test
Source: Research calculations

Decision	Critical value	λ	Null hypothesis
Acceptance	3.84	-5.6	H_0

Log of MLE under H_0 hypothesis is 95.31 and λ is as follows:

$\lambda = -2 \times (141.6 - 138.8) = -2$, table $\chi^2 \neq 3/84$

Since λ is an estimation of X^2 statistic of the second table, H_0 is accepted. In other words, the model has time-dependent inefficiency.

Finally, concerning the above tests, final form of the function is as follows:

$$\ln(TC) = \alpha_0 + \sum_{i=1}^{2} \alpha_i \ln(Q_i) + \sum_{j=1}^{2} \beta_j \ln(P_j) + u_{it} + v_{it} \quad (6)$$
$$, i = 1,2,...,t = 1,2,...$$

In which:

Outputs include:

Q_1: non-operating income,

Q_2: operating income,

Inputs include:

P_1: overdue loan,

P_2: default,

P_3: Exim Bank capital,

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Summary of model parameters estimation (**Tabel 4**):

Tabel 4. Parameter Estimation
Source: Research calculations

Variables		Model	
		Coefficient	**T- value**
C	α_0	10.93	10.75
Ln(Q_1)	α_1	-0.102	7.41
Ln(Q_2)	α_2	0.330	5.81
Ln(P_1)	α_3	0.047	4.54
Ln(P_2)	α_4	0.103	2.44
Ln(P_3)	α_5	0.343	5.45
Sigma		0.17	-
Log- likelihood		138.8	

Based on the results of final model, all model variables were significant ($p<0.05$). In addition, braches' capital was one of the main input variables of the model that shows the importance of this variable in different branches of Export Development Bank. Although the bank is a specialty bank in non-oil exports section and its main capital is provided by the government, the role of the government in this efficiency is undeniable.

5- Unit Root Test

In the earlier models, bank deposits variable was studied as one of the bank's inputs but its significance was not confirmed. The reason is the specialty structure of this bank that cannot absorb deposits.

According to the results of LLC, IPS, ADF tests (**Tabel 5**), in all variables except the exchange rate and the null hypothesis (the value of the significance level is less than 0.05) as a result of the above variables during the research period, at the level Have been stationarity and the nominal exchange rate variable has been mana with double differentiation. In econometric models, a single root test is performed before estimating the model:

Tabel 5. The results of the unit root
Source: Research calculations

Variable	Interrupt length	Test statistics ADF	Test statistics IPS	Test statistics LLC
Monthly Exchange Rate	1	34.43 (0.000)	-9.64 (0.000)	-6.32 (0.000)
Monthly GNP	0	126.60 (0.000)	-15.29 (0.000)	-11.70 (0.000)
Monthly Oil Price	0	168.75 (0.000)	-19.08 (0.000)	-20.53 (0.000)
Monthly Cost Efficiency of Export Development Bank	0	105.64	-10.21 (0.000)	-11.98 (0.000)

In connection with the generalized torque model, Sargan Testis used in order to select the appropriate instrumental variables. Sargan test statistic has a chi-square distribution with degrees of freedom equal to the number of excesses specified. According to the probability value of this statistic, it can be concluded that the instrumental variables used in the model have been properly selected and the hypothesis of zero validity of the instrumental variables is confirmed. Orlando and Bound's Test statistics were also used to determine the degree of autocorrelation of noise sentences. To determine the degree of autocorrelation of noise sentences, the results of the above test are reported in (**Tabel 6**).

Tabel 6. Results of Sargan test, Orlando, and Bound's Test
Source: Research calculations

Test	**Test statistics IPS**
Sargan	8.04 (0.33)
Autocorrelation rank 1	2.84 (0.000)
Autocorrelation rank 2	2.48 (0.000)

*. The numbers in parentheses indicate the significance of the coefficient.

6- Estimation of non-oil exports function:

After estimating the cost efficiency of branches, the effect of the

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average cost efficiency of branches (as bank efficiency) on non-oil exports was investigated. Along with this purpose, non-oil export was considered as a function of exchange rate, GNP, Oil Price and cost efficiency of Iranian Export Development Bank. The general form of the function is as follows (7):

$$Log\ EX = \alpha + \beta_1.Log\left(X_1\right) + \beta_2.Log\ \left(X_2\right) + \beta_3.Log\left(X_3\right) + \beta_4.Log\left(X_4\right) + U \quad (7)$$

In which:

X_1: Monthly exchange rate,

X_2: Monthly GNP,

X_3: Monthly Oil Price,

X_4: Monthly the average cost efficiency of branches (as bank cost efficiency) estimated in the previous section using Scholastic Frontier Function. U is model disturbance sentence.

Before model estimation, reliability of the model variables was confirmed using Dickey Fouler Test. When reliability of variables was confirmed, the model was estimated using ordinary minimum squares method and Eviews software. Model estimation using OLS method is as follows:

$$Log\ EX = \underset{(3.35)}{19.37} - \underset{(-3.14)}{4.56}Log\left(X\,1\right) + \underset{(3.33)}{0.77}\ Log\left(X\,2\right) - \underset{(-2.51)}{0.29}Log\left(X\,3\right) + \underset{(6.97)}{10.6}.Log\left(X\,4\right) \quad (8)$$

R^2 of the model is about 69%. That is 69% of the dependent variables can be explained by the independent ones.

t statistic related to all the independent variables of the model is significant ($p<0.05$). At 95% significance level the value of model t statistic is to be more than 1.96.

Model F statistic is 17.01 that shows that the total fitted model is significant.

Durbin–Watson statistic, according to the estimated results, is 1.96.If Durbin–Watson statistic is between 1.5 to 2.5, the hypothesis that there is no self-correlation in model errors can be accepted. Thus, independence of errors among model errors can be accepted.

X_1 variable coefficient is estimated to be -4.56. That is nominal exchange rate has a negative effect on non-oil exports and 1 unit increase in nominal exchange rate decreases non-oil export up to 4.56 units. discussed Theories in this regard have confirmed this also. Based on these theories, in developing countries, import has more impact on the economy rather than export. Therefore, in such items, relation between the exchange rate and export is reversed.

X_2 variable coefficient is 0.77. That is GDP has a positive direct effect on non-oil exports. One unit of increase in GNP results in 0.77 unit of increase in non-oil exports.

X_3 variable coefficient is -0.29. That is Oil price has a negative direct effect on non-oil exports. One unit of increase in Oil Price results in -0.29 unit of decrease in non-oil exports. This theory is according to Dutch disease in economy.

X_4 variable coefficient is 10.6. That is bank's Cost efficiency has a positive correlation with non-oil exports. In case of the effect of bank's efficiency on non-oil export it should be mentioned that the inputs related to bank's efficiency is in percentage and non-oil export data are in million dollars. When the Cost efficiency of all the branches of Export Development Bank increases one unit, non-oil export increases 10.6 units. Therefore, the efficiency of bank ranches played an effective role in non-oil exports in the period under study.

7- Conclusion

Based on the research findings, nine proposals have been presented to improve the Cost efficiency of Exim Bank and develop non-oil

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exports.

a) Increasing the bank's capital continuity over time: Increasing the bank's capital strengthens the bank's ability to finance export companies and creates a competitive advantage for export companies. With the increase of the bank's capital, the bank's financing power for the countries importing goods and services from Iran will increase.

b) Reduction and merger of loss-making branches that due to the situation and conditions, the branch is not able to cover its costs. With the reduction of loss branches, the Cost efficiency of Exim Bank increases.

c) Increasing the productivity of human and physical capital by holding effective training courses and revising the recruitment and employment of manpower in a traditional way and using scientific methods to attract talented, specialized, motivated and interested manpower, etc.

d) Although a slight decrease in the exchange rate of the rial against other currencies leads to an increase in the competitiveness of export goods and services,however, this advantage, through the occurrence of high domestic inflation, leads to an increase in the price of export goods and services and reduces the competitiveness of export products globally and against imported products. Therefore, the central bank should strictly avoid applying monetary policies that result in inflation in the economy.

e) Since the increase in the Cost efficiency of the Export Development Bank leads to more support from the Export Development Bank to exporters in providing the required financial resources, it is suggested that the management of the Export Development Bank prioritize increasing the Cost efficiency of the bank in the medium and long term planning.

f) Since the Cost efficiency of Exim Banks plays an important role in export development, the government can increase supportive

facilities by Exim Banks to improve non-oil exports.

g) The central bank should adopt policies in relation to large fluctuations in the nominal exchange rate to prevent shocks. The occurrence of shocks in the foreign exchange market and the increase in the nominal exchange rate leads to an increase in the general level of prices in the domestic economy and thus reduces the competitiveness of domestic products.

h) In order to increase cost efficiency, it is suggested that the Export Development Bank of Iran prioritize the reduction of fixed assets over a medium-term period.

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Simulation of human development index in Khuzestan province with emphasis on healthy living and access to knowledge and comparison with Iran

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ABSTRACT

The Human Development Index is a composite index for measuring the three criteria of long and healthy life, access to knowledge and the right level of well-being in life. Since 2011, the components of Human Development Index including, education, the combination of the average age of education for adults (25 years and older population) and the expected years of schooling, life expectancy index and per capita income. Human Development Index (HDI henceforth) is in fact the geometric mean of these three indexes. This index is calculated annually by the United Nations Development Program (UNDP) for countries but not for states, provinces, urban areas and regions in those countries. The main purpose of this study was to simulate human development index in Khuzestan province and compare it with that of Iran as a whole in 1996, 2006, 2011 and 2016. The results show that human development index in Khuzestan has reached from the average level of 0.64 in 1996 to the high level of 0.74 in 2016. The results also show that Khuzestan province is better in human development index with oil sector, and worse in human development index without oil sector. HDI simulation results show that there was a steady upward trend in the years under review, but there has been a structural break in Human Development Index since 2005. Based on this simulation, human development index in Khuzestan province reached an intermediate level until 2009, and a high level after 2010.

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1- Introduction

The importance of human, as the goal and factor for development, has made the countries of the world and international organizations pay special attention to " human development " and identify the factors which have influence on it through their researchers and scientists. Before raising the issue of human development index, per capita income was considered to be as a criterion for measuring the level of development in those countries, but since the growth of per capita income, income distribution and many social and cultural aspects does not encompass human life Mahbub ul Haq (1999), a Pakistani economist in collaboration with Amartya Sen (1999), a development expert and winner of the 1998 Nobel Prize in Economics, introduced and calculated a new index called "Human Development Index", which, in addition to per capita income, also included the index of education and public health (Haq, 2000; Sen, 2000). After this measure, the first Human Development Reports of United Nations Development Programme was compiled and published in 1990. Since 1990, Human Development Report has been published annually by United Nations Development Programme (UNDP), in which countries are compared in terms of educational and health indexes. One of the neglected aspects of human development index is its regional dimension which means that it is not calculated for provinces and states. Although there is no tendency for regional calculations in international dimension, its calculation for provinces can be of great help to regional planners in countries (Bhanojirao, 1991).

lack of such statistics in Iran is one of the statistical gaps in this country that has made regional and provincial research critically limited and inaccurate. To address this shortcoming, in this study, the human development index of Khuzestan province in years 1996, 2006, 2011 and 2016 has been calculated using the latest formula. It should be noted that simulating human development index is a very time-consuming and difficult task and lack of attention to details can distort the index. Therefore, in order to ensure the accuracy of calculations, human development index has been calculated for Iran and compared with the UN Human Development Index for Iran, to ensure the

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accuracy of calculations for the human development index in Khuzestan province.

2- The concept of human development and the introduction of its index (HDI)

Generally, development is an idea originated in the early nineteenth century and since World War II has found a special place in social, economic, political, and international affairs (Frazier, 1997). Criticizing the view that merely introduced economic growth as a measure of development, development economists have defined development as a concept beyond economic growth, and according to them, countries with higher per capita incomes are not necessarily considered more developed (Ramirez, Ranis, & Stewart, 1997). In fact, according to the historical evolution of the above mentioned concept, development is a process that includes all dimensions of a social system with the goals of growth, justice, poverty reduction, democracy and political stability (Basu, 1997). In the framework of this interpretation, increasing production and wealth is just a means, and the main goal of development is to improve the quality of human life or in fact human development and human development requires improving the process of expanding the range of choices for individuals (Nayak, 2008).

Streiten (1981) also argues that in the human development approach, development is not limited to per capita income growth but depends on improvement in other needs of human society such as health, enjoying the basic living standards and education (Streeten, 1981). According to the United Nations, human development is development through the creation of human capabilities that are achieved through human beings themselves by actively participating in the processes that shape their lives, and in fact human beings are not only the goal of development but also the axis of development (Selim, 2015).

To measure human development in countries, the United Nations has, since 1990, used a composite index consisting of three dimensions of education (health and economic welfare) on a scale ranging from

zero (lowest human development) to one (highest human development) (Bhanojirao, 1991). The Human Development Index was developed in 1990 by Amartyasen, a Nobel Award winner in economics as well as, a Pakistani economist, in collaboration with Ranis, a professor at Yale University, and Desai, a professor at the University of London, and since then, it has been used by the United Nations Development Programme (Stanton, 2007).

In the human development index estimation method by the United Nations, health dimension is measured by life expectancy index at birth. In the field of education, two indexes are being used: the average length of education for adults 25 years and older; and the length of the expected period for children's education when they reach school age. However, prior to 2010, instead of these two indexes, adult literacy rate and the enrollment rate of children at school age were used (Bhanojirao, 1991).

Prior to 2010, the components of Human Development Index included education indexes (weighted average of the composite index of gross education cover rate (Gross enrollment rate) in different educational levels (the division quotient of the number of employed people studying in different educational levels into Population of the same age group) and adult literacy rate index (the over 15 years old population), life expectancy index (life expectancy at birth provided that the common mortality pattern at birth is stable, which is a function of health, Quality of life, health facilities, access to minimum living, lack of anxiety, peace of mind as well as economic and social security) and per capita income index (logarithm of ratio of per capita gross income to the purchasing power parity of US dollar due to large gap between high- and low -income countries), and in fact, human development index was arithmetic average of these three indexes. Because the rate of adult literacy made it impossible to compare countries, adult literacy rate index lost the power to differentiate between countries and was replaced by another index. Since 2011, the components of the Human Development Index include education indexes (the combination of mean years of schooling for adults (25

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years and older population) and the index of expected years taken for education), life expectancy index (The average number of years a person is expected to survive if the current mortality rate situation continues) and per capita income index (the natural logarithm of ratio of gross national per capita to the purchasing power of dollar), and Human Development Index is actually the geometric average of these three indices. Replacing literacy with average years of adult education has led to covering more countries andit reveals differences between countries better than literacy rate. Using the expected years taken for children education instead of school enrollment ratio will include a change in the framework of this index from ratio to the number of years; Therefore, quantity in education indexes has turned into quality (Kovacevic, 2010).

For economic welfare, per capita gross national income of countries is also used based on the purchasing power parity of US dollar. In estimating this index, instead of the absolute figure of gross per capita national income to purchasing power parity, the logarithm of gross per capita national income to purchasing power parity of US dollar is used (Bhanojirao, 1991).

According to the classifications in 2015 Annual Report of the United Nations Human Development Report, Human Development Index above 0.8 is classified as a very high human development index, a Human Development Index above 0.7 and below 0.799 is classified as a high human development index and a Human Development Index above 0.550 and below 0.699 is classified as a moderate human development index and values below 0.549 are classified as low human development (Selim, 2015).

In 1977, the last year of the Pahlavi regime, Iran's human development index was 0.437. In this regard, it was ranked 130th among 180 countries in the world. According to the Human Development Report, Iran was classified as a country with low human development until 1980, but since 1981, with the improvement of the components of the index, especially health and education, it has been upgraded to the group of countries with moderate human development

index, and in recent years, it is located in middle and upper ranks of this group. According to the Program and Budget Organization report, which was published on the eve of the 40th anniversary of the Islamic Revolution, in accordance with the United Nations report on changes in the human development index, Iran's human development index has been increasing in the post-revolutionary years.Its value has increased from about 0.57 in 1990 to about 0.8 in 2017, which has placed Iran among the high ranking countries. According to this report, Iran's human development index in 2005, 2010 and 2015, respectively, is estimated at 0.695, 0.755 and 0.789, which has a growth of 13.5 percent. Also, according to the United Nations, Iran's human development index increased by 1.26 times between 1990 and 2015 (Selim, 2015).

Some researchers such as Bakhtiari et al. (2006), Ziari et al. (2010), Asefzadeh, Jahandideh and Mousavi (2013), Asefzadeh, Alijanzadeh and Nasiri Asal (2013), Zanganeh (2016) And Afgheh et al. (2016) have calculated the human development index based on the provinces of Iran (Afghah, Ahangari, & Askari por, 2020; Asefzade, Jahandideh, & Arefeh, 2013; Hesari, 2015; Sadegh, Majid, & Seyed Mojtaba, 1385; saeed Asefzadeh, Mehran Alijanzadeh, & Marjan Nasiri asl, 2013; Zanganeh, 2016; Zayyari, Zanjirchi, & Sorkhkamal, 2010).

3- Calculation of human development index for Khuzestan province

In this study, the human development index of Khuzestan province is calculated by modeling the formula introduced in the human development report of the United Nations Development Programme in 2018 as follows:

$$HDI = \sqrt[3]{LEI \times II \times EI} \quad (1)$$

where HDI is human development index, LEI is life expectancy index, II is income index and EI is education index.

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3-1- Life expectancy index

Long and healthy life is measured with life expectancy and is the average number of years during which a person is expected to survive if the current mortality rate continues. Life expectancy index is calculated by the difference of life expectancy (LE) and the minimum years of survival (which according to international standard equals to 20 years), divided by life expectancy difference of the world's top country (according to international standard equals to 85 years) and the minimum years of survival in those years, as follows:

(2) $$\text{LEI} = \frac{\text{LE (real value of life expectancy)} - \text{minimum years of survival}}{\text{minimum years of survival} - \text{maximum years of survival}} = \frac{\text{LE}-20}{85-20}$$

Accordingly, the life expectancy index of Khuzestan province is calculated and compared with the values of the life expectancy index of Iran as a whole (calculated by the researcher) and the life expectancy index of Iran (calculated by the United Nations Development Program), **Table 1** presented and compared :

Table 1. Calculation results of life expectancy index
Source: Research results

Year	Life expectancy of the whole of Khuzestan Province	Khuzestan's life expectancy index	Iran's Life expectancy index (researcher calculations)	Iran's Life expectancy index (UN calculations)
1996	66.85	0.71	0.728	0.75
2006	71.83	0.78	0.801	0.80
2011	72.44	0.79	0.831	0.84
2016	72.58	0.79	0.857	0.86

As shown in **Table 1**, the life expectancy index calculated for Iran is reasonably close to the UN calculations, and based on this, the life expectancy index for Khuzestan province can be trusted. According to the results, the life expectancy index in Khuzestan province, like the

country on the whole, has been improving from 1996 to 2016, however, it is lower than the national average.

3-2- Income index

Livelihood criteria or the same Living standard is measured by Gross National Index per capita (GNI pc). The calculation of income index requires considering the natural logarithm of GNI pc, before using it in the following general relation:

(3) Index=(actual value-minimum value)/(maximum value-minimum value)

Then, we will have:

(4)
$$II = \frac{\mathrm{Ln}\left(\mathrm{GNI\ pc}\right) - \mathrm{Ln}\left(100\right)}{\mathrm{Ln}\left(75000\right) - \mathrm{Ln}\left(100\right)}$$

where, II is income index and Ln (GNI pc) is the natural logarithm of the ratio of gross national income per capita equal to the purchasing power parity of US dollar in 2011, and Ln (100) is the natural logarithm of the gross national income per capita of a country with the lowest gross national income per capita in the world equal to the purchasing power parity of US dollar in 2011 (according to the international standard equal to 100 US dollar), and Ln (75000) is the natural logarithm of the gross national per capita income of a country with the highest gross national per capita income in the world to the purchasing power parity of US dollar in 2011 (according to the international standard equal to 75,000 US dollar).

To obtain the GDP per capita of Khuzestan province at the base price (2011= 100) to the purchasing power parity of US dollar in 2011, the following formula is used:

(5)
$$GDP - percapita = \frac{\dfrac{\text{Constant } GDP(2011)}{exchange\ rate}}{Khuzestan\ population} \times PPP$$

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By dividing Iran's current gross domestic product by Iran's gross domestic product by the fixed price in 2011, the price index (2011 = 100) is calculated to be placed in relation (5):

Table 2. Calculation results of the price index to the base price (2011 = 100)
Source: Research results

Year	Iran's Current GDP (billion Rials)	Iran's gross domestic product to base price in 2011 (billion rials)	Price index (100 = 2011)
1996	261529	3010017	0.09
1385	2486861.7	5476337	0.45
1390	6364368.6	6364369	1.00
1395	12722850	6691109	1.90

By dividing Iran's GNI_pc by the purchasing power parity of dollar in 2011 (calculated by the United Nations) by Iran's GNI_pc at a fixed price in 2011, the purchasing power parity rate in terms of base price to be placed in Equation (6) is calculated as follows:

$$Price\ base\ to\ buy\ power\ parity\ rate\ = \frac{\left(\left(UN\ Computing\right)\ Iran\ GDP\ per\ capita\right)}{\left(\left(Calculator\ researcher\right)\ Iran\ GDP\ per\ capita\right)} \tag{6}$$

By dividing Iran's GDP at a fixed price in 2011 by exchange rate and then by the population of Iran, Iran's GDP per capita is obtained at the base price:

$$Price\ base\ to\ Iran\ GDP\ per\ capita\ GDP = \frac{\left(\left(Iran\ GDP\right) /\ \left(exchange\ rate\right)\right)}{\left(Iran\ Country\ Population\right)} \tag{7}$$

Table 3. Calculation results of the purchasing power parity rate at the base price
Source: Central Bank of Iran and research results

Year	Iran's GDP at fixed price in 2011 (billion rials)	Official exchange rate (dollars to rials)	Iran's GDP in dollars	Iran's population (billion people)	Iran's GDP_pc (dollars per capita)	Iran's GNI_pc (UN calculation based on PPP)	Purchasing power parity rate at base price
1996	3010017	1751	1718.8	0.0601	28621	12731	0.44
2006	5476337	9171	597.1	0.0705	8471	16218	1.91
2011	6364369	10616	599.5	0.0751	7977	18194	2.28
2016	6691109	30915	216.4	0.0799	2708	18544	6.85

Now by placing the results of **Table 2** and **Table 3** into relation (5), we will have:

Table 4. Khuzestan's GDP_pc (2011 = 100) to the purchasing power parity of US dollar in 2011
Source: Research results

Year	Khuzestan's GDP at fixed price	Exchange rate (dollars to rials)	Khuzestan's GDP to exchange rate ratio	Population of Khuzestan (billion people)	Khuzestan's GDP_pc (dollars per person)	Purchasing power parity rate	Khuzestan GDP_pc at the base price to the purchasing power parity of US dollar
1996	430483	1751.2	245.8	0.0037	65622	0.45	29190
2006	811265	9170.94	88.5	0.0043	20697	1.92	39628
2011	805671	10616.3	75.9	0.0045	16749	2.28	38200
2016	582868	30914.9	18.9	0.0047	4003	6.85	27412

Now, after obtaining GDP_pc of Khuzestan province at the base price equal to the purchasing power parity of US dollar, the income index of Khuzestan province is calculated and compared with the values of Iran's income index:

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Table 5. Calculation results of revenue index in terms of base price
Source: Research results

Year	Khuzestan's GDP per capita (dollars per person)	Khuzestan Revenue Index (with oil)	Khuzestan Income Index (excluding oil)	Iran Income Index (Researcher Calculations)	Iran Income Index (UN Calculations)
1375	29190	0.86	0.71	0.7	0.73
1385	39628	0.90	0.78	0.76	0.77
1390	38200	0.90	0.77	0.77	0.79
1395	27412	0.85	0.79	0.78	0.79

The per capita GDP of Khuzestan province at the base price increased from 1996 to 2006 and decreased from 2006 to 2016, but the per capita GDP of Iran according to UN calculations increased until 2011 but in 1395 it remained constant compared to 90. Khuzestan province income index values with a slight difference compared to the country's income index values also increased from 1375 to 1390 and decreased from 1390 to 1395. Iran's per capita GDP at the base price (calculated by the researcher in **Table 3**) wasnot adjusted for the dollar purchasing power parity rate in 2011.

The results of this calculation show that Khuzestan province is in a better position than the country in terms of income index, especially in 2006 and 2011. It seems that the sanctions have shown more impact in the years after the nuclear sanctions in Khuzestan province. It also seems that the revenue index of Khuzestan province is relatively overestimated due to the added value of the oil sector. For this purpose, based on the same method, the revenue index of Khuzestan province without oil has been recalculated and placed in the table.

3-3- Education Index

The index of access to knowledge is a bit more complex than the other two indexes involved in calculating the index of human development

and, in fact it is obtained by combining the following two indexes of education:

$$EI = \frac{\sqrt{EYSI*MYSI} - 0}{1 - 0} = \sqrt{EYSI*MYSI} \quad (8)$$

Where EI is education index, $\sqrt{EYSI * MYSI}$ is the index calculated in the understudy province or country, zero is the lowest value of the index according to the international standard and 1 is the highest value of the index according to the international standard.

A) Mean years of schooling: Obtaining average schooling years requires access to a population distribution based on degrees and educational levels.

$$MYS = \sum_{a=1}^{A} l_t^a \times s_t^a \quad (9)$$

$$s_t^a = \sum_j h_{j,t}^a \times dur_{j,t}^a \quad (10)$$

MYS (Mean Years of Schooling) is average number of years of study, l_t^a is the ratio (share) of the age group A population to the population aged 25 and over in year t, s_t^a is average number o fschooling years of age groups of 5 (a) to 75 years and older in year t, a = 1 is age group of 25 to 29 years, a = 2 is age group of 30 to 34 years,. ..,and a = 11 is age group of 75 years and older, $h_{j,t}^a$ is the share of the age group population (*a*) in year t who have education level of *j*, *j* is elementary, secondary and tertiary levels, $dur_{j,t}^a$is the duration of schooling years of age groups *a* in year *t*. The levels of educations include elementary, middle, high school, pre-university, higher education and Nehzat (education for older illiterate people), and the age groups are divided as much as possible into 5-age groups from 25 to 74 years old, and the highest age group is 75 years and older.

Based on Barro & Lee's (1997) method (Lee & Barro, 2001) the average schooling years is equal to the duration of schooling at each education level per year ($dur_{j,t}^a$), multiplied by the share of the

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population in different age groups who have reached that level of education as the highest level ($h_{j,t}^{a}$). At first, for each age group, the total number of students in each grade, including students studying and literate students not currently studying (the table for the population aged 6 and older by gender, age groups, literacy status and literacy level) , are multiplied by the number of years of formal education of the country until the end of that grade (for elementary level (5 years), middle school level (8 years), secondary school level (11 years), pre-university level (12 years), higher education level (16 years), Nehzat (2 years) and other indefinite and undeclared courses (11 years); The resulting numbers for each age group are added together to obtain the number of schooling years for each age group; afterwards, it is divided by the population of the same age group (population table according to age, sex and residence status) to obtain the average number of schooling years (s_t^a); Then the average schooling years of each age group is multiplied by the population share of the same age group (l_t^a), and their sum will be considered equal to the mean years of schooling (MYS):

(11) $$\mathrm{MYSI} = \frac{\mathrm{MYS} - \min MYS}{\max MYS - \min MYS}$$

(12) $$\mathrm{MYSI} = \frac{\mathrm{MYS} - 0}{15 - 0} = \frac{\mathrm{MYS}}{15}$$

where MYSI is Mean Years of Schooling Index, MYS is mean years of schooling(according to the international standard, 0 is the lowest and 15 is the highest mean years of schooling).

B) Expected Years of Schooling: it refers to the total number of schooling years which a 6-year-old child is expected to enjoy in the coming years.

(13) $$EYS = \sum_{i=a}^{n} \frac{E_t^i}{P_t^i} + \sum_{l=\text{level education}} \frac{E_t^{\text{unknown}}}{P_t^{\text{age of level}} / D_l}$$

where EYS is the expected years of schooling, E_t^i is the number of students enrolled in age *i* in academic year *t*, P_t^i is the number of

population in age i in academic year t, D_l is the number of years of course l, n is the highest age of education, $E_t^{unknown}$is the number of students enrolled in school in academic year tregardless of age, and $P_t^{age\ of\ level}$ is the number of population in schooling age in academic year t.

First, the number of students studying in the country at the age related to each academic year (E_t^i) separated by individual ages (for example, the number of 6-year-old students studying in the first grade of primary school or the number of 11-year-old students studying in the first grade of middle schools studying in the country) is divided by the total population at the age of each grade level (P_t^i) separated by individual ages (for example, the total number of people aged 6 or the total number of people aged 11);the Sum of the obtained numbers will become $\sum_{i=a}^{n} \frac{E_t^i}{P_t^i}$. Then the total number of students studying in the country at the relevant age (E_t^i) separated by each educational grade (for example, the total number of 6- to 10-year-old students studying within the country in the first to fifth grades of elementary school or the total number of 11- to 13-year-old students studying within the country in the first to third grades of middle school) are subtracted from the total number of people studying in each grade within the country (for example, the total number of people of all ages who are studying in primary schools in the country, or the sum of people of all ages studying in middle schools within the country) to find the number of students of other ages ($E_t^{unknown}$) for each grade. The Number of students in other ages ($E_t^{unknown}$) during the period of official education of the country for each grade is multiplied by the number of years (for elementary level=5 years, middle level=3 years, secondary level=3 years, pre- university level=1 year, higher education level= 6 years and other undeclared courses=18 years) and the summation of the population at the age of each grade(P_t^i) is divided by each grade ($P_t^{age\ of\ level}$for example, the total number of 6-10-year-old population schooling in the grades of 1-5 or the total number of 11-13 year-old population in the first to third years of middle school; the summation

of the obtained numbers gives us $\sum_{l=\text{level education}} \frac{E_t^{unknown}}{P_t^{age\ of\ level} / D_l}$ and the summation of $\sum_{l=\text{level education}} \frac{E_t^{unknown}}{P_t^{age\ of\ level} / D_l}$ and $\sum_{i=a}^{n} \frac{E_t^i}{P_t^i}$ is considered to be quivalent to the expected years of scholling(EYS).

(14) $$EYSI = \frac{EYS - \min EYS}{\max EYS - \min EYS}$$

(15) $$EYSI = \frac{EYS - 0}{18 - 0} = \frac{EYS}{18}$$

where EYSI is the expected years of schooling index, EYS is the average of expected years of schooling, 0 is the lowest expected years of schooling according to the international standard and 18 is the maximum expected years of schooling according to the international standard.

Now the calculation results related to the mean years of schooling (for Khuzestan) obtained from Eq(12), the calculation results related to the expected years of schooling (for Khuzestan) obtained from Eq(13) and the calculation results related to the average years of schooling index and the expected years of schooling index of Iran are placed in Eq(8):

Table 6. Calculation results of education index for Khouzestan Province
Source: Research results

Year	Mean years of schooling in Khuzestan province	Mean years of schooling index in Khuzestan province	Expected years of schooling in Khuzestan province	Expected years of schooling index in Khuzestan province	Khuzestan's Education Index
1375	4.69	0.31	10.48	0.58	0.43
1385	6.52	0.44	11.20	0.62	0.52
1390	7.24	0.48	12.37	0.69	0.58
1395	8.42	0.56	14.20	0.79	0.67

Furthermore, the calculation results related to the mean years of schooling (for Iran) in Eq(12), the calculation results related to the expected years of schooling (for Iran) in Eq(13) and the calculation results related to the mean years of schooling index and the expected years of schooling index in Iran are replaced in Eq(8):

Table 7. Calculation results of Iran's education index
Source: Research results

Year	Mean years of schooling in Iran	Mean years of schooling index in Iran	Expected years of schooling in Iran	Expected years of schooling index in Iran	Iran Education Index
1375	4.81	0.32	11.26	0.63	0.45
1385	6.82	0.45	13.23	0.74	0.58
1390	7.56	0.50	13.82	0.77	0.62
1395	8.82	0.59	14.90	0.83	0.70

Now, after obtaining the mean years of schooling index and the expected years of schooling index, the education index of Khuzestan province calculated with the values of Iran education index (calculated by the researcher) and Iran education index (calculated by the UNDP), are compared:

Table 8. Calculation results of education index
Source: Research results

Year	Khuzestan's Education Index	Iran's Education Index (researcher calculation)	Iran's Education Index (UN calculation)
1375	0.43	0.45	0.49
1385	0.52	0.58	0.63
1390	0.58	0.62	0.68
1395	0.67	0.70	0.74

The results of the calculations show that in Khuzestan province, the education index is in a worse situation than the country. However, its trend has improved since 1996.

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3-4- Human Development Index

By placing the values of life expectancy index from Table 1, income index according to basic prices from **Table 5** and education index from **Table 8** into Eq(5),the human development index of Khuzestan province is calculated according to basic prices and compared with Iran's Human Development Index (calculated by the researcher) and Iran's Human Development Index (calculated by the United Nations Development Program):

Table 9. Calculation results of human development index in terms of base price
Source: Research results

Year	Khuzestan's Human Development Index with Oil	Khuzestan's Development Index without oil	Iran's Development Index (researcher calculation)	Iran's Development Index (UN calculation)
1375	0.64	0.60	0.62	0.65
1385	0.72	0.68	0.71	0.73
1390	0.75	0.71	0.74	0.77
1395	0.77	0.75	0.78	0.80

The results of calculating the human development index in Iran compared with the UN calculations show a high correlation, based on which the calculated human development index for Khuzestan province can be considered reliable.

Based on the results, the human development index of Khuzestan province since 1996 with a value of 0.64 from the average level to the high level in the years 2006-2016 has reached an acceptable growth in this index. As it is clear, the index of human development without oil in Khuzestan province is lower than the index of human development in the country and shows the worse situation of Khuzestan province than that of the country in this field. Moreover, based on these results, until 2006, the situation of the province was average in terms of indexes, and after 2011, it has improved and is considered at a high level.

3-5- Simulation of Human Development Index

Simulation is the creation of an artificial environment and the use of a theoretical model to estimate the behavior of a real-world system. An

artificial environment is a virtual space in which the analyst tries to model a system in the real world (Nawrocki, 2001). Depending on the purpose of the simulation, four types of simulation can be defined that are used individually or collectively in experimental works:

Simple generator simulation: This type of simulation is used when for some reason it is not possible to obtain a sample for the variable under consideration. The reason for that can be it has not yet occurred or been recorded or it is not economical to sample it. This type of simulation can be used to predict through regression models containing random perturbations. For example, suppose that there is a $Y = a + bZ + cX + e$ relation between X, Y and Z. Where Y is the studied variable, Z is the variable with the available sample, X is the positive variable with specified mean and distribution and non-sampling probability, and e is error term with normal distribution. In this case, the values of X and e must be simulated to investigate the behavior of Y. The Monte Carlo simulation is an example of this type of simulation (Nawrocki,2001).

Sensitivity or tactical analysis simulation: This type of simulation is used when the main question is how the model or variable under consideration behaves in the event of a change in the model parameters. For example, in a $Y = a + bX + cX^2$ relation in order to measure the sensitivity of y to changes in c, we can simulate this by making artificial changes.

Strategic or exploratory simulation: This type of simulation is mostly used when the effect of a controlled variable on the studied variable is considered. Suppose that in the example above the variable is controlled by x, that is, the value it gives depends on the decision and action of the reviewer. In this case, this type of simulation is changed into "What happens if?". Ex-post simulation is one type of this simulation.

Interactive simulation: This type of simulation is modelling of the human brain's decision-making process about the effective variables that are used in the construction of artificial intelligence after copying.

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Sugar space simulation is an example of this type of simulation (Rahman & Setayeshi, 2007).

The ex-post simulation method, which is a part of dynamic disequilibrium adjustment model (DDAM) is based on strategic or exploratory simulation. In this method, after performing the operation of estimating regression equations in the model, different scenarios can be simulated using the estimated model. In other words, numerical model is an estimation of the structural form of the model that must be solved for endogenous variables to find the summarized form. If this pattern is solved in the sample period, the sample period simulation or retrospective simulation will be obtained and the values of the solved endogenous variables can be compared with the real values to evaluate the performance of the model in the past but if the values of the exogenous variables are considered in the period, The sample will change and then the pattern is solved for the endogenous variables. The values of the endogenous variables are obtained based on the amount of the endogenous policy variable known as "shock analysis" (Bid Abad & Peykarjoo, 2007). In this research, using the econometric model, the human development index in Iran has been simulated. The adopted method is a simultaneous pattern of behavior that considers the effects of changes in the Human Development Index through the components of the UN Human Development Index and at the same time predicts it and considers it in the Human Development Index. The estimation method is based on the dynamic least squares method proposed by Stoke and Watson (1993) which is very useful for predicting variables. In general, the DOLS estimator compared to other convergence vector estimators has severaladantages, some of which are mentioned:

1. Similar to the ARDL estimator, this estimator does not need to be all first-order collective time series I (1) and can be used in cases where the collective degree of the variables is different.

2- This estimator is easy to calculate, so that the estimation of the model with the help of this estimator is much easier compared to other

estimators with asymptotic performance, and therefore the long-term estimation of the parameters is compatible with DOLS method.

DOLS estimator is a good way to correct the problem of endogenousness and autocorrelation.

4. The waste obtained through DOLS method is not correlated with any of the independent variables and can be considered completely exogenous.

5. In DOLS method, the endogenousness of explanatory variables does not affect asymptotic properties, especially estimator consistency.

6. In case all variables have a collective order of one and there is only one convergence vector, DOLS estimator is asymptotically equivalent to Johansson (1988) maximum likelihood estimator.

7. In small samples, estimations obtained by DOLS method have a lower mean squared error than those obtained by the Johansson maximum likelihood method. In addition, DOLS has the least esquaerd error among all convergence vector regression estimators (Stock & Watson, 1993).

Hence, , the short-term estimation equations have the following general form:

$$X_t = A_0 + A_1 Y_t + \sum_{i=-k}^{k} a_{it} \Delta Y_{t-i} + A_2 Z_t + \varepsilon_t \quad (16)$$

where X represents the dependent variable (in this study, the human development index for Khuzestan province HDI), Y is the vector of independent variables (in this study, including LEI life expectancy index, II income index and EI education index calculated by the UN), Δ is The difference sign and Z t is the vector of other variables that do not need delay and precedence. In order to obtain long-run equations and coefficients, it is assumed that t equals long - term antecedence and precedences. One of the main problems of DOLS method is determining the appropriate number of precedence and antecedence of

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variables, while DOLS estimator results are also sensitive to the selection of the number of precedence and antecedence periods. Due to the importance of this research subject , using Akaik statistics, the optimal length of antecedence and precedence is investigated. Therefore, the estimation of equations from this method is evaluated for the time data of 2017-2020 taken from the United Nations.

Various statistics have been used to evaluate the performance of the simulation model in the retrospective simulation period. One of the statistics that has traditionally been used as a measure of pattern simulation accuracy is the variance of simulation error (Pindyck & Rubinfeld, 1998). Based on these statistics, the degree of proximity of the simulation variable to the real series is measured. Assume that for the historical period $T1 = 1, \dots, T$ and for the retrospective period $T2 = T + 1, \dots, T + h$, then the criteria for predicting power are defined as follows:

(17)

$$(Root - Mean - Square\ Error\ of\ simulation)$$

$$RMSE = \sqrt{\sum_{i}^{N}(\tilde{Y} - Y)^2} \quad i = 1, \dots, T, T+1, \dots, T+h$$

(18)

$$Correlation\ coefficient$$

$$r = \sqrt{\frac{\sum_{i}^{N}(\tilde{Y} - Y)^2}{\sum_{i}^{N}(\tilde{Y} - \bar{\tilde{Y}})^2 \sum_{i}^{N}(Y - \bar{Y})^2}}$$

In the above equations, Y represents the real variable and $\tilde{Y}$ represents the simulated variable. The above traditional criteria show important properties in comparing simulation and real variables. Eq (7) shows that the closer minimum simulation error to zero, the closer simulation to the real values, and correlation coefficient is a coefficient in which the degree of correlation between two variables is obtained, regardless of being exogenous or endogenous. The closer the correlation coefficient to one, the better (Gujrati, 2004).

According to the research results, the human development index of Khuzestan province can be simulated for the period 1990-2018. The results of this simulation are shown in Table 10.

Table 10. Simulation of Khuzestan Human Development Index
Source: Research results

Indicator	Year	Indicator	Year	Indicator	Year
0.7	2010	0.62	2000	0.54	1990
0.71	2011	0.63	2001	0.55	1991
0.73	2012	0.64	2002	0.57	1992
0.73	2013	0.64	2003	0.58	1993
0.73	2014	0.64	2004	0.59	1994
0.73	2015	0.65	2005	0.6	1995
0.74	2016	0.68	2006	0.6	1996
0.74	2017	0.68	2007	0.61	1997
0.74	2018	0.69	2008	0.61	1998
0.74	2019	0.7	2009	0.62	1999

In order for further examination of simulation results with the actual data values, the results of the calculation of the simulation evaluation criteria are shown in **Table 11.** These results indicate the validity of the simulation performed.

Table 11. Predictive error criteria
Source: Research results

r	RMSE
0.97	0.02

As the results of Table 10 show, Khuzestan Human Development Index had a growing and gentle trend until 2005, but from 2006, it seems that a structural leap or failure occurred in the Human Development Index.Thenfrom 2016 to 2018, the trend stabilized and somehow

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reached a stable value. Also, based on this simulation, the human development index in Khuzestan province was at a moderate level until 2008, but has reached a high level since 2009.

4- Summary and Conclusion

Human Development Index is a composite index to measure success in any countryin three basic criteria of human development, long and healthy life and access to knowledge and awareness. Based on this index, the success rate of countries can be measured based on these three main criteria. Khuzestan province, with a large share of oil and gas resources and large and national economic units, is expected to have a relatively higher human development index than the national-level average.

To test this hypothesis, in this study, using the new formula, the human development index of Khuzestan province for the years 1996, 2006, 2011 and 2016 was calculated. The results of this study showed that life expectancy index and education index in Khuzestan province are worse than that of the country, but the income index (including oil) was higher than its counterpart in the country level. However, the calculation of the oil-free human development index for Khuzestan showed that this income index is in a more unfavorable situation than that of the country.

Based on the results, the human development index of Khuzestan province from 1996 with a value of 0.64 from the average level reached the high level in the years 2006 to 2016, which is an acceptable growth in this index. Also, the non-oil human development index of Khuzestan province is lower than the similar index of the country and shows the worse situation of Khuzestan province compared to the country in this field.

The simulation results of the Human Development Index show that there was a growing and gentle trend until 2005, but since 2005 it seems that there has been a leap or failure in the Human Development Index. Moreover, based on this simulation, the human development

index in Khuzestan province was at a moderate level until 2009, which reached a high level after 2010.

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Determinants of the changes in the elasticity of CO_2 emissions in Iran

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ABSTRACT

In this study, while calculating the CO_2 emission demand elasticity and CO_2 emission output elasticity of production sectors for 2001 and 2011 using Input-Output analysis, CO_2 emission elasticities are decomposed using structural decomposition analysis to identify stimuli. Findings show that the "Electricity generation, transmission, and distribution" sector has the most elasticity in these years. The "Ghosh inverse matrix" effect is a strong stimulus to the CO_2 emission elasticity of the sectors. This result indicates that the change in the share of output i, which is sold to sector j as an intermediate input, is a strong stimulus to increase the elasticity of CO_2 emissions. These changes can be due to increased economic activities and the inefficiency of production structure. Increasing the share of renewable energy in the energy consumption basket of production sectors, increasing energy efficiency (reducing energy intensity) by replacing new and advanced equipment with old and worn equipment and improving production structure can help reduce the elasticity and CO_2 emission in Iran's production sectors. The results of this study are significant for energy and environmental policymakers.

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1- Introduction

Today, the environment is one of the most challenging economic and political issues in international politics. In recent years, numerous meetings and conferences have focused on climate change and environmental challenges, reflecting the concerns of economists, politicians, and ecologists about environmental issues.

In 2019, Iran is ranked sixth among world countries and fifth among Asian countries (including Russia) in terms of CO_2 emissions.[1] Therefore, studying the CO_2 emission elasticity of the production sectors of this country is significant and important for energy and environmental policymakers. What factors influence changes in CO_2 emission elasticities? Which are the stimulants and which are the inhibitors? The answers to these questions are useful in reducing and controlling CO_2 emissions. In the present study, CO_2 emission elasticities of production sectors are calculated, and then, with the aim of identifying CO_2 emission elasticity stimuli, the changes in CO_2 emission elasticities are broken down into different components.

The methodology of this research is based on Input-Output analysis and decomposition analysis. The economy of all countries of the world is composed of different sectors that in a general classification can be divided into two groups of manufacturing industries and non-manufacturing industries. Input-Output tables are widely used today in predicting and describing the environmental conditions of countries due to their inclusion of manufacturing and non- manufacturing groups. It can be said that Input-Output analysis and decomposition analysis are used in conjunction with econometric techniques, and perhaps even more econometric techniques are used to explain and describe environmental and energy issues. In recent years, Structural Decomposition Analysis (SDA) has been an important tool for breaking down and analyzing changes in physical

[1] http://www.statista.com

variables, such as energy consumption or CO_2 emissions, to changes in their economic and physical determinants. Structural decomposition analysis is a static comparative technique in which the structural term refers to the inclusion of output and demand structure by Input-Output tables (Rormose, 2011). In the analysis of the complex interaction between the economy and the environment, it is very important to obtain all the details of the consumption and production structure obtained by Input-Output tables.

The novelty of this paper is to determine and calculate the components of changes in CO_2 emission elasticities using SAD. Guo et al. (2018) have presented a method for calculating CO_2 emission elasticities based on the Input-Output analysis. CO_2 emission demand elasticity is the percentage change in CO_2 emissions of the economy as a result of a 1% change in the final demand of sector and CO_2 emission output elasticity is the percentage change in sectoral CO_2 emissions as a result of a 1% change in the final demand of all sectors. In this study, first CO_2 emission elasticities calculated based on Input-Output analysis and then decomposed based on the structural decomposition analysis with the aim of identifying the stimuli of CO_2 emission elasticities. In this study, unlike Guo et al. (2018), it takes two years (not one year) for the purpose of the study, and by having two times, the components of the changes in CO_2 emission elasticities are calculated (Guo, Zhang, & Zhang, 2018).

Based on the decomposition analysis, we have identified the effect of "changing the Ghosh inverse matrix", the effect of "changing the share of final demand in the total output of sector" and the effect of "changing the share of CO_2 emission of sectors" for changes in CO_2 emission demand elasticity and the effect of "changing the Ghosh inverse matrix" and the effect of the "changing the share of final demand in the total output of sectors" and the effect of the "changing the share of CO_2 emission of sector" for changes in the production elasticity of CO_2 emissions.

The organization of the article is as follows: the literature review is presented in the second section. Methodology and data analysis are explained in the third section. Experimental findings and discussion are dedicated to the fourth and fifth sections, respectively. Finally, conclusions and recommendations are the subjects of section six.

2- Literature Review

In the 1970s, oil shocks coupled with the recession led economists to focus on energy input. At the same time, due to the importance and role of energy consumption in economic growth, environmental concerns were raised and the quality of the environment was considered by economists and politicians. Since then, extensive research has been conducted on environmental quality and emissions of pollutants. The answer to the question of what factors affect CO_2 emissions has always been of interest to energy and environmental researchers and policymakers.

Some research studied Environmental Kuznets Curve hypothesis (Ahmadian, Abdoli, Jabalameli, Shabankhah, & Khorasani, 2019; Apergis & Ozturk, 2015; Azomahou, Laisney, & Van, 2006; Chen & Chen, 2015; Grossman & Krueger, 1991, 1995; Selden & Song, 1994; Shafik & Bandyopadhyay, 1992; Stern, 2015; Tao, Zheng, & Lianjun, 2008) and examined the impact of economic growth on emissions and some research studied Pollution Haven hypothesis (Cole, 2004; Guzel & Okumus, 2020). The pollution haven hypothesis posits that, when large industrialized nations seek to set up factories or offices abroad, they will often look for the cheapest option in terms of resources and labor that offers the land and material access they require. However, this often comes at the cost of environmentally unsound practices. Some studies focused on econometric methods and examined the impact of effective factors (economic growth, technological factors, financial factors, international trade factors and political factors) on CO_2 emissions (Adams & Klobodu, 2018; Al-Mulali & Ozturk, 2015; Gorus &

Aslan, 2019; Nasreen, Anwar, & Ozturk, 2017; Ozcan, Tzeremes, & Tzeremes, 2020; Pandey & Rastogi, 2019; Salahuddin, Alam, Ozturk, & Sohag, 2018; Y. Zhang & Zhang, 2018). Numerous studies have been conducted since the early 1990s on the relationship between economics and the environment using Input-Output analysis and decomposition analysis (structural decomposition analysis and index decomposition analysis). In this group of studies, the factors affecting CO_2 emissions are examined (Chang, Lewis, & Lin, 2008; Kim, Yoo, & Oh, 2015; Lim, Yoo, & Kwak, 2009; Paul & Bhattacharya, 2004; Su, Ang, & Li, 2017; Tunc, Türüt-Aşık, & Akbostancı, 2007; Wang, Chen, Zhang, & Niu, 2015; Yabe, 2004; Yu, Zheng, Ba, & Wei, 2016; Y.-J. Zhang, Bian, Tan, & Song, 2017; Y.-J. Zhang & Da, 2015). Some researchers in the coming years have tried to use the concept of *elasticity* to link CO_2 emissions and economic activity. Heutel (2012), Klarl (2015 and 2020), Azami and Angazbani (2020) estimated elasticity of CO_2 emissions with respect to GDP by use of DSGE, MSDR and MSAR, respectively (Azami & Angazbani, 2020; Heutel, 2012; T Klarl, 2015; Torben Klarl, 2020). They showed there is a difference between elasticity of CO_2 emissions during expansions and elasticity of CO_2 emissions during recessions. A group of studies such as Rafaty et al. (2020) investigated the impact of carbon pricing on elasticity of CO_2 emissions (Rafaty, Dolphin, & Pretis, 2020). Another group of studies has tried to link CO_2 emissions and economic activity using Input-Output analysis and elasticity (Guo et al., 2018; Hondo, Sakai, & Tanno, 2002; Morán & del Río González, 2007; Tarancón & Del Rio, 2007). Guo et al. (2018) examine the key sectors that save energy and reduce CO_2 emissions in China by using the Input-Output analysis and calculating emission elasticities. We also look for determinants of elasticity changes by decomposing elasticities. This study seeks to determine the changes in CO_2 emission elasticities of the production sectors by calculating and decomposing elasticities (Guo et al., 2018).

3- Methodology and Data

3-1- Methodology

Following Guo et al. (2018), we calculate the elasticity of CO_2 emissions (Equations 1-7) (Guo et al., 2018). The output equation of production sectors is considered as Equation (1).

$$X = (I - A)^{-1} Y \tag{1}$$

Where X is total output, Y is the final demand and $(I - A)^{-1}$ is the Leontief inverse matrix. I is unit matrix and A is technical coefficient matrix. CO_2 emissions of production sectors are calculated according to the CO_2 emissions intensity and the total output as Equation (2).

$$X = f'(I - A)^{-1} Y \tag{2}$$

Where E is a row vector whose elements represent the total CO_2 emissions of each sector in the production activity system and f' is a row vector whose elements represent the CO_2 emissions caused by per unit of output in each sector. According to the purpose of CO_2 emission elasticity calculation, the following changes in CO_2 emission are calculated:

$$\Delta E = f'(I - A)^{-1} Y\theta \tag{3}$$

Where θ is the proportion of changes in the final demand. According to $S = \widehat{X}^{-1} Y$:

$$\Delta E = f'(I - A)^{-1} \widehat{X} S\theta \tag{4}$$

Where the symbol ^ represents the corresponding vector diagonalisation. S is a column vector whose elements represent the shares of the final demand of each sector in the total output. According to the purpose of CO_2 emission elasticity calculation, both sides of equation (4) are divided by E :

(5) $$E^{-1}\Delta E = E^{-1} f'(I-A)^{-1}\hat{X}S\theta$$

According to: $f' = E\beta'\hat{X}^{-1}$

(6) $$E^{-1}\Delta E = \beta'\hat{X}^{-1}(I-A)^{-1}\hat{X}S\theta$$

β' is a row vector whose elements represent the shares of CO_2 emissions in each sector in the total CO_2 emissions caused by the final use of all sectors. According to $\hat{X}^{-1}(I-A)^{-1}\hat{X} = (I-\vec{A})^{-1}$, the equation for calculating CO_2 emission elasticity is summarized as Equation (7):

(7) $$E^{y} = \hat{\beta}'(I-\vec{A})^{-1}\hat{S} = \hat{\beta}'(I-B)^{-1}\hat{S}$$

According to Equation (7), the matrix E^y is written as Equation (8):

(8) $$E^{y} = \begin{bmatrix} \beta_1 g_{11}\frac{y_1}{x_1} & \beta_1 g_{12}\frac{y_2}{x_2} & \cdots & \beta_1 g_{1n}\frac{y_n}{x_n} \\ \vdots & \vdots & & \vdots \\ \vdots & \vdots & & \vdots \\ \beta_n g_{n1}\frac{y_1}{x_1} & \beta_2 g_{n2}\frac{y_2}{x_2} & \cdots & \beta_n g_{nn}\frac{y_n}{x_n} \end{bmatrix}$$

g_{ij} is matrix elements of $(I-B)^{-1}$. $B = \frac{x_{ij}}{x_i}$ is the direct output coefficients matrix and shows the proportions that each sector i sells to every other sector j out of its total output and $(I-B)^{-1}$ is the Ghosh inverse matrix and show the direct and indirect sales that sector j must encourage to every other sector i. $A = \frac{x_{ij}}{x_j}$ is the technical coefficients matrix, the proportion of each good i that each sector j uses in as input to produce a product and $(I-A)^{-1}$ is the Leontief inverse matrix and

shows the direct and indirect requirements of inputs produced by sector i per unit of output produced sector j.

In the following TI_j and DI_i are rewritten according to Equation (8):

(9) $$TL_j = \sum_i E_{ij}^y = \sum_i \beta_i g_{ij} \frac{y_j}{x_j} = \frac{y_j}{x_j} \sum_{i=1}^{n} \beta_i g_{ij}$$

(10) $$DI_i = \sum_j E_{ij}^y = \sum_j \beta_i g_{ij} \frac{y_j}{x_j} = \beta_i \sum_{j=1}^{n} \frac{y_j}{x_j} g_{ij}$$

TI_j indicates the percentage change in CO_2 emissions of the economy as a result of a 1% change in the final demand of sector. This elasticity shows the effect of demand structure on CO_2 emissions of the whole economic system. DI_i indicates the effect of one percent change in the final demand of all economic sectors on the CO_2 emissions of sector i. DI_i indicates the percentage change in sectoral CO_2 emissions as a result of a 1% change in the final demand of all sectors. This elasticity shows the effect of production structure on CO_2 emissions of the whole economic system.

Based on the structural decomposition approach, the increase in TI_j over a specific period can be decomposed as follows:

(11)
$$\Delta TI_j = \Delta\left(\frac{y_j}{x_j}\right)\sum_i \beta_i g_{ij} + \Delta\left(\sum_i \beta_i g_{ij}\right)\frac{y_j}{x_j}$$
$$= \Delta\left(\frac{y_j}{x_j}\right)\sum_i \beta_i g_{ij} + \frac{y_j}{x_j}\left(\sum_i \beta_i \Delta g_{ij}\right) + \frac{y_j}{x_j}\left(\sum_i g_{ij} \Delta\beta_i\right)$$

According to the decomposition ΔTI_j and based on Equation (11), ΔTI_j is decomposed into three factors; "changing the share of

final demand in the total output of sector", "changing the Ghosh inverse matrix" and "changing the share of CO_2 emission of sector". The interpretation of "change in the Ghosh inverse matrix" is derived from the matrix of production coefficients (or allocation coefficients); A change in the share of industry i production that is sold to industry j as an intermediate input.

Based on the structural decomposition approach, the increase in DI_i over a specific period can be decomposed as follows:

$$\Delta DI_i = \Delta(\beta_i)\sum_j \left(\frac{y_j}{x_j}\right) g_{ij} + \Delta\left(\sum_j \frac{y_j}{x_j} g_{ij}\right)\beta_i$$
$$= \beta_i\left(\sum_j g_{ij}\Delta\left(\frac{y_j}{x_j}\right)\right) + \beta_i\left(\sum_j \frac{y_j}{x_j}\Delta g_{ij}\right) + \Delta\beta_i \sum_j \frac{y_j}{x_j} g_{ij} \quad (12)$$

According to the decomposition of ΔDI_i and based on Equation (12), ΔDI_i is decomposed into three effects; "changing the share of final demand in the total output of sectors", "changing the Ghosh inverse matrix" and "changing the share of CO_2 emission of sector". It should be noted that the effect of "changing the Ghosh inverse matrix" on elasticity decomposition of TI_j $\left(\beta_i\left(\sum_j \frac{y_j}{x_j}\Delta g_{ij}\right)\right)$ is different from this effect on elasticity decomposition of DI_i ($\frac{y_j}{x_j}\left(\sum_i \beta_i \Delta g_{ij}\right)$).

3-2- Data

The Statistics Center of Iran and the Central Bank of Iran publish input-output tables for Iran. In this study, we have used input-output tables published in 2001 and 2011 by the Statistics Center of Iran[2].

To accurately calculate the share of CO_2 emissions of production sectors, we need to eliminate the influence of inflation. Therefore, the input -output tables of 2001 and 2011 with the price of 2011 are converted into input-output tables with a constant price. Due to the differences in the sector classification of the input-output tables of 2001 and 2011, we match some production sectors and finally take into account the 65 unified sectors. Also, for price indices, the 82-sectors table of the statistics center has been used, which has been aggregated into 65 sectors.

In order to calculate the CO_2 emission of each production sector, we first obtain the total consumption of each energy for each year from the Iranian energy balance sheet, and then we allocate each energy consumption to production sectors and single household sector, according to input-output tables and the share of production sectors and the share of the household sector (Kim et al., 2015). Then, using the 1996 IPCC guidelines and according to the emission factors of each energy source, we calculate the CO_2 emissions of each sector (Eggleston, Buendia, Miwa, Ngara, & Tanabe, 2006). The types of energy source used in Iran's production sectors and the details of CO_2 emissions related to each source are reported in **Tabel 1**.

Tabel 1. CO_2 emission factors of different energy sources
Source: Research calculations

Code	Energy source	kton CO_2 /Pj
1	furnace oil	76.593
2	gas oil	73.326
3	kerosene	71.148

[2] This article is taken from the master's thesis that was defended in 2021 and data was collected in 2020, which at that time the last published input -output table was table of 2001. Recently, the input -output table of 2016 has been published.

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4	gasoline	68.607
5	natural gas	55.820
6	liquefied gas	62.436
7	light jet fuel	68.244
8	heavy fuel jet	75.785
9	coal	92.500
10	electricity	148.333
11	coke	100.842
12	solid fuel	92.5

Fuels used to generate electricity include natural gas, kerosene, gas oil, gasoline, and fuel oil. Blast furnace gas, coke, coke gas, and tar are also products obtained from coal and due to lack of access to their emission factor, the amount of carbon dioxide emissions is calculated for coal in general. Firewood, charcoal, and animal waste have been used as energy in Iranian industries and their CO_2 emissions have been calculated based on solid fuels in the 1996 IPCC guidelines due to their lack of emission factors.

4- Experimental findings

Aim of this paper is to investigate the factors affecting CO_2 emission elasticities, CO_2 emission demand elasticity and CO_2 emission production elasticity. In the first step, the elasticities are calculated; TI_j is the percentage change in CO_2 emissions of the whole economic system compared to one percent change in final demand of sector j (CO_2 emission demand elasticity) and DI_i is the percentage change in CO_2 change in sector i to one percent change in final demand of all production sectors (CO_2 emission output elasticity). In the second step, changes of elasticities are decomposed.

4-1- Calculating the TIj and DIi elasticities of Iran's production sectors

Using Equations (9) and (10), the TI_j and DI_i elasticities are calculated for 65 production sectors in Iran in 2001 and 2011. S_i is the share of final demand in output and β_i is the share of emissions in sector i.

Tabel 2. Calculation of TI_j and DI_i elasticities of Iran's production sectors in 2001 and 2011
Source: Research calculations

Sectors		**2001**				**2011**			
Sector code	Sector name	TI_j	DI_i	S_i	β_i	TI_j	DI_i	S_i	β_i
1	agriculture and horticulture	0.024169	0.022358	0.668817273	0.031632245	0.032376	0.025564	0.665432594	0.023790262
2	agriculture, forestry and animal husbandry	0.008118	0.009153	0.312431256	0.023027219	0.012143	0.017091	0.231718609	0.016385703
3	fishing	0.001621	0.001409	0.815738129	0.001699211	0.003082	0.001603	0.839754298	0.001589667
4	crude oil extraction, natural gas and mining support services	0.05513	0.054327	0.881619465	0.061568594	0.061104	0.10117	0.570152987	0.099241779
5	extraction of other mines	4.65E-05	0.000353	0.008931604	0.004814287	0.002222	0.006609	0.17329943	0.005300576
6	production of food and beverage products	0.038296	0.035055	0.7180013	0.047478129	0.085693	0.036965	0.771356538	0.035582251
7	productio	0.000	0.000	0.96308	0.00057	0.000	0.000	0.98729	0.00051

	n of tobacco products and Tobacco	686	556	9382	6881	939	526	1699	4147
8	textiles	0.006692	0.002952	0.64329686	0.004274092	0.010219	0.005019	0.600210012	0.004528578
9	apparel	0.00318	0.002804	0.815926481	0.003353599	0.009842	0.005891	0.938531423	0.005303402
10	Production of leather and related products	0.001238	0.000915	0.758368905	0.001152444	0.004603	0.002804	0.876703238	0.002433833
11	wood and wood products	-7.2E-05*	6.71E-05	-0.042837402	0.001449739	0.00044	0.003491	0.047390807	0.002542956
12	paper and paper products, printed paper	0.000404	0.000488	0.117696168	0.002365285	0.00151	0.004872	0.167109134	0.002854148
13	coke, oil refining products	0.055123	0.06031	0.737428595	0.074569839	0.090275	0.054433	0.788624651	0.052079401
14	chemicals and chemical products	0.019567	0.026007	0.384793177	0.049754163	0.033408	0.029175	0.478957502	0.023654668
15	rubber and plastic products	0.0012	0.001349	0.18465774	0.005103125	0.00205	0.007913	0.095465441	0.005988283
16	other non-	0.002	0.002	0.17579	0.00897	0.010	0.011	0.24174	0.01045

	metallic mineral products	304	312	0716	8067	656	116	3218	1951
17	production of base metals	0.001905	0.003317	0.095809532	0.016327833	0.006299	0.035061	0.074394868	0.019544194
18	production of metal products except machinery and equipment	0.007939	0.007494	0.405803637	0.015755988	0.038423	0.019583	0.472390104	0.016997733
19	production of computer, electronic and optical products, electrical equipment	0.009377	0.008509	0.838842725	0.009385834	0.015822	0.0131	0.561202543	0.009098969
20	production of machinery and equipment not elsewhere classified	0.013184	0.012719	0.771380008	0.014681745	0.017612	0.021913	0.659751447	0.013100428
21	production of motor vehicles and other	0.024495	0.022968	0.865342345	0.025466902	0.063667	0.031307	0.594897828	0.025214345

	transport equipment								
22	production of furniture	0.002587	0.002416	0.955580291	0.002523266	0.007966	0.003377	0.844223587	0.003271084
23	Production of other products	0.001786	0.001815	0.604162515	0.002807355	0.003158	0.003131	0.569450965	0.002568658
24	Production, transmission and distribution of electricity	0.063811	0.080058	0.224109681	0.272470858	0.088833	0.336381	0.241325604	0.301880684
25	Production and distribution of natural gas	0.001361	0.001496	0.075676308	0.017871298	0.018418	0.028059	0.605214025	0.026066716
26	Water supply, Waste management, Wastewater and treatment activities	0.000896	0.000766	0.349278115	0.001888975	0.002751	0.001962	0.263170897	0.001873434
27	Residential buildings	0.019642	0.018848	0.913246671	0.020051175	0.059116	0.018416	0.873998891	0.018369022
28	Other buildings	0.029724	0.027015	0.867101611	0.030734564	0.096652	0.031323	0.907145 07	0.031161826

29	Wholesale and retail, Repair of motor vehicles	0.052 939	0.049 043	0.78637 6588	0.05958 4274	0.087 055	0.058 989	0.64453 0666	0.05635 773
30	Repair services	0.004 984	0.003 888	0.98934 5732	0.00359 6716	0.005 184	0.004 346	0.48619 9333	0.00411 8131
31	Transport ation Quoted from Intercity rail	0.001 349	0.001 346	1.04000 3977	0.00122 9232	0.000 78	0.001 076	0.29810 0285	0.00097 3077
32	other land transportat ion	0.013 39	0.012 865	0.43159 6614	0.02723 5504	0.021 625	0.026 186	0.48137 7662	0.02434 1375
33	pipeline transportat ion	0.000 27	0.000 223	0.56858 4842	0.00038 4295	0	0.001 01	0	0.00094 5491
34	water transportat ion	0.002 727	0.001 83	0.60028 923	0.00276 7792	0.004 384	0.002 377	0.59925 9983	0.00192 112
35	air transportat ion	0.002 41	0.001 153	0.79560 0972	0.00139 3523	0.002 623	0.006 868	0.44102 8935	0.00320 4695
36	warehousi ng and transportat ion support activities	0.000 877	0.001 179	0.27792 154	0.00276 9185	0.001 324	0.003 242	0.20800 9695	0.00261 4209
37	post and courier activities	0.013 897	0.014 085	1.26739 3397	0.01074 7794	0.015 515	0.009 264	0.54243 4139	0.00901 1625

38	accommodation	0.000643	0.000477	0.449960364	0.001018178	0.003429	0.005455	0.767467178	0.003089822
39	service activities related to Food & Beverage (Restaurants, etc.)	0.006131	0.005202	0.75738724	0.006771503	0.015289	0.007767	0.895467135	0.007518823
40	Information and Communication	0.001207	0.001302	0.93009283	0.001284961	0.000951	0.000889	0.556753349	0.000708219
41	Banks and Financial Institutions	0.004046	0.004722	0.403143973	0.009709259	0.00626	0.00983	0.340141749	0.009465134
42	Other Financial and Insurance Services	0.000202	0.000216	0.078277766	0.002447236	0.000167	0.002948	0.059098486	0.002227565
43	Insurance	0.001101	0.001523	0.499661185	0.002154759	0.000825	0.002171	0.270661127	0.002058544
44	Private Housing Services	0.009081	0.008063	0.308359064	0.026147926	0.028682	0.025205	1	0.025204463
45	Rental Housing Services	0.003207	0.003104	0.265267678	0.011699654	0.012602	0.011311	0.997413504	0.011307296
46	Non-Housing Services	8.22E-06	0.000243	0.001682709	0.004626629	0	0.007287	0	0.006902426
47	Brokers	0.001	0.001	0.71555	0.00230	0.001	0.001	0.61779	0.00141

	Services	708	696	7892	5136	551	532	7838	205
48	Research and Development	0.0018	0.00177	1.132275398	0.001527756	0.001853	0.001352	0.693641498	0.001319611
49	Other professional, scientific and technical activities	0.002167	0.002642	0.402490058	0.005202588	0.003631	0.004302	0.35043571	0.003808887
50	veterinary activities	0.000248	0.000245	1.264216432	0.000188283	0.000217	0.000184	0.615732103	0.000181086
51	public administration, social services	0.013042	0.012213	1.155382433	0.010567067	0.024259	0.012573	0.874879153	0.012398222
52	defense	0.013147	0.012353	1.294653816	0.009540971	0.02173	0.009467	0.996963278	0.009453737
53	law enforcement	0.00221	0.001889	0.599367724	0.003150259	0.004743	0.003039	0.938534293	0.003036529
54	compulsory social security	0.001353	0.001273	1.864569088	0.000682556	0.002488	0.000751	1	0.000750761
55	public primary education	0.004562	0.004351	1.149251955	0.003785761	0.004912	0.003633	1	0.003633281
56	private primary education	0.000287	0.000264	1.591047	0.000165868	0.000362	0.000135	1	0.000135404
57	general	0.005	0.005	1.04368	0.00499	0.009	0.004	1	0.00479

	and technical secondary education	491	216	1595	7979	623	799		8736
58	public vocational education and Technical Vocational High Schools	0.000619	0.000558	1.377863112	0.000404721	0.000871	0.00037	1	0.00037 0292
59	Public Higher Education	0.003079	0.002738	0.935289839	0.002927643	0.005863	0.002956	0.999999976	0.00295 6368
60	Private Higher Education	0.004315	0.004264	1.209721972	0.003522258	0.00393	0.002422	0.999999964	0.00242 2069
61	Adult Education	0.001161	0.000815	0.755309195	0.001057805	0.001383	0.001203	0.782964508	0.00117 0764
62	Human Health and Social Welfare Activities	0.013626	0.012108	0.845591547	0.014295481	0.024647	0.013604	0.9747672	0.01357 965
63	Arts, Entertainment	0.006469	0.006344	1.255834845	0.005012846	0.007643	0.002913	0.938512261	0.00288 8534
64	Religious Organizations and Member Organizations	0.001446	0.000653	0.660780284	0.000967 48	0.001432	0.000678	0.61934 616	0.00065 9839

65	Other Personal Service Activities	0.002871	0.002788	1.12531 2149	0.00237 3077	0.004 569	0.001 684	0.97594 6756	0.00166 5714

* Negative numbers are due to negative inventory in these sectors.

As can be seen from **Tabel 2**, the sector "Electricity generation, transmission and distribution" has the highest amount of DI_i elasticity and the highest amount of emission share in 2001 and 2011 and the highest amount of TI_j elasticity in 2001. This is due to the high share of CO_2 emissions and the share of final demand in the total output of this sector. The highest amount of TI_j elasticity in 2011 is allocated to the sector "Coke production, products of oil refining" and "Other buildings". This is due to the high share of final demand in the total output of these sectors and the inefficiency of production structure.

4-2- Decomposition of TI_j and DI_i elasticities of Iran's production sectors in 2001-2011

In this section, TI_j changes are decomposed using Equation (11) and DI_i elasticity changes are decomposed using Equation (12).

Tabel 3. Decomposition of TI_j and DI_i elasticities of Iran's production sectors
Source: Research calculations

Sector code	dTI			dDI		
	$\frac{y_j}{x_j}(\sum_i \beta_i \Delta g_{ij})$	$\Delta(\frac{y_j}{x_j})\sum_i \beta_i g_{ij}$	$\frac{y_j}{x_j}(\sum_i g_{ij}\Delta\beta_i)$	$\beta_i(\sum_j \frac{y_j}{x_j}\Delta g_{ij})$	$\beta_i(\sum_j g_{ij}\Delta(\frac{y_j}{x_j}))$	$\Delta\beta_i \sum_j \frac{y_j}{x_j} g_{ij}$
1	0.015383883	-0.000164676	-0.00701235	0.011591229	4.16082E-05	-0.00842659
2	0.011607778	-0.004229631	-0.00335288	0.016118988	-0.001254246	-0.00692731
3	0.001538102	8.81448E-05	-0.00016555	0.000249123	5.49495E-05	-0.00011044
4	0.005727596	-0.03338007	0.033625919	0.026405223	-0.017966919	0.038405323
5	6.09641E-05	0.00210718	7.04705E-06	0.005203221	0.00044593	0.000606322
6	0.057106705	0.005927472	-0.01563714	0.011415015	0.002853563	-0.01235787
7	0.000318905	2.30284E-05	-8.8732E-05	1.797E-05	1.6474E-05	-6.4221E-05
8	0.004980494	-0.00073355	-0.00072021	0.001962908	-0.000178467	0.000282026
9	0.003781825	0.001285754	0.001595054	0.000581417	0.000339866	0.002166008
10	0.001646922	0.000621232	0.001096198	0.000260589	0.000152186	0.001476252
11	-0.000245834	0.000836906	-7.9532E-05	0.001819257	0.000103816	0.001500749

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12	0.000566982	0.000446527	9.2526E-05	0.003685177	-0.000135409	0.000834551
13	0.034241159	0.005860513	-0.00494934	0.014244989	0.003384758	-0.02350674
14	0.01842944	0.006568078	-0.01115635	0.031408149	0.003950146	-0.03219033
15	0.003056091	-0.001914849	-0.00029214	0.00629099	-0.000897345	0.001169596
16	0.004800556	0.002907077	0.000643642	0.006417979	0.000818459	0.001567585
17	0.005364646	-0.001813238	0.000843083	0.028561157	-0.002587183	0.005769977
18	0.022550714	0.005416081	0.002517987	0.011203998	-0.000544726	0.001430213
19	0.014080297	-0.007827754	0.000193235	0.008381448	-0.003377421	-0.00041302
20	0.008059784	-0.002979922	-0.00065206	0.016720827	-0.004882339	-0.00264504
21	0.066196235	-0.028943229	0.001918374	0.022542625	-0.013890518	-0.00031358
22	0.005094059	-0.001050771	0.001335619	0.000574822	-0.000385699	0.000772115
23	0.001752794	-0.000192495	-0.00018842	0.001835261	-0.000228389	-0.00029099
24	0.010834215	0.006337262	0.007850753	0.245067126	-0.02151473	0.032770944
25	0.000268031	0.016114624	0.0006744	0.008106734	0.00963448	0.008821765
26	0.002511585	-0.000900043	0.000243404	0.00157467	-0.000362529	-1.6271E-05
27	0.041406405	-0.002654655	0.0007223	0.00177474	-0.000519785	-0.00168648
28	0.058502186	0.004266423	0.004159377	0.002760769	0.001118061	0.000429475
29	0.050786308	-0.019158761	0.002488479	0.022999921	-0.009676295	-0.0033772
30	0.004943753	-0.005364398	0.000620073	0.00180311	-0.001894977	0.000550316
31	0.001624431	-0.001941413	-0.00025145	0.001071111	-0.001057447	-0.00028328
32	0.007329967	0.002236361	-0.00133063	0.015913002	0.000520782	-0.00311343
33	0.000719872	-0.00140755	0.000417587	0.000269792	-8.25408E-05	0.000599505
34	0.002049795	-7.52987E-06	-0.00038467	0.001717198	-0.00012296	-0.00104752
35	0.000770286	-0.002108559	0.001551413	0.002454895	-0.000621638	0.003881366
36	0.000865608	-0.000444997	2.59129E-05	0.002958093	-0.000702573	-0.00019219
37	0.023748802	-0.020735508	-0.00139575	0.008482754	-0.011518433	-0.0017848
38	0.000398934	0.001418415	0.000967867	0.001085957	0.000234911	0.00365771
39	0.006595622	0.002357582	0.000205446	0.000949742	0.000843304	0.000771982
40	0.000868271	-0.000637383	-0.00048786	0.000977099	-0.000666356	-0.00072381
41	0.003317586	-0.001159442	5.57378E-05	0.006507368	-0.00115295	-0.0002466
42	3.47073E-05	-5.41809E-05	-1.5414E-05	0.003275222	-0.000252066	-0.00029073
43	0.000475179	-0.000697716	-5.3411E-05	0.001402647	-0.000652984	-0.00010149
44	1.14593E-05	0.019837466	-0.00024868	0	0.018084976	-0.0009433
45	0.000241736	0.009250268	-9.708E-05	3.45819E-05	0.008564196	-0.00039247
46	7.90369E-06	-2.01429E-05	4.0241E-06	0.005398163	-0.000756322	0.002402623
47	0.000685129	-0.000245507	-0.00059658	0.00105464	-0.000248501	-0.00096926
48	0.00145965	-0.001171722	-0.00023453	0.000527441	-0.000732679	-0.00021325
49	0.002408534	-0.00053939	-0.00040511	0.003897353	-0.00066317	-0.00157409
50	0.000242179	-0.000229044	-4.3581E-05	7.22308E-05	-0.000125683	-7.33E-06
51	0.015576766	-0.007777818	0.003417677	0.001600404	-0.003096903	0.001856967
52	0.015500231	-0.006488506	-0.00042845	4.09859E-05	-0.002839923	-8.7353E-05
53	0.000895092	0.001714047	-7.5876E-05	0.000252582	0.001011705	-0.00011383
54	0.002916431	-0.002150989	0.000369629	0	-0.000590117	6.82057E-05
55	0.001217944	-0.000733118	-0.00013518	0	-0.000565032	-0.00015248
56	0.00033704	-0.000214022	-4.8293E-05	0	-9.80357E-05	-3.0464E-05
57	0.004351307	-0.000420334	0.000200529	0	-0.00021832	-0.00019924
58	0.000625138	-0.000329195	-4.3473E-05	0	-0.000152929	-3.4428E-05
59	0.002350312	0.000379369	5.39759E-05	9.13744E-11	0.000189448	2.87252E-05
60	0.001777497	-0.000824277	-0.00133806	-2.75225E-06	-0.000738695	-0.00110019
61	9.91609E-05	4.88399E-05	7.35799E-05	0.000271499	4.63064E-07	0.000116049
62	0.008533433	0.003266233	-0.00077841	0.000353336	0.001860605	-0.00071713
63	0.006241388	-0.00258431	-0.00248241	0.000356245	-0.001644729	-0.00214236

64	0.000247439	-9.57975E-05	-0.00016586	0.000433929	-9.2504E-05	-0.00031627
65	0.003039617	-0.000699217	-0.00064269	-1.79222E-05	-0.000370015	-0.00071531

As can be seen from **Tabel 3**, the highest amount of incremental changes in TIj and DIi elasticity in the period 2001-2011 are related to the "Electricity generation, transmission and distribution" and "Other Buildings" sectors, respectively. In the period 2001-2011, out of 65 production sectors, 42 sectors have experienced an increase in TI_j elasticity and DI_i elasticity, 13 sectors an increase in TI_j elasticity and a decrease in DI_i elasticity, 5 sections a decrease in TI_j elasticity and an increase in DI_i elasticity, and 5 sectors a decrease in TI_j elasticity and a decrease in DI_i elasticity.

5- Discussion

In the previous section, the elasticities and their changes for each sector were calculated. Based on the elasticity decomposition, the demand elasticity is affected by the three effects of "changing the Ghosh inverse matrix", "changing sectoral final demand share" and "changing the share of CO_2 emission of sectors", and the output elasticity is influenced by the three effects of "changing the Ghosh inverse matrix", "changing final demand share of sectors" and "changing sectoral share of CO_2 emissions". In the following, the sectors should be divided to 4 groups according to the changes of DI_i and TI_j. The aim is to investigate what factor in the production sectors of Iran is the determining factor in explaining the changes in CO_2 emission elasticity. In this regard, according to **Tabel 4** industries are divided into two groups once based on changes in TI_j (dTI_j): $dTI_j > 0$ and $dTI_j < 0$, and also once based on changes in DI_i (dDI_i) into two groups: $dDI_i > 0$ and $dDI_i < 0$.

Tabel 4. A summary of the situation of production sectors in terms of the components of elasticity decomposition
Source: Research calculations

	Group	Number of industries in each group	The components of TI_j elasticity decomposition		
			changing the Ghosh inverse matrix	changing sectoral final demand share	changing the share of CO_2 emission of sectors
dTI_j	$dTI_j>0$	55	In 54 industries, it has increased TIj.	In 24 industries, it has increased TIj.	In 28 industries, it has increased TIj.
			In 46 industries, it has the greatest impact on growth.	In 7 industries, it has the greatest impact on growth.	In 2 industries, it has the greatest impact on growth
			108%	-11.4%	2.6%
	$dTI_j<0$	10	It has not reduced TIj in any industry.	In 10 industries, it has reduced TIj.	In 8 industries, it has reduced TIj.
			In no industry, has the greatest effect on reducing TIj.	In 7 industries, it has the greatest impact on reduction.	In 3 industries, it has the greatest impact on reduction.
			-333%	307%	126%
	Group	Number of industries in each group	The components of DI_i elasticity decomposition		
			changing the Ghosh inverse matrix	changing final demand share of sectors	changing sectoral share of CO_2 emissions
dDI_i	$dDI_i>0$	47	In 46 industries, it has increased DIi.	In 20 industries, it has increased DIi.	In 24 industries, it has increased DIi.
			In 33 industries, it has the greatest	In 6 industries, it has the greatest impact on	In 8 industries, it has the greatest impact on

			impact on growth.	growth	growth
			100%	-6.8%	6.8%
	dDI_i <0	18	In 2 industries, it has reduced DIi.	In 16 industries, it has reduced DIi.	In 17 industries, it has reduced DIi
			In no industry, it has the greatest effect on reducing DIi.	In 10 industries, it has the greatest effect on reducing DIi.	In 8 industries, it has the greatest effect on reducing DIi.
			-120%	79%	141%

55 industries from 65 industries, 85% of industries, are placed in the group $dTI_j>0$. In general, in this group, the effect of "changing the Ghosh inverse matrix", "changing sectoral final demand share" and "changing the share of CO_2 emission of sectors" with a share of 108%, -11.4% and 2.6%, respectively have played a role in increasing TI_j elasticity. 10 of the 65 industries, 15% of the industries, are placed in the group $dTI_j<0$. In general, in this group, the effect of "changing the Ghosh inverse matrix", "changing sectoral final demand share" and "changing the share of CO_2 emission of sectors" with a share of -333%, 307% and 126%, respectively, have played a role in reducing TI_j.

47 out of 65 industries, 72% of the industries are placed in the group $dDI_i >0$. In general, in this group, the effect of "changing the Ghosh inverse matrix", "changing final demand share of sectors" and "changing sectoral share of CO_2 emissions" with a share of 100%, -6.8% and 6.8%, respectively have played a role in increasing DI_i elasticity. 18 out of 65 industries, 28% of the industries are in the group $dDI_i <0$. In general, in this group, the effect of "changing the Ghosh inverse matrix", "changing final demand share of sectors" and "changing sectoral share of CO_2 emissions" with a share of -120%, 78% and 140%, respectively played a role in reducing DI_i elasticity.

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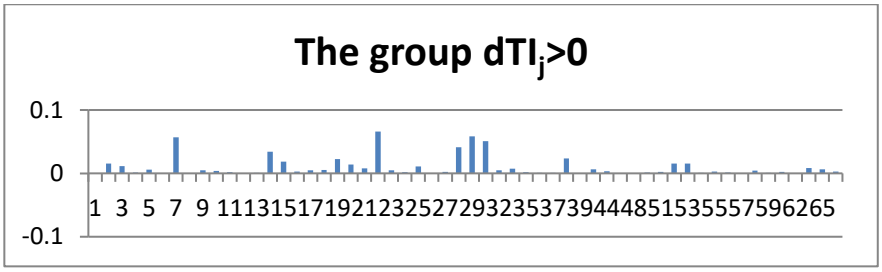
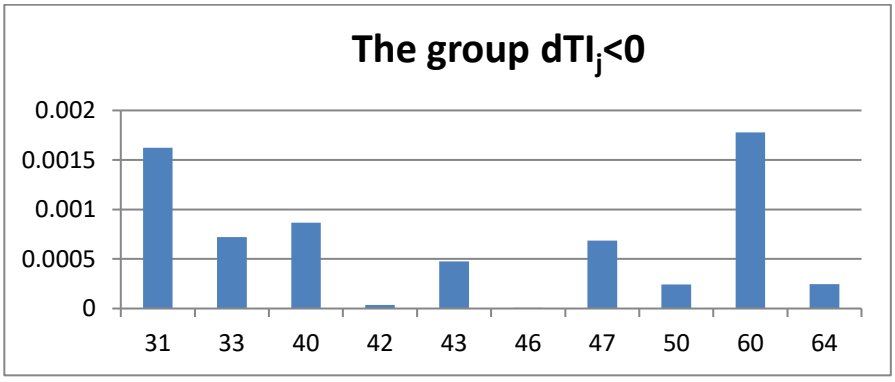
5-1- Analyzing the role of "the Ghosh inverse matrix" in elasticity changes: an inhibitory factor or a stimulus factor

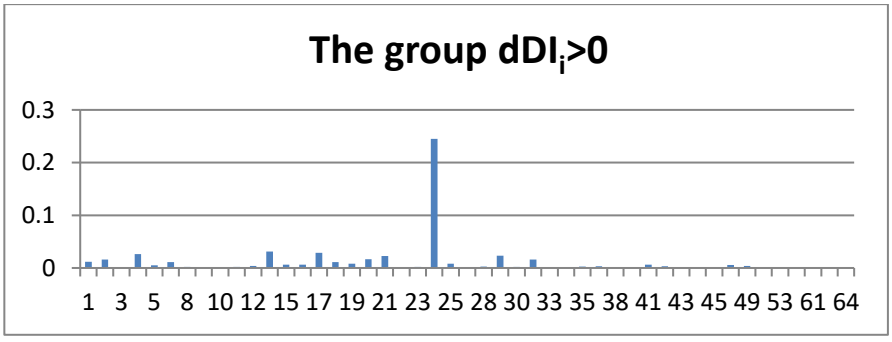
"The Ghosh inverse matrix" is one of the factors of decomposition of the elasticity of CO_2 emissions. TI_j elasticity is the effect of a 1% change in the final demand of sector j on the CO_2 emissions of the whole economy. As a result of a 1% change in the final demand of sector j, sector j changes its purchases from other sections to meet the final demand, so the effect of "the Ghosh inverse matrix" on the TI_j elasticity decomposition indicates a change in the share of sales of sectors (as intermediate input) to sector j (change in the purchase share of sector j from the production of other sectors). DI_i elasticity is the effect of a one percent change in the final demand of all sectors on the CO_2 emissions of sector i. As a result of a 1% change in the final demand of all sectors, all sectors change their purchases from sector i, so the effect of "the Ghosh inverse matrix" on DI_i elasticity indicates a change in the output share of sector i as an intermediate input to other sectors (change the share of purchasing parts from sector i). As can be seen from **Tabel 4**, "the Ghosh inverse matrix" effect increased TI_j elasticity in all sectors of the group $dTI_j > 0$ except for sector 10 and decreased TIj elasticity in all sectors of the group $dTI_j < 0$. This effect in the group $dDI_i > 0$ in 46 of the 47 sectors helped to increase the DI_i elasticity and in the group $dDI_i < 0$ in 16 of the 18 sectors helped to increase the DI_i elasticity. Thus, as shown in **Tabel 4** and **Figure 1**, "the Ghosh inverse matrix" in sectors that have experienced an increase in TI_j and DI_i as well as in sectors that have experienced decrease in in TI_j and DI_i is a strong stimulus to increase in TI_j and DI_i.

But what do these results mean? The strong stimulus of the "the Ghosh inverse matrix" effect on TI_j elasticity indicates a change in the share of output of sectors that are sold to sector j as an intermediate input (increasing the purchase share of sector j from the output of other sectors). The strong stimulus of "the Ghosh inverse matrix" effect on DI_i elasticity indicates a change in the share of output of

sector i, which sells as an intermediate input to all sectors (increasing the share of purchases of other sectors from sector i).







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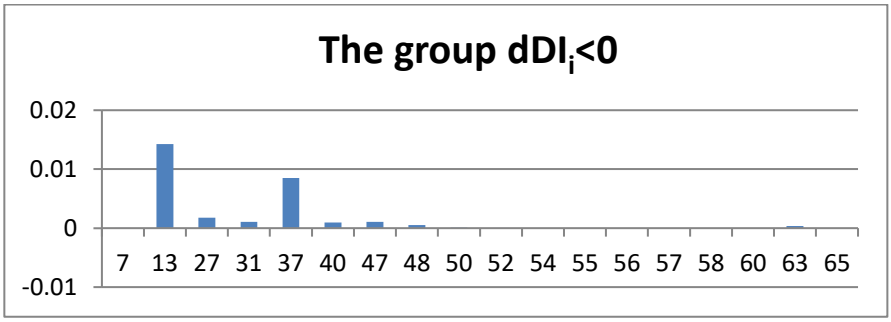
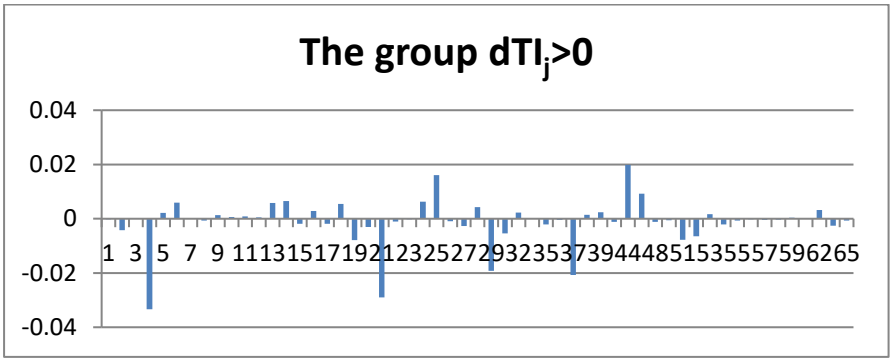


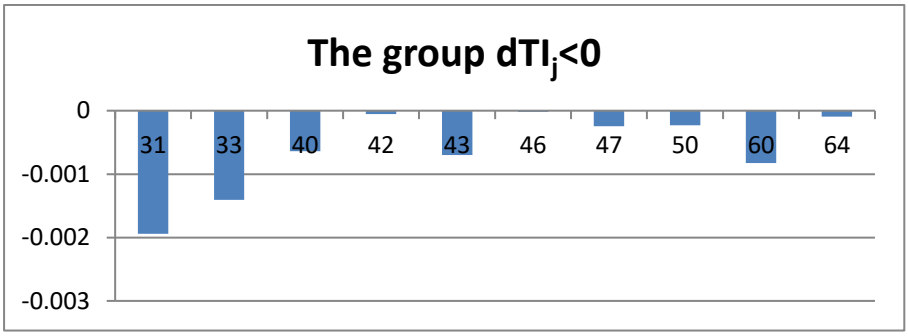
Figure 1. The contribution of "the Ghosh inverse matrix" in the decomposition of elasticity in the production sectors of Iran in the period 2001-2011
Source: Research calculations

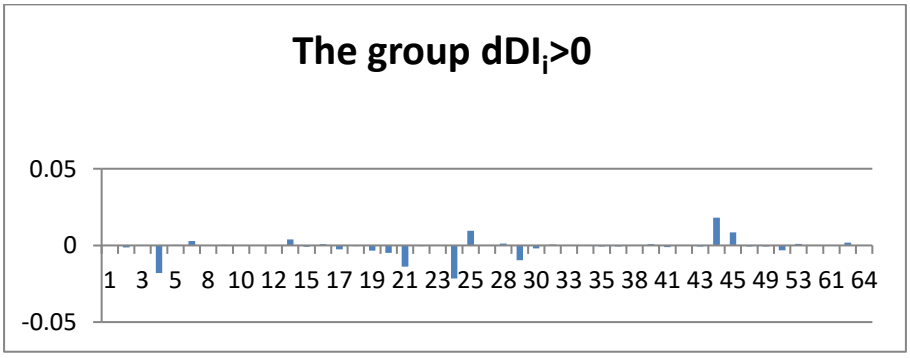
5-2- Analyzing the role of "final demand share" in elasticity changes: an inhibitory factor or a stimulus factor

The share of final demand in the output is one of the factors that break down the elasticity of CO_2 emissions. As can be seen from **Tabel 4**, "the sectoral final demand share" factor reduced TI_j in 31 of the 55 sectors of the group $dTI_j > 0$ and in all sectors of the group $dTI_j <0$. The reason for this result is that the share of final demand in the output of these 31 sectors has decreased from 55 sectors of the group $dTI_j> 0$ and all sectors of the group $dTI_j <0$ in the period 2001-2011. "The share of final demand of sectors" has helped to reduce the DI_i elasticity in 27 of the 47 sectors of the group $dDI_i> 0$ and in 16 of the 18 sectors of the group $dDI_i <0$. Therefore, "Changing the share of final demand in output" effect has helped to reduce the TI_j in 41 of the 65 sectors (63% of the industries) and reduce the DI_i in 43 of the 65 sectors (66% of the industries).

Figure 2 shows the share of final demand in the output in the decomposition of elasticity of Iran's production sectors in the period 2001-2011.


The group dTI_j>0
0.04
0.02
0
-0.02
-0.04
1 3 5 7 9 11131517192123252729323537394448515355575962 65


The group dTI_j<0
0
-0.001
-0.002
-0.003
31
33
40
42
43
46
47
50
60
64


The group dDI_i>0
0.05
0
-0.05
1 3 5 8 10 12 15 17 19 21 23 25 28 30 33 35 38 41 43 45 49 53 61 64

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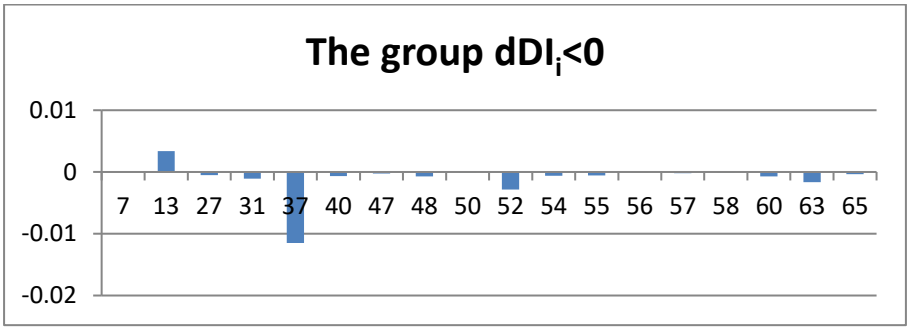
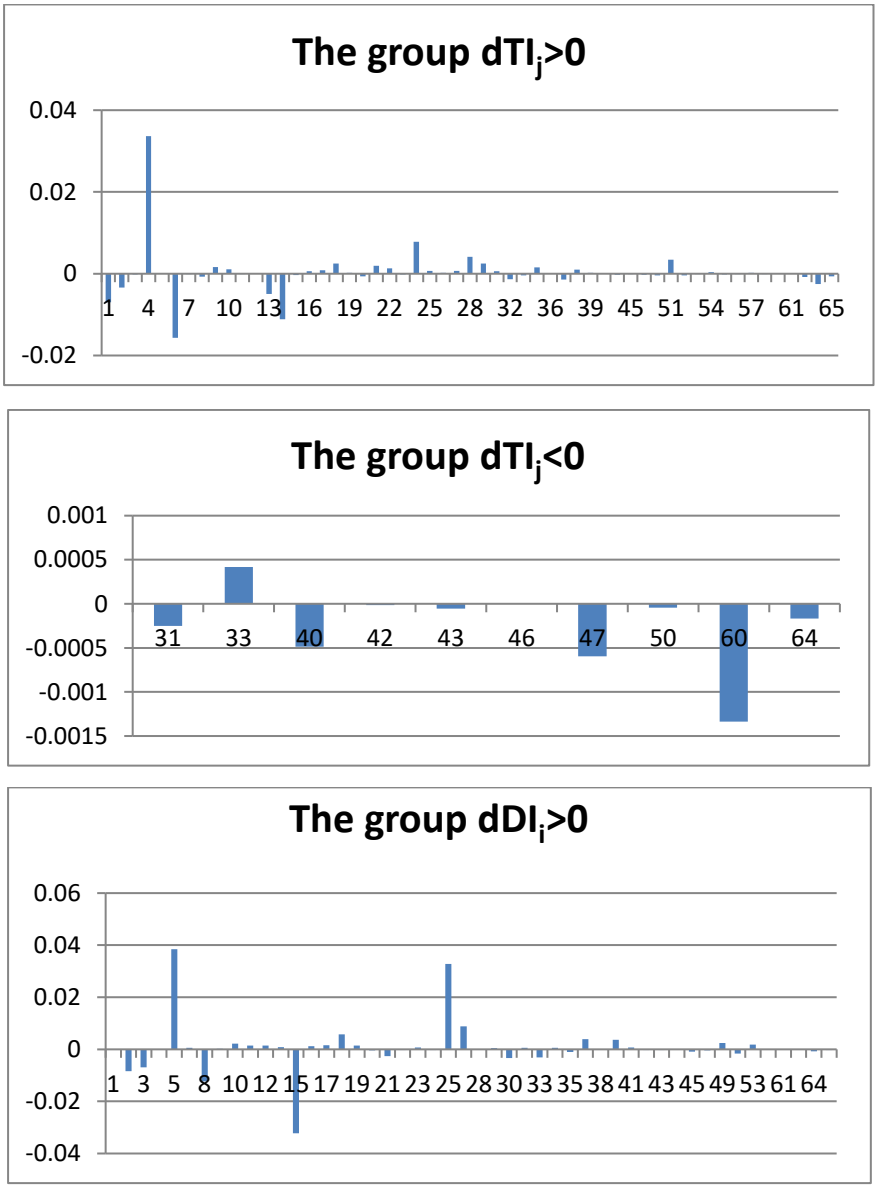


Figure 2. The share of final demand in the output in the decomposition of elasticity of Iran's production sectors in the period 2001-2011
Source: Research calculations

5-3- Analyzing the role of "CO_2 emission share" in elasticity changes: an inhibitory factor or a stimulus factor

CO_2 emission share is one of the factors in the decomposition of CO_2 emission elasticity. As can be seen from **Tabel 4**, "the share of CO_2 emission of sectors" factor increased TI_j in 28 of 55 sectors of the group $dTI_j > 0$ and decreased the TI_j in 8 of the 10 sectors of the group $dTI_j < 0$. The effect of "sectoral share of CO_2 emissions" increased in 24 of the 47 sectors of the group $dDI_i > 0$ and decreased the DI_i in 17 of the 18 sectors of the group $dDI_i < 0$. The reason for this result is that the share of CO_2 emission of these 24 out of 47 sectors in the group $dDI_i > 0$ and 17 out of 18 sectors in the group $dDI_i < 0$ increased and decreased in the period 2001-2011, respectively. Therefore, as shown in **Tabel 4** and **Figure 3**, the CO_2 emission share has been able to increase TI_j and DI_i elasticity in the groups $dTI_j > 0$ and $dDI_i > 0$ and in the groups $dTI_j < 0$ and $dDI_i < 0$ act as an inhibitory factor to increase the TI_j and DI_i elasticity. Therefore, "Changing CO_2 emission share" effect has helped to reduce the TI_j in 35 of the 65 sectors (54% of the industries) and reduce the DI_i in 40 of the 65 sectors (61.5% of the industries). This result is mainly due to the declining share of CO_2 emission of sectors that have experienced a decline in DI_i.

Figure 3 shows the share of CO_2 emissions in the decomposition of elasticity of Iran's production sectors in the period 2001-2011.



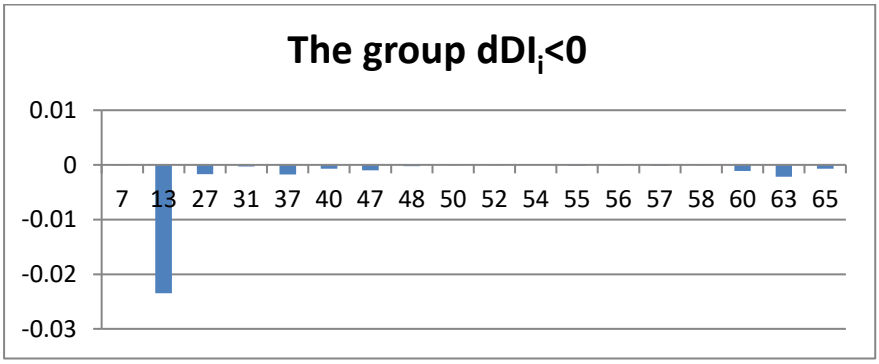


Figure 3. The share of CO_2 emissions in the decomposition of elasticity of Iran's production sectors in the period 2001-2011

Source: Research calculations

6- Conclusions and policy recommendations

In 2019, Iran ranks sixth in the world and fifth in Asia in terms of CO_2 emissions. The purpose of this article is to investigate the factors affecting the CO_2 emission demand elasticity and CO_2 emission output elasticity, and we seek to answer the question of what factors are able to explain the changes in these elasticities. What are the factors that stimulate and inhibit the elasticity of CO_2 emissions in Iran? We try to answer this question by decomposition of the CO2 emission elasticities.

We have calculated these two elasticities for all production sectors of Iran (65 sectors) in 2001 and 2011 and also based on the decomposition analysis and with the aim of identifying the drivers of CO_2 emission elasticities determined and calculated the components of changes in CO_2 emission elasticities. Based on the formula $E^y = \hat{\beta}'(I-B)^{-1}\hat{S}$ introduced by Guo et al. (2018), two types of CO_2 emission elasticities can be introduced for each sector; Final demand elasticity of CO_2 emissions (TI_j) and developmental elasticity of CO_2 emissions (DI_i). TI_j elasticity is the effect of one percent change in the final demand of sector j on CO_2 emissions of the whole economy and

DI_i elasticity is the effect of one percent change in the final demand of all sectors on CO_2 emissions of sector i. Based on the decomposition approach, CO_2 emission demand elasticity changes are decomposed to three effects: "changing the Ghosh inverse matrix", "changing the share of final demand in the total output of sector" and "changing the share of CO_2 emission of sectors", and CO_2 emission output elasticity changes are decomposed to three effects: "changing the Ghosh inverse matrix", "changing the share of final demand in the total output of sectors" and "changing the share of CO_2 emission of sector".

Due to the lack of access to CO_2 emission data of production sectors in Iranian information and data sources, we have calculated the CO_2 emissions of production sectors through the energy consumption of sectors. The results indicate that the sector "Electricity generation, transmission and distribution" in 2001 and 2011 had the highest amount of DI_i elasticity and the highest amount of CO_2 emission share and the highest amount of TI_j elasticity in 2001. The highest amount of TI_j elasticity in 2011 is allocated to "Coke production, products of oil refining" sector and "Other buildings" sector.

The highest amount of incremental changes in TI_j and DI_i elasticities in the period 2001-2011 are related to the "Electricity generation, transmission and distribution" and "Other Buildings" sectors, respectively. These two types of elasticities have increased in this time interval for 47 out of 65 industries. Now, the important question is why these elasticities have increased and what is the most important stimulus in this increase? "Changing the share of final demand in output" effect has helped to reduce the TI_j in 41 of the 65 sectors (63% of the industries) and reduce the DI_i in 43 of the 65 sectors (66% of the industries). "Changing CO_2 emission share" effect has helped to reduce the TI_j in 40 of the 65 sectors (61.5% of the industries) and reduce the DI_i in 35 of the 65 sectors (54% of the industries).

The results indicate that the most important stimulus to increase TI_j elasticity and DI_i elasticity is the effect of the "changing the Ghosh inverse matrix". In other words, the increase in the share of output of sector i, which is sold as an intermediate input to industry j, is a strong driver of CO_2 emission elasticity in Iran in the period 2001-2011. These changes can be due to increased economic activities and the inefficiency of production structure.

"Electricity generation, transmission and distribution" sector should be considered by energy and environmental policy makers due to having the highest amount and changes in CO_2 emission elasticity than other sectors. Increasing the share of renewable energy in the energy consumption basket of production sectors, increasing energy efficiency (reducing energy intensity) by replacing new and advanced equipment with old and worn equipment and improving production structure can help reduce the CO_2 elasticity and CO_2 emission in Iran's production sectors. The results of this study are significant for energy and environmental policymakers.

Finally, due to the high of CO_2 emission elasticities in the "Electricity generation, transmission and distribution" sector, future research can focus on this area and suggest solutions to increase production efficiency and energy efficiency. Also, future research can focus on the production structure of production sectors and provide solutions to improve the production structure of Iran's production sectors.

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نتیجه:

بخش «تولید، انتقال و توزیع برق» به دلیل دارا بودن بالاترین میزان و تغییرات کشش انتشار CO_2 نسبت به سایر بخش‌ها باید مورد توجه سیاستگذاران انرژی و محیط زیست قرار گیرد. افزایش سهم انرژی‌های تجدیدپذیر در سبد مصرف انرژی بخش‌های تولیدی، افزایش کارایی انرژی (کاهش شدت انرژی) با جایگزینی تجهیزات جدید و پیشرفته با تجهیزات قدیمی و فرسوده و بهبود ساختار تولید می‌تواند به کاهش کشش CO_2 و انتشار CO_2 بخش‌های تولیدی ایران کمک کند. سرانجام، با توجه به بالا بودن کشش انتشار CO_2 بخش «تولید، انتقال و توزیع برق»، تحقیقات آتی می‌تواند بر این حوزه تمرکز کرده و راه‌حل‌هایی را برای افزایش کارایی تولید و بهره‌وری انرژی پیشنهاد کند. همچنین پژوهش‌های آتی می‌تواند بر ساختار تولیدی بخش‌های تولیدی متمرکز شود و راهکارهایی برای بهبود ساختار تولیدی بخش‌های تولیدی ایران ارائه کند.

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تغییرات کشش‌ها تجزیه می‌شوند. در این تحقیق از جداول داده- ستانده منتشر شده در سال‌های ۱۳۸۰ و ۱۳۹۰ توسط مرکز آمار ایران استفاده شده است. با توجه به تفاوت در طبقه بندی بخش جداول داده- ستانده سال‌های ۱۳۸۰ و ۱۳۹۰، برخی از بخش‌های تولیدی را ادغام و در نهایت ٦٥ بخش را در نظر می‌گیریم. برای محاسبه انتشار دی‌اکسید کربن هر بخش تولیدی، ابتدا کل مصرف انرژی هر سال را از ترازنامه انرژی ایران به‌دست می‌آوریم و سپس هر انرژی مصرفی را با توجه جداول داده- ستانده و سهم بخش‌های تولیدی و بخش خانوار به بخش‌های تولیدی و خانوار تخصیص می‌دهیم.

$$TI_j = \sum_i E_{ij}^y = \sum_i \beta_i g_{ij} \frac{y_j}{x_j} = \frac{y_j}{x_j} \sum_{i=1}^{n} \beta_i g_{ij}$$

$$DI_i = \sum_j E_{ij}^y = \sum_j \beta_i g_{ij} \frac{y_j}{x_j} = \beta_i \sum_{j=1}^{n} \frac{y_j}{x_j} g_{ij}$$

$$\Delta TI_j = \Delta\left(\frac{y_j}{x_j}\right)\sum_i \beta_i g_{ij} + \Delta\left(\sum_i \beta_i g_{ij}\right)\frac{y_j}{x_j}$$

$$= \Delta\left(\frac{y_j}{x_j}\right)\sum_i \beta_i g_{ij} + \frac{y_j}{x_j}\left(\sum_i \beta_i \Delta g_{ij}\right) + \frac{y_j}{x_j}\left(\sum_i g_{ij} \Delta\beta_i\right)$$

$$\Delta DI_i = \Delta(\beta_i)\sum_j \left(\frac{y_j}{x_j}\right) g_{ij} + \Delta\left(\sum_j \frac{y_j}{x_j} g_{ij}\right)\beta_i$$

$$= \beta_i \left(\sum_j g_{ij} \Delta\left(\frac{y_j}{x_j}\right)\right) + \beta_i \left(\sum_j \frac{y_j}{x_j} \Delta g_{ij}\right) + \Delta\beta_i \sum_j \frac{y_j}{x_j} g_{ij}$$

یافته‌ها:

یافته‌ها نشان می‌دهد که بخش «تولید، انتقال و توزیع برق» بیشترین کشش انتشار CO_2 را دارد. اثر "ماتریس معکوس *Ghosh*" یک محرک قوی برای کشش انتشار CO_2 بخش‌های تولیدی است. این نتیجه نشان می‌دهد که تغییر در سهم تولیدی بخش i، که به بخش j به عنوان نهاده واسطه فروخته می‌شود، یک محرک قوی برای افزایش کشش انتشار CO_2 است. این تغییرات می‌تواند ناشی از افزایش فعالیت‌های اقتصادی و ناکارآمدی ساختار تولید باشد.

ارجاع به مقاله:
اعظمی، سمیه و محمدی، زهرا. (۱۴۰۱). تعیین کننده‌های تغییرات کشش انتشار CO2 در ایران. *فصلنامه‌ی اقتصاد مقداری (بررسی های اقتصادی سابق)*، ۱۹(۱)، ۱۶۴-۱۲۷
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چکیده گسترده

معرفی:

ایران در سال ۲۰۱۹ بر حسب انتشار CO_2 در بین کشورهای جهان حایز رتبه ششم و در بین کشورهای آسیایی (با در نظر گرفتن روسیه به عنوان کشور اوراسیایی) حایز رتبه پنجم است. بنابراین بررسی کشش انتشار CO_2 بخش‌های تولیدی این کشور برای سیاست‌گذاران انرژی و محیط زیست مهم و حائز اهمیت است. چه عواملی بر تغییرات کشش انتشار CO_2 تأثیر می‌گذارد؟ کدام عوامل محرک و کدام عوامل بازدارنده هستند؟ پاسخ به این سوالات در کاهش و کنترل انتشار CO_2 مفید است. در مطالعه حاضر، ابتدا کشش‌های انتشار CO_2 بخش‌های تولیدی محاسبه و سپس با هدف شناسایی محرک‌های کشش انتشار CO_2، تغییرات کشش‌های انتشار CO_2 به اجزای مختلف تقسیم می‌شوند. روش شناسی این تحقیق مبتنی بر تحلیل داده- ستانده و تحلیل تجزیه است. نوآوری این مقاله تعیین و محاسبه مولفه‌های تغییرات کشش انتشار CO_2 با استفاده از تحلیل تجزیه ساختاری است. گوو و همکاران (۲۰۱۸) روشی را برای محاسبه کشش انتشار CO_2 بر اساس تحلیل داده-ستانده ارائه کرده‌اند، در این مطالعه کشش‌های انتشار با استفاده از روش تحلیل تجزیه ساختاری تجزیه می‌شوند.

متدولوژی:

هدف این مقاله بررسی عوامل موثر بر کشش انتشار CO_2، کشش تقاضای انتشار CO_2 و کشش تولید انتشار CO_2 است. در مرحله اول کشش‌ها محاسبه شده و در مرحله دوم

فصلنامه‌ی اقتصاد مقداری (بررسی‌های اقتصادی سابق) بهار ۱۴۰۱ ۱۹(۱) ۱۶۴-۱۲۷

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تعیین کننده‌های تغییرات کشش انتشار CO_2 در ایران

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*** کارشناس ارشد اقتصاد، گروه اقتصاد، دانشکده ی علوم اجتماعی، دانشگاه رازی، کرمانشاه، ایران.*

ایمیل: *zahra.mohamadi6666@gmail.com*

اطلاعات مقاله	طبقه‌بندی JEL	واژگان کلیدی
تاریخ دریافت: ۱۷ دی ۱۴۰۰	***Q50,Q53,Q40,C67,P28***	***کشش انتشار CO_2، مصرف انرژی، تحلیل داده- ستانده، تحلیل تجزیه***
تاریخ بازنگری: ۱۵ اردیبهشت ۱۴۰۱		
تاریخ پذیرش: ۲۰ خرداد ۱۴۰۱		

اطلاعات تکمیلی:
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قدردانی: از تمامی افراد و موسساتی که در انجام این تحقیق مولف را مساعدت نمودند، قدردانی می‌شود.
تضاد منافع: نویسنده‌ها مقاله اعلام می‌کنند که در انتشار مقاله ارائه شده تضاد منافعی وجود ندارد.
منابع مالی: نویسنده‌ها هیچگونه حمایت مالی برای تحقیق، تألیف و انتشار این مقاله دریافت نکرده‌اند.

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نتیجه گیری:

برای سنجش این فرضیه، در این تحقیق با استفاده از فرمول جدید، شاخص توسعه انسانی استان خوزستان برای سال های ۱۳۷۵، ۱۳۸۵، ۱۳۹۰ و ۱۳۹۵ محاسبه گردید. نتایج این تحقیق نشان داد که شاخص امید به زندگی و شاخص آموزش در استان خوزستان از کشور وضعیت بدتری دارد ولی شاخص درآمدی (با احتساب نفت) از مقدار مشابه کشوری اش بیشتر بوده است. با این وصف، محاسبه شاخص توسعه انسانی بدون نفت برای خوزستان نشان داد که این شاخص درآمدی از کشور وضعیت نامناسب تری دارد.

براساس نتایج به دست آمده، شاخص توسعه انسانی استان خوزستان از سال ۱۳۷۵ با مقدار ۰/۶۴ از سطح متوسط به سطح بالا در سال های ۱۳۸۵ تا ۱۳۹۵ رسیده است که رشد قابل قبولی در این شاخص است. همچنین شاخص توسعه انسانی بدون نفت استان خوزستان از شاخص مشابه کشوری کمتر است و نشان از وضعیت بدتر استان خوزستان نسبت به کشور در این زمینه دارد.

نتایج شبیه سازی شاخص توسعه انسانی نشان می دهد تا سال ۱۳۸٤ روند رو به رشد و ملایمی طی شده است اما از سال ۱۳۸٤ به نظر می رسد در شاخص توسعه انسانی یک جهش و یا شکست رخ داده است. همچنین بر اساس این شبیه سازی شاخص توسعه انسانی در استان خوزستان تا سال ۱۳۸۸، در سطح متوسط قرار داشته که بعد از سال ۱۳۸۹ به مرحله‌ی بالا رسیده است.

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۱۳۷۲	۰٫۵۸	۱۳۸۲	۰٫٦٤	۱۳۹۲	۰٫۷۳
۱۳۷۳	۰٫۵۹	۱۳۸۳	۰٫٦٤	۱۳۹۳	۰٫۷۳
۱۳۷٤	۰٫٦	۱۳۸٤	۰٫٦٥	۱۳۹٤	۰٫۷۳
۱۳۷٥	۰٫٦	۱۳۸٥	۰٫٦۸	۱۳۹٥	۰٫۷٤
۱۳۷٦	۰٫٦۱	۱۳۸٦	۰٫٦۸	۱۳۹٦	۰٫۷٤
۱۳۷۷	۰٫٦۱	۱۳۸۷	۰٫٦۹	۱۳۹۷	۰٫۷٤
۱۳۷۸	۰٫٦۲	۱۳۸۸	۰٫۷	۱۳۹۸	۰٫۷٤

به منظور بررسی کامل‌تر نتایج شبیه سازی با مقادیر داده‌های واقعی، نتایج محاسبه معیارهای ارزیابی شبیه سازی در **جدول ۲** نشان داده شده است. این نتایج نشان از اعتبار شبیه سازی انجام شده دارد.

جدول ۲. معیارهای خطای پیش بینی

مأخذ: نتایج پژوهش

RMSE	r
۰/۰۲	۰/۹۷

همانطور که نتایج جدول ۱ نشان می دهد شاخص توسعه انسانی خوزستان تا سال ۱۳۸٤ روند رو به رشد و ملایمی طی شده است اما از سال ۱۳۸۵ به نظر می رسد در شاخص توسعه انسانی یک جهش و یا شکست ساختاری رخ داده است اما در سال های ۱۳۹۵ تا ۱۳۹۷ این روند ثابت بوده است و به نوعی به نظر می رسد به مقدار باثبات خود رسیده است. همچنین بر اساس این شبیه سازی شاخص توسعه انسانی در استان خوزستان تا سال ۱۳۸۷، در سطح متوسط قرار داشته ولی از سال ۱۳۸۸ به مرحله ی بالا رسیده است.

متودولوژی:

نبود چنین آماری در ایران نیز از جمله خلاء های آماری در کشور است که انجام پژوهش های منطقه ای و استانی را به شدت محدود و غیردقیق کرده است. برای رفع این کمبود، در این تحقیق، شاخص توسعه انسانی استان خوزستان در سال های ۱۳۷۵، ۱۳۸۵، ۱۳۹۰ و ۱۳۹۵ با استفاده از جدیدترین فرمول محاسبه شده است. لازم به ذکر است شبیه سازی شاخص توسعه ی انسانی بسیار وقت گیر و دشوار است که عدم توجه به جزئیات می تواند شاخص را دچار انحراف سازد. لذا به منظور پیدا کردن حصول اطمینان از دقت محاسبات، شاخص توسعه انسانی برای کشور نیز محاسبه شده است و با شاخص توسعه انسانی محاسبه شده ی سازمان ملل برای ایران، مقایسه شده است، تا از صحت محاسبات برای شاخص توسعه انسانی در استان خوزستان اطمینان حاصل شود. روش اتخاذ شده يك الگوي رفتاري هم‌زمان بوده که اثرات تغییرات شاخص توسعه انسانی را از طریق مولفه های شاخص توسعه انسانی سازمان ملل مد نظر قرار می‌دهد و به طور هم زمان آن را پیش بینی و در شاخص توسعه انسانی ملحوظ می‌دارد. روش برآورد، بر اساس روش حداقل مربعات پویا ارائه شده توسط استوک و واتسون (۱۹۹۳) که به منظور پیش بینی در متغیرها بسیار مفید است، می‌باشد.

یافته‌ها:

با توجه به نتایج تحقیق شاخص توسعه انسانی استان خوزستان را می توان برای دوره ی ۱۳۶۹-۱۳۹۷ شبیه سازی کرد. نتایج این شبیه سازی در **جدول ۱** نشان داده شده است.

جدول ۱. شبیه سازی شاخص توسعه انسانی استان خوزستان
مأخذ: نتایج پژوهش

سال	شاخص	سال	شاخص	سال	شاخص
۱۳۶۹	۰٫۵٤	۱۳۷۹	۰٫٦۲	۱۳۸۹	۰٫۷
۱۳۷۰	۰٫۵۵	۱۳۸۰	۰٫٦۳	۱۳۹۰	۰٫۷۱
۱۳۷۱	۰٫۵۷	۱۳۸۱	۰٫٦٤	۱۳۹۱	۰٫۷۳

اطلاعات تکمیلی:
مقاله حاضر برگرفته از پایان نامه کارشناسی ارشد شیوا شریف زاده اهوازی با استاد راهنمایی سید مرتضی افقه و سید امین منصوری در دانشگاه شهید چمران اهواز است.
تشکر و قدردانی: نویسندگان از معاونت پژوهشی دانشگاه شهید چمران اهواز برای حمایت های مالی تشکر می‌کنند.
تضاد منافع: نویسندگان هیچ تضاد منافع را اعلام نمی کنند.
تامین مالی: این مطالعه بخشی از پایان نامه کارشناسی ارشد است که توسط دانشگاه شهید چمران اهواز از طریق شماره گرنت SCU.EE98.30460 حمایت مالی شده است.

ارجاع به مقاله:
منصوری، سید امین.، افقه، سید مرتضی.، آقایی جنت مکان، حسین و شریف زاده اهوازی، شیوا. (۱۴۰۰). شبیه سازی شاخص توسعه انسانی در استان خوزستان با تأکید بر زندگی سالم و دسترسی به دانش و مقایسه با ایران. *فصلنامه‌ی اقتصاد مقداری (بررسی های اقتصادی سابق)*، ۱۹(۱)، ۱۲۶-۱۰۱.
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چکیده گسترده

معرفی:

شاخص توسعه ی انسانی، شاخصی ترکیبی برای سنجیدن سه معیار شامل زندگی طولانی و سالم، دسترسی به دانش و معرفت و سطح رفاه مناسب در زندگی است. از سال ۲۰۱۱ تاکنون، اجزای شاخص توسعه ی انسانی شامل شاخص های آموزش ترکیب شاخص میانگین سال های تحصیل برای بزرگسالان (جمعیت ۲۵ساله و بیشتر) و شاخص سال های مورد انتظار تحصیل، شاخص امید به زندگی و شاخص درآمد سرانه هستند و شاخص توسعه ی انسانی در واقع میانگین هندسی این سه شاخص است. این شاخص سالانه توسط سازمان ملل برای کشورها محاسبه می شود ولی برای ایالت ها، استان ها، شهرستان ها و مناطق در کشورها محاسبه نمی شود. لذا محققین می بایست برای اهداف مشخصی خود به محاسبه ی این شاخص برای استان ها بپردازند.

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شبیه سازی شاخص توسعه انسانی در استان خوزستان با تأکید بر زندگی سالم و دسترسی به دانش و مقایسه با ایران

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الف) افزایش مداوم سرمایه بانک در طی زمان: سرمایه بانک توسعه صادرات به جهت دولتی بودن بانک متغیری برون‌زا است و افزایش سرمایه بانک مستلزم حمایت مستقیم دولت است. دولت برای حمایت عملی از صادرات کشور ضروری است تلاش نماید در طی زمان با افزایش سرمایه بانک ظرفیت تأمین مالی بانک توسعه صادرات را گسترش دهد.

ب) کاهش و ادغام شعب زیان ده که با توجه به موقعیت و شرایط موجود، شعبه قادر به تامین هزینه های خود نیست. با کاهش شعب زیان ده، کارایی هزینه اگزیم بانک افزایش می‌یابد.

ج) برنامه‌ریزی میان‌مدت بانک مرکزی برای کاهش محدودیت‌های قانونی و مقررات مربوط به بانک‌های تجاری در بانک توسعه صادرات ایران.

د) اگر چه کاهش ملایم نرخ برابری ریال در مقابل سایر ارزها، منجر به افزایش توان رقابت‌پذیری کالاها و خدمات صادراتی می‌گیرد، اما این مزیت از طریق بروز نرخ تورم داخلی در سطح بالا، منجر به افزایش قیمت کالاها و خدمات صادرات می‌گردد و رقابت‌پذیری محصولات صادراتی را در سطح جهانی و همچنین در مقابل محصولات وارداتی کاهش می‌دهد. بنابراین بانک مرکزی باید از اعمال سایست‌های پولی که نتیجه آن بروز تورم در اقتصاد است به شدت اجتناب نماید.

ه) افزایش بهره‌وری سرمایه انسانی و فیزیکی با برگزاری دوره‌های آموزشی مؤثر و بازنگری در جذب و به‌کارگیری نیروی انسانی به روش سنتی و استفاده از روش‌های علمی برای جذب نیروی انسانی مستعد، متخصص، با انگیزه و علاقه‌مند و غیره.

و) دولت از انتصاب مدیران غیر بانکی به‌ویژه در سطح هیئت‌مدیره و مدیرعامل بانک که تخصص، تجربه و دانش پایه بانکی لازم و آشنایی با مأموریت، فرهنگ، ارزش‌ها و چشم‌انداز بانک ندارند، خودداری نماید.

یافته‌ها:

همان‌طور که در بالا ذکر شد، برآورد اقتصادسنجی تابع هزینه مستلزم انتخاب فرم تابع است. براي بررسی تجربی برآورد ناکارآیی هزینه از تابع ترانسلوگ استفاده شده است. همچنین مدل با ورودی و خروجی‌های مختلف برآورد گردید. شکل کلی تابع به صورت شرح زیر است:

$$\ln(TC) = \alpha_0 + \sum_{i=1}^{2} \alpha_i \ln(Q_i) + \sum_{j=1}^{2} \beta_j \ln(P_j) + u_{it} + v_{it},$$

$$i = 1,2,\ldots, t = 1,2,..$$

$$\ln(TC) = \alpha_0 + \sum_{i=1}^{2} \alpha_i \ln(Q_i) + \sum_{j=1}^{2} \beta_j \ln(P_J) + \sum_{i=1}^{2} \alpha_{ii} (\ln Q_i)^2$$

$$+ \sum_{i=1}^{2} \beta_{jj} (\ln P_j)^2$$

$$+ \sum_{i=1}^{2} \sum_{j=1}^{2} \gamma_{ij} (\ln Q_i)(\ln P_J) + u_{it} + \upsilon_{it}$$

$$, i = 1,2,\ldots, t = 1,2\ldots.,$$

TC_{it}= هزینه کل شعبه iام در سال tام،

Qit =تولید شعبه iام در سال tام،

P_{it} = قیمت ورودی شعبه iام در سال tام،

U_{it} = ناکارایی هزینه شعبه iام در سال tام،

v_{it} = خطای آماری که دارای میانگین صفر و واریانس ثابت است.

$\beta, \alpha, ln(TC)$ پارامترهاي مجهول هستند که باید برآورد گردند.

نتیجه:

بر اساس یافته‌های پژوهش شش راه‌کار برای بهبود کارایی شعب و توسعه صادرات غیرنفتی پیشنهاد شده است.

چکیده گسترده

معرفی:

در عصر حاضر بانکداری یکی از مهم‌ترین بخش‌های اقتصادی است که در سازمان‌دهی و هدایت دریافت‌ها و پرداخت‌ها، تسهیل مبادله‌های تجاری و بازرگانی باعث گسترش بازارها و رشد و شکوفایی اقتصادها شده است. بانک‌ها از طریق تجهیز پس‌اندازها و تخصیص آن‌ها به سمت کسب‌وکارهای مختلف می‌توانند نقش بسیار سازنده در اقتصاد ایفا کنند. بانک توسعه صادرات ایران به‌عنوان تنها اگزیم بانک کشور می‌تواند با افزایش کارایی خود و در کنار پرداخت وام‌های ارزان‌قیمت به بنگاه‌های صادراتی و تأمین سرمایه گردش موردنیاز آن‌ها، با تأمین مالی طرح‌های سرمایه‌گذاری و طرح‌های توسعه‌ای به‌صورت کارا به افزایش توان صادراتی و رقابت‌پذیری آن‌ها در بازارهای جهانی کمک زیادی نماید.

هفت معیار برای ارزیابی عملکرد شرکت عبارت‌اند از: اثربخشی، کارایی، بهره‌وری، کیفیت، سودآوری و سودآوری، کیفیت زندگی کاری و خلاقیت و نوآوری. مقدار خروجی تولیدشده توسط شرکت با استفاده از مقدار معینی از نهاده‌ها را بهره‌وری می‌گویند. بنابراین، بهبود سطح بهره‌وری نتیجه تولید خروجی بیشتر با استفاده از مقدار ثابت ورودی یا تولید مقدار ثابت خروجی با استفاده از ورودی کم‌تر است.

متدولوژی:

برای تحقق اهداف تحقیق مراحل زیر انجام‌شده است:

در مرحله اول، به‌منظور ارزیابی کارایی بانک، کارایی شعب مختلف با استفاده از تابع تولید مرزی تصادفی سنجیده شد. بر این اساس، ۲۷ شعبه با فعالیت مستمر طی سه سال گذشته به‌عنوان نمونه انتخاب و کارایی ماهانه آن‌ها برآورد شد. برای اندازه‌گیری کارایی شعب، هزینه‌های بانک تابعی از متغیرهای ورودی و خروجی در نظر گرفته شد و سپس با استفاده از نرم‌افزار *Frontier 4* برآورد شد. درآمدهای غیرعملیاتی و عملیاتی به‌عنوان خروجی و وام‌ها، تأمین مالی و سرمایه شعب به‌عنوان ورودی‌های بانک در مدل گنجانده شدند.

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تحلیل تأثیر کارایی اگزیم بانک بر صادرات غیرنفتی

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اطلاعات مقاله	طبقه‌بندی JEL	واژگان کلیدی
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قدردانی: از تمامی افراد و موسساتی که در انجام این تحقیق مولف را مساعدت نمودند، قدردانی می‌شود.

تضاد منافع: نویسنده مقاله اعلام می‌کند که در انتشار مقاله ارائه شده تضاد منافعی وجود ندارد.

منابع مالی: نویسنده هیچگونه حمایت مالی برای تحقیق، تألیف و انتشار این مقاله دریافت نکرده است.

ارجاع به مقاله:

سیف اللهی، ناصر. (۱۴۰۱). تحلیل تأثیر کارایی اگزیم بانک بر صادرات غیرنفتی. *فصلنامه‌ی اقتصاد مقداری (بررسی های اقتصادی سابق)*، ۱۹(۱)، ۱۰۰-۷۳.

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یافته‌ها:

یافته‌ها براساس داده‌های سری زمانی برای دوره‌ی زمانی ۱۳۹۶-۱۳۵۰ و روش رگرسیون آستانه‌ای (*TR*) نشان می‌دهد که نرخ ارز مؤثر حقیقی ۶۱۶۰/۲۷ ریال به عنوان یک آستانه عمل کرده است. به عبارت دیگر، براساس مقدار آستانه‌ی فوق، مقدار برآورد شده نشان می‌دهد که ضریب نرخ ارز تا حدودی از رژیم اول به رژیم دوم افزایش یافته است.

نتیجه:

با عنایت به این‌که حفظ ارزش پول ملی از جمله مهم‌ترین وظایف بانک مرکزی محسوب می‌شود، بنابراین، توجه به نرخ ارز و اثرات آستانه‌ای آن در طراحی و اجرای سیاست‌های پولی و ارزی در برنامه‌ریزی برای کنترل تورم ضروری به نظر می‌رسد. نتایج حاصل از این پژوهش، ما را به این رهنمود سیاستی هدایت می‌کند که به دلیل نوسانات نرخ ارز در ایران و با توجه به آثار مخرب تورم بر اقتصاد و رفاه خانوارها، سیاست‌گذاران پولی کشور باید تکانه‌های ارزی را مهار کنند.

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در اثرگذاری نرخ ارز از اهمیت و جایگاه متفاوتی برخوردار است. زیرا ممکن است واکنش سیاست‌گذاران پولی کشور به میزان اثرگذاری نرخ ارز از یک حد آستانه‌ای وابسته باشد. در حقیقت، این امکان وجود دارد که آن‌ها نوسانات نرخ ارز و تأثیر آن بر قیمت‌های داخلی را تا سطحی از نرخ ارز برای اقتصاد کشور، مهم قلمداد نکنند. در صورتی‌که اگر نرخ ارز از یک سطح آستانه‌ای معینی فراتر رود به استنباط آن‌ها به اقتصاد کشور و همچنین رفاه مردم آسیب جدی وارد می‌کند، بنابراین لازم بدانند که در این شرایط در بازار ارز دخالت کنند.

متدولوژی:

یکی از دلایل واکنش غیرخطی تورم، ماهیت غیرخطی روند نرخ ارز است. در حقیقت، از نظر هندسی، از بین تمام مسیرهای زمانی نرخ ارز، احتمال مسیر خطی بین هر دو نقطه‌ی زمانی، بسیار اندک است. برآیند تأثیر همه‌ی تعیین‌کننده‌های نرخ ارز، در تغییرات آن نمایش داده می‌شوند. در این‌جا توجه به دو نکته بسیار مهم است. نخست این‌که اثرات متقابل تعیین‌کننده‌های نرخ ارز می‌تواند تأثیر هر یک از تعیین‌کننده‌ها را تحت‌الشعاع خود قرار دهد. دوم، اهمیت ارز، به خصوص در کشورهای در حال توسعه و نقش کلیدی آن بین بازارهای ارزی و مالی، نرخ ارز را به یک متغیر هوشمند تبدیل نموده است، که از طریق فرایند یادگیری[1]، به تصحیح اشتباهات در نرخ بعدی می‌پردازد. از این‌رو، انتظار می‌رود که مسیر نرخ ارز در طی زمان، غیرخطی باشد.

هدف مقاله حاضر، آزمون یک مدل غیرخطی است که واکنش تورم به نرخ ارز مؤثر حقیقی در ایران را تخمین می‌زند. به منظور بررسی اثرات آستانه‌ای نرخ ارز بر تورم در ایران، با پیروی از پاسدل و تیکا[2] (۲۰۰۹) الگوی زیر مورد استفاده قرار گرفت:

$$\pi_t = I_{t-d}\left[\alpha_1 + \sum_{i=0}^{k}\beta_{1i}e_{t-i}\right] + (1 - I_{t-d})\left[\alpha_2 + \sum_{i=0}^{k}\beta_{2i}e_{t-i}\right] + \varepsilon_t$$

$$I_{t-d} = 1 \quad if \quad e_{t-i} \geq \tau$$

$$I_{t-d} = 0 \quad if \quad e_{t-i} < \tau$$

که در آن، تورم (π) تابعی از نرخ ارز مؤثر حقیقی (e) است. متغیر I یک متغیر دامی (ساختگی) است، $I = 1$ است اگر نرخ ارز مؤثر حقیقی (e) برابر یا بزرگتر از آستانه (τ) باشد و $I = 0$ است اگر نرخ ارز مؤثر حقیقی (e) کوچکتر از آستانه (τ) باشد.

[1] Learning
[2] Posedel & Tica

ارجاع به مقاله:
عبدی سیّدکلایی، محمد.، طهرانچیان، امیرمنصور.، جعفری صمیمی، احمد و فاورو، جینو. (۱۴۰۱). واکنش غیرخطی تورم به نرخ ارز مؤثر حقیقی در ایران. *فصلنامه‌ی اقتصاد مقداری (بررسی های اقتصادی سابق)*، ۱۹(۱), ۷۱-۵۳.

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چکیده گسترده

معرفی:

نرخ ارز، متغیری است که تکانه‌های اقتصادی بین‌المللی را به اقتصاد داخلی منتقل می‌کند. در کشورهایی مانند ایران که نر خ تورم بالا را تجربه می‌کنند و تولید ناخالص داخلی‌اشان همانند مخارج مصرفی از وابستگی بیشتری به واردات و جریان‌های سرمایه‌ای خارجی برخوردار است، تغییرات نرخ ارز و اثرات آن نیازمند این است که با دقت بیشتری توسط سیاست‌گذاران و پژوهشگران اقتصادی رصد شود. با توجه به اهمیت تورم در مباحث نظری و نیز بالا بودن نرخ تورم در برخی از کشورهای درحال‌توسعه، بررسی تأثیر نرخ ارز بر تورم مورد توجه اقتصاددانان علاقه‌مند به موضوعات اقتصاد پولی و اقتصاد بین‌الملل بوده است. رفتارهای غیرخطی در اثرگذاری نرخ ارز بر تورم می‌تواند در شرایطی که الگوی اقتصادسنجی به صورت خطی برآورد می‌شود تخمین‌های خلاف واقع از ضریب نرخ ارز ارایه کند. در این شرایط می‌توان پذیرفت که وضعیت تورم و نرخ آن می‌تواند بر پاسخ عوامل اقتصادی به تکانه‌ی نرخ ارز تأثیر بگذارد. در حقیقت، قیمت‌های داخلی ممکن است به علت تورم پایین و باثبات به یک تکانه‌ی نرخ ارز واکنش نشان ندهند. اما اگر تورم بالای سطح آستانه‌اش باشد آن‌ها به تکانه‌های مشابه واکنش نشان می‌دهند.

با وجودی که مطالعات انجام شده بیشتر بر اندازه‌گیری میزان اثرگذاری نرخ ارز بر سطح قیمت‌ها متمرکز شده است، اما بررسی امکان وجود یک و یا بیشتر از یک حد آستانه‌ای

فصلنامه‌ی اقتصاد مقداری (بررسی‌های اقتصادی سابق) بهار ۱۴۰۱ ۱۹(۱) ۷۱-۵۳

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واکنش غیرخطی تورم به نرخ ارز مؤثر حقیقی در ایران

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قدردانی: از تمامی افراد و موسساتی که در انجام این تحقیق مولف را مساعدت نمودند، قدردانی می‌شود.
تضاد منافع: نویسنده‌های مقاله اعلام می‌کنند که در انتشار مقاله ارائه شده تضاد منافعی وجود ندارد.
منابع مالی: نویسنده‌ها هیچگونه حمایت مالی برای تحقیق، تألیف و انتشار این مقاله دریافت نکرده‌اند.

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غیرتجاری کاهش می‌یابد که احتمالاً نشان دهنده علائم بیماری هلندی است. از سوی دیگر، پاسخ‌های پویا متغیرهای کلان اقتصادی منتخب وجود اثر بالاسا-ساموئلسون را نشان می‌دهد که در آن افزایش بهره‌وری در بخش معامله‌شده، نرخ ارز واقعی را افزایش می‌دهد و قیمت کالاهای غیرقابل تجارت را از طریق یکسان‌سازی دستمزد افزایش می‌دهد.

نتیجه گیری:

به طور کلی، زمانی که اقتصاد شوک‌های رابطه مبادله یا شوک‌های بهره‌وری صادراتی را تجربه می‌کند، هدف‌گذاری تورم *CPI* نسبتاً بهتر از هدف‌گذاری نرخ ارز و هدف‌گذاری تورم غیرتجاری بهتر در تثبیت اقتصاد کلان است.

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جدول ۱. کالیبراسیون مدل
مأخذ: نتایج تحقیق

پارامتر	تعریف و شرح	ارزش
α	سهم کالاهای غیر تجاری در مصرف	0.8
ρ	کشش جایگزینی بین کالاهای مبادله شده و*غیرتجاری*	3.4
β	عامل تخفیف ذهنی	0.96
θ_N	پارامتر چسبندگی در بخش غیرتجاری	0.2488
θ_Ψ	پارامتر چسبندگی در بخش واردات	0.2
σ	معکوس کشش جایگزینی بین مصرف و کار	1.57
ρ_r	پارامتر هموارسازی برای قانون تیلور	0.7
ρ_r^*	پارامتر تداوم نرخ بهره خارجی	0.88
$\rho_{A_I}^*$	پارامتر پایداری بهره وری لوبار در بخش میانی	0.8
ρ_{xt}^*	پارامتر پایداری قیمت نفت	0.6
α^*	سهم کالاهای تجارت نشده در مصرف در خارج از کشور	0.8
ρ^*	کشش جایگزینی بین کالاهای مبادله شده و غیر قابل معامله در خارج	3.5
ρ_{Nt}^*	پارامتر تداوم بهره وری لوبار در بخش غیرتجاری خارجی	0.75

یافته‌ها:

مقایسه پاسخ‌ها تحت رژیم‌های مختلف سیاست پولی نشان می‌دهد که هدف‌گذاری تورم *CPI* نسبت به هدف‌گذاری *NTIT* و *ET* زمانی که شوک‌های رابطه مبادله اتفاق می‌افتد، برتری دارد. برای شوک بهره وری صادرات، عملکرد قانون *CIT* بهتر از سایر قوانین سیاست پولی است. همچنین نرخ واقعی ارز که به عنوان تابعی از شرایط تجارت کالا و تفاوت‌های بهره وری تعریف می‌شود، امکان بررسی نقش شوک بهره وری صادراتی بر تغییرات کلان اقتصادی و آزمون وجود اثر بالاسا-ساموئلسون را فراهم می‌کند. واکنش‌های تکانه‌ای به شرایط شوک تجاری کالایی نشان‌دهنده افزایش در تولید کل و تورم *CPI* و کاهش مصرف و نرخ اسمی ارز تحت سه قانون سیاستی است. تجزیه و تحلیل همچنین نشان می‌دهد که شوک‌های رابطه مبادله کالایی باعث واکنش کمتر متغیرهای کلان اقتصادی تحت هدف گذاری تورمی *CPI* نسبت به هدف گذاری تورمی غیرتجاری و هدف گذاری نرخ ارز می‌شود. تحت شوک بهره‌وری بخش صادرات، تولید صادراتی افزایش می‌یابد درحالی که تولید

نظری یک اقتصاد باز کوچک صادرکننده نفت را توسط دو بخش داخلی مشخص می‌کند: بخش تجاری و بخش غیرتجاری. طبق نظر کالوو (۱۹۸۳) در بخش غیرتجاری، قیمت‌ها ثابت هستند. همچنین یک بخش خارجی وجود دارد که بقیه جهان است. همچنین گذر ناقص نرخ ارز از طریق مقاومت اسمی بر روی قیمت‌های وارداتی معرفی می‌شود. این مدل برای ارزیابی واکنش رژیم های مختلف سیاست پولی به شوک‌های رابطه مبادله و شوک های بهره وری صادراتی توسعه یافته است. بر اساس شواهد تجربی مانند شجری و همکاران (۲۰۱۵)، گذر در مدل، ناقص فرض شده است. از آنجایی که صادرات نفت درصد بالایی از درآمدهای صادراتی را تشکیل می‌دهد و بخش قابل توجهی از مخارج دولت در ایران را تأمین مالی می‌کند، تحلیل واکنش‌های مختلف سیاست پولی به شوک‌های رابطه مبادله در یک کشور صادرکننده نفت، مانند ایران، مهم است. هدف این مطالعه بررسی اثرات پویای شوک‌های رابطه مبادله و ارزیابی عملکرد و ویژگی‌های تثبیت قواعد مختلف سیاست پولی ساده برای اقتصادهای وابسته به نفت است. سه قانون: جایگزینی سیاست پولی، شامل قانون هدف گذاری تورم *(CIT) CPI*، قانون هدف گذاری تورم غیرتجاری *(NTIT)* و قانون هدف گذاری نرخ ارز *(ET)* در نظر گرفته شده است. قواعد مختلف سیاست پولی بر اساس درجه‌ای که نوسان متغیرهای کلان اقتصادی منتخب را که توسط توابع واکنش ضربه‌ای منعکس می‌شود، به حداقل می رساند، ارزیابی می‌شوند.

متدولوژی:

این مدل برای مطابقت با ویژگی های کلیدی اقتصاد ایران با استفاده از داده‌های دوره ۱۹۹۱ :*Q1* تا ۲۰۱۷ *Q1* :کالیبره شده است. سری تولیدات نفتی و غیرنفتی از «مرکز آمار ایران» دریافت می‌شود. سری نرخ سود و قیمت نفت از «بانک مرکزی ایران» اخذ می‌شود. سری تولیدات و قیمت کالاها در بخش واسطه ای خارجی از "آرشیو داده‌های اقتصادی فدرال رزرو " به دست آمده است. سایر پارامترها از مطالعات قبلی درباره اقتصاد ایران و ادبیات چرخه تجاری در جهان به دست آمده است. این مدل برای اقتصاد ایران کالیبره شده است. مدل به صورت عددی حل شده و پارامترهای انتخاب شده برای مدل در جدول ۱ خلاصه شده است.

اطلاعات تکمیلی:
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قدردانی: از تمامی افراد و موسساتی که در انجام این تحقیق مولف را مساعدت نمودند، قدردانی می‌شود.
تضاد منافع: نویسنده مقاله اعلام می‌کند که در انتشار مقاله ارائه شده تضاد منافعی وجود ندارد.
منابع مالی: نویسنده‌ها هیچگونه حمایت مالی برای تحقیق، تألیف و انتشار این مقاله دریافت نکرده‌اند.

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چکیده گسترده

معرفی:

شوک‌های رابطه مبادله کالایی در توضیح نوسانات اقتصاد کلان در کشورهای صادرکننده نفت اهمیت دارند. شوک های قیمت نفت منبع اصلی تغییرات در کشورهای صادرکننده نفت هستند. با توجه به تأثیرات قابل توجه نوسانات رابطه مبادله بر متغیرهای کلان اقتصادی داخلی، درک انتقال و انتشار نوسانات رابطه مبادله در طراحی و اجرای سیاست‌های کلان اقتصادی در کشورهای صادرکننده نفت بسیار مهم است. یک سیاست پولی مناسب می تواند به تثبیت این شوک ها کمک کند.

این مطالعه پاسخ سه رژیم سیاست پولی جایگزین به شوک‌های رابطه مبادله و شوک بهره‌وری بخش صادرات را با استفاده از مدل تعادل عمومی تصادفی پویا کینزی *(DSGE)* ارزیابی می‌کند. در این مطالعه، مدل بر اساس هو و همکاران (۲۰۱۵)، موناسلی (۲۰۰۵) و کشین و همکاران (۲۰۰۴) برای اقتصاد ایران توسعه داده شده است. این چارچوب

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اطلاعات مقاله	طبقه‌بندی JEL	واژگان کلیدی
تاریخ دریافت: ۸ دی ۱۳۹۷ تاریخ بازنگری: ۰۱ اردیبهشت ۱۳۹۸ تاریخ پذیرش: ۲۷ خرداد ۱۳۹۸	E17,E52,F59,F31, F41	سیاست پولی، مدلDSGE ، شوک‌های رابطه مبادله، شوک های بهره وری صادراتی، انتقال ناقص نرخ ارز

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بازده سهام داشته است. همچنین در دوره رکود بازار سهام به کارگیری یک سیاست پولی انبساطی باعث کاهش احتمال ماندن در در دوره رکود بازار خواهد شد و احتمال جابجایی از دوره رکود به دوره رونق را افزایش خواهد داد. بعلاوه سرمایه گذاران فعال در بازار سهام که به تحولات سیاست پولی هنگام اتخاذ تصمیمات سرمایه گذاری توجه می کنند باید به این نکته نیز توجه داشته باشند که تاثیر سیاست پولی بر بازده سهام بستگی دارد به اینکه هنگام اعمال سیاست پولی، بازار سهام در چه وضعیتی به لحاظ رونق یا رکود قرار دارد.

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یافته‌ها:

یافته‌های مدل‌های خطی و *MS* نشان می دهد که مدل های *MS* عملکرد بهتری نسبت به مدل های خطی دارند. بر اساس یافته هاي تحقيق مدل هاي *MS* دو رژيم با ميانگين و واريانس هاي متفاوت به نام هاي رژيم رونق و رژيم ركود را شناسايي كرده اند. هر دو رژیم بسیار ماندگار بوده بطوریکه بصورت متوسط در حدود ۱۰-۱۲ فصل به طول انجامیده‌اند. نتايج نشان مي دهند كه سياست پولي تاثير معني داري بر بازده سهام فقط در دوره هاي ركود بازار سهام داشته است. بطوریکه افزایش *M2* بازده سهام را افزایش و افزایش نرخ بهره بازده سهام را کاهش داده است. تاثير شديدتر سياست پولي بر بازده سهام در دوره هاي ركود بازار نسبت به دوره هاي رونق در جهت پيش بيني مدل هاي با محدوديت هاي مالي می باشند. نتایج حاصل از مدل های *TVTP-MS* نشان می دهند که یک سیاست پولی انبساطی (تغییرات مثبت در *M2* واقعی یا تغییرات منفی در نرخ بهره واقعی) احتمال ماندن در رژیم رونق بازار سهام را افزایش می دهد در حالی که احتمال تغییر از رژیم رونق به رژیم رکود را کاهش می دهد. علاوه بر این ، سیاست پولی انبساطی احتمال ماندن در رژیم رکودی بازار را کاهش می دهد در حالی که می تواند احتمال تغییر از وضعیت رکود به وضعیت رونق را افزایش دهد.

نتیجه:

نتایج مدل *MS* تعدیل یافته نشان می دهد که سیاست پولی بازده سهام را فقط در دوره‌های رکود بازار سهام به طور معنی داری تحت تاثیر قرار داده است. به طور مشخص تر افزایش در *M2* واقعی، بازده سهام را افزایش داده در حالی که افزایش در نرخ بهره باعث کاهش بازده سهام در دوره رکود بازار سهام شده است. این یافته ها در جهت پیش بینی مدل‌های با محدودیت های مالی می باشند. نتایج حاصل از مدل های *TVTP-MS* نشان می‌دهند که یک سیاست پولی انبساطی احتمال ماندن در رژیم رونق بازار سهام را افزایش می‌دهد در حالی که احتمال ماندن در دوره رکود بازار سهام را کاهش می دهد. با توجه به نتایج بدست آمده از تخمین مدل ها می توان این پیشنهاد سیاستی را مطرح نمود که سیاست گذاران پولی هنگام اعمال سیاست های پولی باید به چرخه های رونق و رکود بازار سهام توجه نمایند، زیرا سیاست پولی در دوره های مختلف رونق و رکود بازار سهام اثرات متفاوتی بر

چکیده گسترده

معرفی:

بررسی ارتباط بین سیاست پولی و بازده سهام برای سیاست گذاران پولی و سرمایه گذاران بازارهای مالی برای اعمال سیاست پولی مناسب و اتخاذ تصمیم های سرمایه گذاری درست از اهمیت زیادی برخوردار می باشد. بعلاوه، فهم اینکه آیا سیاست پولی در چرخه های رونق و رکود بازار سهام اثرات یکسانی بر بازده سهام ایجاد می کند برای اقتصاددانان از اهمیت زیادی برخوردار می باشد. اگر سیاست پولی اثرات نامتقارن داشته باشد سیایت گذاران پولی باید چرخه های بازار سهام را هنگام اعمال سیاست پولی در نظر داشته باشند. هدف مطالعه حاضر بررسی واکنش بازده سهام به سیاست پولی و اثرات نامتقارن سیاست پولی بر بازده سهام در دوره‌های رونق و رکود بازار سهام می باشد. در این مقاله همچنین تاثیر سیاست پولی بر احتمالات جابجایی بین رژیم های رونق و رکود بازار سهام آزمون شده است. اثرات نامتقارن سیاست پولی بر بازده سهام در دوره های رونق و رکود بازار سهام از طریق مدل‌های با محدودیت های مالی قابل توضیح می باشد.

متدولوژی:

در این مطالعه اثرات نامتقارن سیاست پولی با استفاده از مدل های مارکوف سوئیچینگ (*MS*) مورد بررسی قرار گرفته اند. در این مطالعه از مدل های مارکوف سوئیچینگ با توابع احتمال ثابت (*FTP-MS*) و مدل های مارکوف سوئیچینگ با توابع احتمال تغییرپذیر در طول زمان (*TVTP-MS*) استفاده مي شود. مدل های *FTP-MS* برای بررسی تأثیرات نامتقارن سیاست پولی بر بازده سهام در دوره های رونق و رکود بازار سهام بکار گرفته شده اند. در مدل‌های *FTP-MS*، احتمال های انتقال، ایستا در نظر گرفته می شوند. در مدل های *TVTP-MS*، فرض می شود که احتمال جابجایی بین رژیم های رونق ورکود به تحولات سیاست پولی بستگی داشته باشد. از مدلهای *TVTP-MS* برای بررسی تأثیر سیاست پولی بر احتمال جابجایی بین رژیم های مختلف استفاده شده است.

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سیاست پولی و چرخه‌های بازار سهام در ایران

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قدردانی: از دانشگاه آزاد اسلامی واحد بیضا به دلیل حمایت مالی این فعالیت پژوهشی تشکر و قدردانی می شود. همچنین از از داوران محترم مقاله که پیشنهادات ارزشمندی بر نسخه های اولیه مقاله ارائه نمودند قدردانی می‌شود.

تضاد منافع: نویسنده مقاله اعلام می‌کند که در انتشار مقاله ارائه شده تضاد منافعی وجود ندارد.

منابع مالی: این مقاله برگرفته از یک طرح پژوهشی می باشد که که توسط دانشگاه آزاد اسلامی واحد بیضا حمایت مالی شده است.

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۷- **هزینه ارسال مقاله :**۱۰۰ هزار ریال است که بعد از تایید مقاله و قبل از ارسال به داوری اخذ می‌شود و **هزینه چاپ مقاله** ۲۵۰ هزار ریال که بعد از پذیرش مقاله برای چاپ اخذ می‌شود.

۸- با توجه به سیاست جدید مجله مبنی بر ارزیابی درجه ی مشابهت، در صورتی که مقالات ارسالی زیر ۱۵ درصد مشابهت داشته باشند، برای داوری ارسال خواهد شد و در صورتی که مقالات بالای ۳۰ درصد مشابهت داشته باشد، رد خواهد شد.

۹- مقاله دریافت شده ابتدا توسط هیات تحریریه مورد بررسی قرار می گیرد و در صورتی که مناسب تشخیص داده شود، توسط حداقل دو نفر از صاحب نظران به صورت محرمانه داوری خواهد شد.

۱۰- مقاله همراه با تعهد نامه نویسنده مسئول، در زمان ارسال فایل مقاله به عنوان فایل تکمیلی (فرم های شماره ۱ و ۲ و ۳) ارسال گردد. پس از دریافت فایل الکترونیکی مقاله، کد رهگیری برای اطلاع از فرآیند بررسی، داوری و سایر پیگیری ها به نویسنده مسئول اختصاص و به آدرس الکترونیکی وی ارسال می شود.

۱۱- مقاله دریافت شده ابتدا توسط هیات تحریریه مورد بررسی قرار می گیرد و در صورتی که مناسب تشخیص داده شود، توسط حداقل دو نفر از صاحب نظران به صورت محرمانه داوری خواهد شد.

راهنمای تدوین و شرایط پذیرش و ارسال مقالات

شرایط ارسال مقاله در فصلنامه اقتصاد مقداری:

۱- موضوع مقاله در ارتباط با پژوهش‌های مقداری یا اقتصاد کاربردی باشد.

۲- مقاله حاصل مطالعات، تجربه ها و تحقیقات نویسنده (یا نویسندگان) و به لحاظ محتوا، مقاله علمی پژوهشی باشد. مسوولیت صحت و سقم مطالب مقاله به عهده ی نویسنده است.

۳- مقاله قبلا برای هیچ یک از نشریات (داخلی یا خارجی) ارسال یا در هیچ یک از نشریات (یا مجموعه مقالات همایش‌ها) چاپ نشده باشد.

٤- مقاله اصلی شامل عنوان، نویسندگان، چکیده، واژه های کلیدی، طبقه بندی JEL، مقدمه، بدنه ی اصلی، پیوست‌ها و فهرست منابع باشد.

تبصره: فایل اصلی مقاله "بدون نام نویسندگان" باشد.

تبصره۲: اعضای هئیت علمی می بایست از ایمیل سازمانی به منظور ارسال مقاله استفاده نمایند.

تبصره۳: به منظور رفاه نویسندگان، رعایت رسم الخط مجله اقتصاد مقداری در مرحله ی اول ارسال برای مجله اجباری نیست، با این وجود می بایست بخش های کلیدی یک مقاله ی پژوهشی را دارا باشد.

- نویسندگان محترم توجه کنند که همانگونه که فایل مشخصات نویسندگان را ارسال می کنند، در سامانه مجله نیز ترتیب نویسندگان مقاله، نویسنده ی مسئول و مشخصات آن ها همانند فرمت فایل ارسال شده باشد. تبعات عدم تطابق و رعایت این مسئله، به عهده ی نویسنده (گان) است.
- درجه ی علمی نویسنده و رشته، دانشکده .....، دانشگاه.....، شهر، کشور. به عنوان مثال:
- استادیار اقتصاد، دانشکده ی اقتصاد و علوم اجتماعی، دانشگاه شهید چمران اهواز، اهواز، ایران
- در صورتی که نویسندگان مقاله بعد از ارسال آن، درخواست تغییر در مشخصات نویسندگان را مقاله داشته باشند، لازم است بصورت مکتوب که در آن تمامی نویسندگان به همراه افیلیشن آن ها طبق فرمت استاندارد مجله تنظیم شده و توسط تمام نویسندگان جدید و قدیم امضاء شده باشد، از طریق ایمیل به مجله ارسال نمایند.
- چارچوب مقاله به صورت استاندارد فصلنامه طبق فایل نمونه فایل راهنمای نویسندگان باشد.

۵- به غیر از چکیده ی فارسی کوتاه که در فرمت اصلی مقاله ارسال می شود، چکیده گسترده (Extended Abstract) به صورت فارسی و انگلیسی حداقل ٤۵۰ کلمه (مطابق با فرم شماره٤) ارسال شود.

٦- برای متون (چکیده یا مقاله) انگلیسی گواهی معتبر ترجمه (Native) به همراه مقاله ارسال شود (بخش فایل‌های تکمیلی/اضافی).

دکتر احمد جعفری صمیمی	دانشکده علوم اقتصادی و اداری دانشگاه مازندران
دکتر کامبیز هژبر کیانی	دانشکده علوم اقتصادی و سیاسی دانشگاه شهید بهشتی
دکتر سعید عابدین درکوش	دانشکده علوم اقتصادی و سیاسی دانشگاه شهید بهشتی
دکتر محمد حسین پور کاظمی	دانشکده علوم اقتصادی و سیاسی دانشگاه شهید بهشتی
دکتر محمد نوفرستی	دانشکده علوم اقتصادی و سیاسی دانشگاه شهید بهشتی
دکتر حشمت الله عسگری	دانشکده علوم انسانی دانشگاه ایلام
دکتر سید ابراهیم حسینی نسب	دانشکده علوم انسانی دانشگاه تربیت مدرس
دکتر علی قنبری	دانشکده علوم انسانی دانشگاه تربیت مدرس
دکتر رضا نجارزاده	دانشکده علوم انسانی دانشگاه تربیت مدرس
دکتر عباس عصاری آرانی	دانشکده علوم انسانی دانشگاه تربیت مدرس
دکتر زهرا نصراللهی	دانشکده علوم انسانی دانشگاه یزد
دکتر سید نظام الدین مکیان	دانشکده علوم انسانی دانشگاه یزد
دکتر حبیب انصاری سامانی	دانشکده علوم انسانی دانشگاه یزد
دکتر بهزاد سلمانی	دانشکده علوم انسانی و اجتماعی دانشگاه تبریز
دکتر جعفر حقیقت	دانشکده علوم انسانی و اجتماعی دانشگاه تبریز
دکتر حسین اصغر پور	دانشکده علوم انسانی و اجتماعی دانشگاه تبریز
دکتر حسین پناهی	دانشکده علوم انسانی و اجتماعی دانشگاه تبریز
دکتر داوود بهبودی	دانشکده علوم انسانی و اجتماعی دانشگاه تبریز
دکتر محسن پور عبادالهان	دانشکده علوم انسانی و اجتماعی دانشگاه تبریز
دکتر محمد باقر بهشتی	دانشکده علوم انسانی و اجتماعی دانشگاه تبریز
دکتر رضا رنچپور	دانشکده علوم انسانی و اجتماعی دانشگاه تبریز
دکتر رحیم چینی پرداز	دانشکده علوم ریاضی و آمار دانشگاه شهید چمران اهواز
دکتر حسین اکبری فرد	دانشکده مدیریت و اقتصاد دانشگاه شهید باهنر کرمان
دکتر عادل پیغامی	دانشگاه امام صادق (ع)
دکتر محمد مهدی عسگری	دانشگاه امام صادق (ع)
دکتر عبداله شایان زینیوند	دانشگاه ایلام
دکتر روح الله زارع	دانشگاه آزاد اسلامی
دکتر فخرالدین فخرحسینی	دانشگاه آزاد اسلامی
دکتر هاشم زارع	دانشگاه آزاد اسلامی
دکتر فرشید پورشهابی	دانشگاه بجنورد
دکتر فرهاد خداداد کاشی	دانشگاه پیام نور
دکتر مجتبی بهمنی	دانشگاه شهید باهنر کرمان
دکتر سید احمدرضا جلالی نائینی	موسسه عالی آموزش و پژوهش مدیریت و برنامه ریزی

دکتر احمد صلاح‌منش	دانشکده اقتصاد و علوم اجتماعی دانشگاه شهید چمران اهواز
دکتر امیر حسین منتظر حجت	دانشکده اقتصاد و علوم اجتماعی دانشگاه شهید چمران اهواز
دکتر حسن فرازمند	دانشکده اقتصاد و علوم اجتماعی دانشگاه شهید چمران اهواز
دکتر سید امین منصوری	دانشکده اقتصاد و علوم اجتماعی دانشگاه شهید چمران اهواز
دکتر عبدالمجید آهنگری	دانشکده اقتصاد و علوم اجتماعی دانشگاه شهید چمران اهواز
دکتر مسعود خداپناه	دانشکده اقتصاد و علوم اجتماعی دانشگاه شهید چمران اهواز
دکتر ابراهیم انواری	دانشکده اقتصاد و علوم اجتماعی دانشگاه شهید چمران اهواز
دکتر سید عزیز آرمن	دانشکده اقتصاد و علوم اجتماعی دانشگاه شهید چمران اهواز
دکتر مرتضی افقه	دانشکده اقتصاد و علوم اجتماعی دانشگاه شهید چمران اهواز
دکتر مصیب پهلوانی	دانشکده اقتصاد و علوم اداری دانشگاه سیستان و بلوچستان
دکتر حسن حیدری	دانشکده اقتصاد و مدیریت دانشگاه ارومیه
دکتر کیومرث شهبازی	دانشکده اقتصاد و مدیریت دانشگاه ارومیه
دکتر فاطمه بزازان	دانشکده علوم اجتماعی و اقتصاد دانشگاه الزهراء
دکتر محمود حائریان	دانشکده علوم اجتماعی و اقتصاد دانشگاه الزهراء
دکتر مهدی پدرام	دانشکده علوم اجتماعی و اقتصاد دانشگاه الزهراء
دکتر شمس الله شیرین بخش	دانشکده علوم اجتماعی و اقتصاد دانشگاه الزهراء
دکتر خدیجه نصراللهی	دانشکده علوم اداری و اقتصاد دانشگاه اصفهان
دکتر محمد واعظ	دانشکده علوم اداری و اقتصاد دانشگاه اصفهان
دکتر مرتضی سامتی	دانشکده علوم اداری و اقتصاد دانشگاه اصفهان
دکتر سعید صمدی	دانشکده علوم اداری و اقتصاد دانشگاه اصفهان
دکتر سید کمیل طیبی	دانشکده علوم اداری و اقتصاد دانشگاه اصفهان
دکتر مصطفی عمادزاده	دانشکده علوم اداری و اقتصاد دانشگاه اصفهان
دکتر محمد طاهر احمدی	دانشکده علوم اداری و اقتصاد دانشگاه فردوسی مشهد
دکتر محمدحسین حسین‌زاده	دانشکده علوم اداری و اقتصاد دانشگاه فردوسی مشهد
دکتر مهدی خداپرست	دانشکده علوم اداری و اقتصاد دانشگاه فردوسی مشهد
دکتر سید مهدی مصطفوی	دانشکده علوم اداری و اقتصاد دانشگاه فردوسی مشهد
دکتر علی اکبر ناجی میدانی	دانشکده علوم اداری و اقتصاد دانشگاه فردوسی مشهد
دکتر محمد رضا لطفعلی پور	دانشکده علوم اداری و اقتصاد دانشگاه فردوسی مشهد
دکتر مصطفی سلیمی فر	دانشکده علوم اداری و اقتصاد دانشگاه فردوسی مشهد
دکتر اسمعیل ابونوری	دانشکده علوم اقتصادی و اداری دانشگاه مازندران
دکتر زهرا کریمی	دانشکده علوم اقتصادی و اداری دانشگاه مازندران
دکتر سعید راسخی	دانشکده علوم اقتصادی و اداری دانشگاه مازندران
دکتر علیرضا پور فرج	دانشکده علوم اقتصادی و اداری دانشگاه مازندران
دکتر محمد تقی گیلک حکیم‌آبادی	دانشکده علوم اقتصادی و اداری دانشگاه مازندران
دکتر نورالدین شریفی	دانشکده علوم اقتصادی و اداری دانشگاه مازندران
دکتر وحید تقی نژاد عمران	دانشکده علوم اقتصادی و اداری دانشگاه مازندران
دکتر یوسف محنت فر	دانشکده علوم اقتصادی و اداری دانشگاه مازندران

همکاران علمی:

دکتر مرتضی عزتی	پژوهشکده اقتصاد دانشگاه تربیت مدرس
دکتر لطفعلی عاقلی کهنه شهری	پژوهشکده اقتصاد دانشگاه تربیت مدرس
دکتر علی ارشدی	پژوهشکده پولی بانک مرکزی
دکتر علی حسن زاده	پژوهشکده پولی و بانکی بانک مرکزی
دکتر شهزاد برومند	پژوهشکده ی امور اقتصادی دانشگاه علامه طباطبایی
دکتر ابوالفضل شاه آبادی	دانشکده اقتصاد دانشگاه الزهرا
دکتر عزت الله عباسیان	دانشکده مدیریت دانشگاه تهران
دکتر علی اکبر قلی زاده	دانشکده اقتصاد دانشگاه بوعلی سینا همدان
دکتر محمد حسن فطرس	دانشکده اقتصاد دانشگاه بوعلی سینا همدان
دکتر نادر مهرگان	دانشکده اقتصاد دانشگاه بوعلی سینا همدان
دکتر اصغر شاهمرادی	دانشکده اقتصاد دانشگاه تهران
دکتر حسین عباسی نژاد	دانشکده اقتصاد دانشگاه تهران
دکتر قهرمان عبدلی	دانشکده اقتصاد دانشگاه تهران
دکتر محسن مهرآرا	دانشکده اقتصاد دانشگاه تهران
دکتر جعفر عبادی	دانشکده اقتصاد دانشگاه تهران
دکتر محمدنبی شهیکی تاش	دانشکده اقتصاد دانشگاه زاهدان
دکتر حسین مرزبان	دانشکده اقتصاد دانشگاه شیراز
دکتر رضا اکبریان	دانشکده اقتصاد دانشگاه شیراز
دکتر ابراهیم هادیان	دانشکده اقتصاد دانشگاه شیراز
دکتر اسفندیار جهانگرد	دانشکده اقتصاد دانشگاه علامه طباطبایی
دکتر جمشید پژویان	دانشکده اقتصاد دانشگاه علامه طباطبایی
دکتر حمید رضا ارباب	دانشکده اقتصاد دانشگاه علامه طباطبایی
دکتر حمید رضا برادران شرکاء	دانشکده اقتصاد دانشگاه علامه طباطبایی
دکتر سهیلا پروین	دانشکده اقتصاد دانشگاه علامه طباطبایی
دکتر سید محمد رضا سید نورانی	دانشکده اقتصاد دانشگاه علامه طباطبایی
دکتر علی اصغر بانویی	دانشکده اقتصاد دانشگاه علامه طباطبایی
دکتر محمد قلی یوسفی	دانشکده اقتصاد دانشگاه علامه طباطبایی
دکتر علی امامی میبدی	دانشکده اقتصاد دانشگاه علامه طباطبایی
دکتر ناصر خیابانی	دانشکده اقتصاد دانشگاه علامه طباطبایی
دکتر سعید مشیری	دانشکده اقتصاد دانشگاه علامه طباطبایی
دکتر مهدی تقوی	دانشکده اقتصاد دانشگاه علامه طباطبایی
دکتر فتح الله تاری	دانشکده اقتصاد دانشگاه علامه طباطبایی
دکتر محسن ابراهیمی	دانشکده اقتصاد دانشگاه خوارزمی تهران
دکتر حمید کرد بچه	دانشکده علوم اجتماعی و اقتصادی دانشگاه الزهرا

فصلنامه علمی ـ پژوهشی

اقتصاد مقداری

(بررسی‌های اقتصادی سابق)

دانشکده اقتصاد و علوم اجتماعی دانشگاه شهید چمران اهواز

دوره نوزدهم، شماره اول، بهار ۱۴۰۱

صاحب امتیاز: دانشگاه شهید چمران اهواز

مدیر مسئول: دکتر حسن فرازمند

سردبیر: دکتر سید عزیز آرمن

دبیر اجرائی: دکتر سید مرتضی افقه

مدیر داخلی: دکتر سید امین منصوری

ویراستار انگلیسی: دکتر امیر مشهدی

ویراستار فنی و صفحه آرا: آزاده بدوی

فصلنامه علمی اقتصاد مقداری

عنوان اختصاری: JQE

محورهای مطالعاتی: اقتصاد نظری و اقتصاد کاربردی

دوره انتشار: فصلنامه

صاحب امتیاز: دانشگاه شهید چمران اهواز

پروانه انتشار: شماره۱۲٤/۷۲۰ مورخ ۱۳۸۳/۱/۲۹ به زبان فارسی- انگلیسی

نشانی: اهواز- دانشگاه شهید چمران اهواز- دانشکده اقتصاد و علوم اجتماعی- دفتر فصلنامه علمی- پژوهشی اقتصاد مقداری (بررسی‌های اقتصادی سابق)؛ کد پستی: ٦١٣٥٧٤٣٣٣٧؛ صندوق پستی: ٦١٣٥٥/١٥٦؛ تلفکس: ۳۳۳۵۶۶۴- ۰۶۱۳

پست الکترونیکی: jqe@scu.ac.ir؛

آدرس سامانه: jqe.scu.ac.ir

آدرس: اهواز- گلستان- دانشگاه شهید چمران اهواز- دانشکده اقتصاد و علوم اجتماعی- دفتر مجله اقصاد مقداری (بررسی های اقتصادی سابق)

DOI: 10.22055 / JQE

دسترسی: آزاد

زبان: فارسی - انگلیسی

نوع داوری: داوری همتا، دو سویه نامشخص

هزینه ارسال مقاله 1000000 :ریال که بعد از تایید مقاله برای ارسال به داوری اخذ می‌شود.

هزینه چاپ مقاله: ۲۵۰۰۰۰۰ ریال که بعد از پذیرش مقاله برای چاپ اخذ می‌شود.

شاپا چاپی: 2008-5850

شاپا الکترونیکی: 2717-4271

تمامی مقالات ارسالی به این مجله، توسط سامانه مشابهت یاب Ithenticate برای مقالات انگلیسی و سمیم نور و همانندجو برای مقالات فارسی ارزیابی می شود.

فصلنامه علمی

اقتصاد مقداری

(بررسی‌های اقتصادی سابق)

دانشکده اقتصاد و علوم اجتماعی دانشگاه شهید چمران اهواز

دوره نوزدهم، شماره اول، بهار ۱۴۰۱

(شماره مسلسل ۷۲)

بر اساس تأییدیه شماره ۳/۲۶۰۲ مورخ ۱۳۸۷/۴/۵ کمیسیون بررسی نشریات علمی کشور، این نشریه دارای درجه‌ی **علمی ـ پژوهشی** است.

این نشریه هم اکنون در سایت‌های پایگاه استنادی علوم جهان اسلام (ISC) به آدرس (www.isc.gov.ir)، پایگاه نظام نمایه سازي مرکز منطقه‌اي اطلاع رساني علوم و فناوري (ایران ژورنال) به آدرس (www.ricest.ac.ir) پایگاه اطلاعات علمی جهاد دانشگاهی (SID) به آدرس (www.sid.ir)، بانک اطلاعات نشریات کشور به آدرس (www.magiran.com)، پایگاه تخصصی نور به آدرس (www.noormags.ir) و همچنین مقالات این نشریه در سایت علمی google scholar به آدرس (https://scholar.google.com/) نمایه شده است. چاپ مقاله‌هاي این نشریه به معني تأیید مواضع نویسندگان نیست.