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Is Free Trade Non-Linear Driver Agricultural Growth and Trade? Lessons Learnt from Iran

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Abstract: The primary purpose of this study is to quantify the impacts of trade liberalization on the growth and trade of agricultural products in Iran as one of the leading indicators of globalization on macroeconomic indicators. Also, study the short-term and long-term effects on the liberalization of growth and trade of agricultural products and Study the existence of a non-linear relationship on the liberalization of growth and trade of agricultural products. Iran has been trying to liberalize its trade regime since 1995 in order to increase its growth and trade performance. Despite a long period of liberalization, however, imports still outpace exports widening the trade deficit. Experimental results show that liberalization by reducing the import duty rate in the short-term increases exports by 1.56 percent, but in the long term reduces the number of imports by about 7.65 percent. Estimating the growth showed that the liberalization index in both regimes has a positive and significant effect on agricultural growth. This means that the implementation of trade liberalization policy in the period under study had a positive effect on the growth of the agricultural sector. Therefore, trade liberalization in the short term leads to growth in exports, and in the long term, increased production leads to an increase in exports and a decrease in imports and economic growth.

Keywords: trade liberalization, agricultural trade, agricultural growth, Markov switching, Iran.

自由贸易非线性驱动农业增长和贸易吗？其他 伊朗的教训

摘要: 本研究的主要目的是量化贸易自由化对伊朗农产品增长和贸易的影响，作为全球化对宏观经济指标的领先指标之一。自 1995 年以来，伊朗一直试图开放其贸易制度，以提高其增长和贸易绩效。然而，尽管长期自由化，进口仍然超过出口扩大贸易逆差。实验结果表明，通过降低进口关税率的自由化在短期内使出口增加 1.56%，但从长期来看，进口数量减少了约 7.65%。对增长的估计表明，两种制度的自由化指数对农业增长都有积极而显着的影响。这意味着研究期间贸易自由化政策的实施对农业部门的增长产生了积极影响。因此，贸易自由化在短期内会导致出口增长，而从长期来看，生产增加会导致出口增加而进口减少和经济增长。

关键词： 贸易自由化, 农业贸易, 农业增长, 马尔可夫转换, 伊朗。

1. Introduction

Trade liberalization has emerged as one of the most profound policy concerns for governments all around the globe, especially in developing countries. It is believed that Trade liberalization enhances economic growth and development through specialization and technological advances. It is also claimed that international trade enables countries to specialize in

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goods and services by stimulating competition and promoting technological changes based on "comparative and competitive advantage". As a result, consumers would consume more products with higher quality and lower prices, and therefore, human welfare would increase [1].

Economic liberalization is one of the essential principles in assessing the economic development of countries in the world [2]. Therefore, it can be regarded as a key component in improving society [3]. Given the significance of trade liberalization and the necessity for membership in the world trade organization (WTO), Iran submitted its application for membership in this organization on July 19, 1996.

A working group was formed in the WTO on May 26, 2005, to review Iran's request. It is now 16 years since the formation of this working group, and Iran is still an observer member of this organization given the imposition of sanctions and the lack of necessary conditions for joining the WTO. Besides removing the legal barriers and problems in trade, one of the most critical steps for Iran's accession to the WTO is to regulate the country's trade tariffs. The realization of this issue necessitates changes in tariff policies to provide the necessary commercial, industrial, technological, and investment infrastructure.

2. Literature Review

Several empirical studies [4-9] have found a consistently positive relationship between trade liberalization and export performance.

The debt crisis in the early 1980s provided an essential argument for trade reform. The developed countries, along with the General Agreement on Tariffs and Trade (GATT), IMF, and WB, were all the proponents of free trade. They believed that trade liberalization would ultimately improve exports and growth, particularly in developing countries [10-19]. According to the endogenous growth model and standard partial equilibrium trade theory, trade liberalization can play an essential role in boosting export and growth through technology transfers [19-23].

This model regards trade liberalization, international trade, and economic growth as closely related and claims empirical support for the notion that the effective implementation of trade liberalization policies can help boost export compared to import. However, views on trade liberalization are equally prominent. Keynesian economists believe that reducing import duties under an import liberalization policy contributes to imports over exports, hence a foreign trade deficit [1].

[4] criticizes trade liberalization and export performance. The work reviewed the latest economic literature related to the sources of countries' export performance and believes that international trade favors large emerging countries by stating that the flow of global trade and international competition increases in such circumstances. The United Nations conference on trade and development (UNCTAD), in their trade development report (TDR) in 1999, found that rapid trade liberalization generates wider trade deficits in many developing countries [1, 24]. The interaction of liberalization with price increases slightly reduces imports and thus improves the trade balance, while the interaction with income worsens the trade balance, and the increase in income mainly stimulates the increase in imports. The International Labor Organization (ILO) [41] also holds the view that trade liberalization can host such problems as unemployment and wage inequality in advanced countries, increased exploitation of workers in developing countries, and de-industrialization and marginalization in low-income countries resulting in poverty, global inequality, and degradation of the environment. UNCTAD's experiences with trade liberalization in developing countries show that a sudden dismantling of support and protection of the domestic industry can have severe repercussions on employment conditions and widens wage differentials [25].

In sum, the literature review demonstrates contradictory results concerning the impact of trade liberalization on trade performance in developing countries. Therefore, the empirical investigation of individual countries is crucial to examine the impact of trade liberalization on imports. In sum, the literature review demonstrates contradictory results concerning the impact of trade liberalization on trade performance in developing countries. Therefore, the empirical investigation of individual countries is crucial to examine the impact of trade liberalization on imports, exports, and trade in each specific country.

3. Materials and Methods

There are various econometric methods used in various studies to estimate the short-term and long-term relationships between variables. The Markov-switching model was first introduced by [21, 26] and then expanded by [27] to extract business cycles. In the Markov model, switching takes place suddenly, unlike other non-linear models like Smooth transition autoregressive (STAR) and artificial neural network (ANNs), where the transition from one regime to another is done gradually [28]. Therefore, based on the theoretical foundations of the subject and some research carried out by [15, 29, 30], the following Markov switching model is used to investigate the effects of Trade Liberalization on trade:

$$\Delta IN_t = c(s_t) + \sum_{i=1}^{O} \alpha_i(s_t)\Delta RVAA_{t-i} + \sum_{j=1}^{P} \beta_i(s_t)\Delta KOF_{t-i} + \sum_{j=1}^{Q} \beta_i(s_t)\Delta RER_{t-i} \sum_{m=1}^{s} \delta_i(s_t)\Delta TB \times KOF)_{t-i} + \varepsilon_t \quad (1)$$

$$\varepsilon_t IID(O, \sigma) \quad (2)$$

$$\Delta IEX_t = c(s_t) + \sum_{i=1}^{O} \alpha_i(s_t)\Delta RVAA_{t-i} + \sum_{j=1}^{P} \beta_i(s_t)\Delta KOF_{t-i} +$$

$\sum_{j=1}^{Q}\beta_i(s_t)\Delta RER_{t-i}\sum_{m=1}^{s}\delta_i(s_t)\Delta TB\times KOF)_{t-i}+\varepsilon_t$ (3)

$\varepsilon_t IID(O,\sigma)$ (4)

$\Delta GR_t=c(s_t)+\sum_{i=1}^{O}\alpha_i(s_t)\Delta KOF_{t-i}+\sum_{j=1}^{P}\beta_i(s_t)\Delta RVAA_{t-i}+\sum_{k=1}^{q}\theta_i(s_t)\Delta RER_{t-i}+\sum_{m=1}^{S}\delta_i(s_t)\Delta GR\times KOF)_{t-i}+\varepsilon_t$ (5)

$\varepsilon_t IID(O,\sigma)$ (6)

Δ shows the changes, EX - the value of exports of the agricultural products; IN - the value of import of the agricultural products; RVAA - the added value rate of the agricultural sector at the constant price in 2016; RER - the real exchange rate at the constant price in 2016; GR - the growth rate of the agricultural sector at the constant price in 2016; KOF - trade liberalization criterion.

S_t: The status or regime is a first-order Markov process that shows the producer regime at time t. It is a discrete and invisible random variable, and one cannot precisely determine in which regime or state we are at time t. However, we can say that it is possible to be in a collision or competitive regime. The discrete variable St is a function of its past values.

ε_t shows a disturbance or error sentence that has a normal distribution, o, p, q, r, s = Maximum lags of variables, α،β،θ ،γ،δ = Template parameters. Modeling can be performed so that the y-intercept or coefficients, or both, differ from one regime to another. Thus, in the above model, α, β, θ, γ, δ depend on the status variable or regime.

The following three equations are used to determine the error correction mechanism for trade demand and growth of Iran's agricultural sector:

1. In the first model, agricultural exports are used as a dependent variable, and the growth rate of the benefit of the agricultural sector, the criterion of trade liberalization, and the real exchange rate as independent variables.

2. In the second model, agricultural imports are used as a dependent variable, and the growth rate of the benefit of the agricultural sector, the criterion of trade liberalization, and the real exchange rate as independent variables.

3. In the third model, the growth rate of the agricultural sector is regarded as a dependent variable, and the real exchange rate, the benefit of the agricultural sector, and trade liberalization as independent variables.

In the MS model, the transmission mechanism is controlled by the invisible state variable St. This status variable follows the Markov first-order chain. In other words, the value of the state variable in period t depends only on its value in period t-1 (As the status variable is not directly visible, these models are sometimes called hidden Markov models). The transmission models for the variable Yt can be formulated as follows:

$$y_t=\begin{cases}C_1+\rho_1 Y_{t-1}+\varepsilon_t, s_t=1\\ C_2+\rho_2 Y_{t-1}+\varepsilon_t, s_t=2\end{cases} \quad (7)$$

Thus, When St takes one for the period (t = 1, 2....T), and two (t = T + 1, T + 2...T), this model is a structural variable in time T1. The model shows the Quandt random switching model when St is an independent Bernoulli random variable [26]. If St is regarded as an Indicator variable, so that its value for c is (St = 1) 1 and for c <is 2 (St = 2) (c is the threshold value), this model is called the threshold model. When St follows the Markov process, this model is called the MS model. Assuming that the variable Yt is modeled by the auto-regression process of order p and with m of the regime MS (m)-AR (P), the result is:

$$y_t=\sum_{i=1}^{m}\left[\sum_{j=1}^{p}(\beta_{ij}y_{t-j})+u_{it}\right]I_i(s_{t-i}) \quad (8)$$

$$I_i(s_{t-i})=\begin{Bmatrix}s_t=i\to 1\\ s_t=i\to 0\end{Bmatrix} \quad (9)$$

In the MS model, Yt properties are determined by εt property and St state variables. State variables cause constant and frequent changes in the model pattern. It is necessary to describe the probabilities of the St Variable moving from one state to another to have the whole dynamics of the variables. Markov first-order chain shows these probabilities:

$P_r[s_t=j\vee s_{t-1}=i,s_{t-2}=k,\dots;y_{t-1},y_{t-2},\dots]=P_r[s_t=j\vee s_{t-1}=i]=p_{ij}$ (10)

The transition probability matrix can represent the transition between states and regimes. In the simple model, which has only two regimes, this matrix is as follows:

$$P=\begin{bmatrix}P_r(s_t=1\vee s_{t-1}=1)P_r(s_t=1\vee s_{t-1}=2)\\ P_r(s_t=2\vee s_{t-1}=1)P_r(s_t=2\vee s_{t-1}=2)\end{bmatrix}=\begin{bmatrix}p_{11}&p_{12}\\ p_{21}&p_{22}\end{bmatrix} \quad (11)$$

Here, Pij (i, j = 1, 2) indicates the transition probabilities St = j, so that $S_{t-1}=i$ and$P_{i1}+P_{i2}=1$. As it was already stated, Yt is directly observable, but the status variable is invisible, and its value can only be deducted from the realized value of Yt, shown as $\xi_{it}=P_r[s_t=1\vee\Omega_t;\theta]$, where i =1 and 2 and Ωt indicates the data set (set of observations available for the period t), and θ is the parameter vector representing the estimate. To sum up, we need an iterative method for the period t (t = 1, 2… T1), when the previous probability $\xi_{it-1}=P_r[s_t=1\vee\Omega_{t-1};\theta]$ is given as the data to be used in the model. To this end, the probability density function is needed under various conditions as follows:

$$n_{it}=f(y_t\vee s_t=i,\Omega_{t-1};\theta)=\frac{1}{\sqrt{2\pi\sigma}}exp\left[\frac{-(y_t-c_1-\rho y_{t-1})2}{2\sigma^2}\right] \quad (12)$$

Conditional density can be calculated as follows:

$(y_t|\Omega_{t-1};\theta)=\sum_{i=1}^{2}\sum_{j=1}^{2}\rho_{ij}\xi_{jt-1}n_{it}$ (13)

Thus, the result is:

$$\xi_{it}=\frac{\sum_{j=1}^{2}\rho_{ij}\xi_{jt-1}n_{it}}{f(y_t\vee\Omega_{t-1};\theta)} \quad (14)$$

Using these results, one can obtain the logarithm of the conditional probability of the observed data for the given value θ:

$logf(y_1, y_2, \dots, y_T, \vee y_0; \theta) = \sum_{t=1}^{T} logf(y_t \vee \Omega_{t-1}; \theta)$ (15)

Optimization is used to estimate θ to maximize the conditional log-likelihood using the initial value ξit. Suppose that the Markov chain is Ergodic (In the ergodic Markov chain, at least one eigenvalue of the transition matrix is equal to one. Two-regime Markov chain is ergodic when: P11 < 1, p22 < 1, p11 + p22 > 0), in which case the unconditional probabilities of being in position j are used as initial values, which can be defined as follows:

$$\xi_j = Pr[s = j] = \frac{1-\rho_{ii}}{2-\rho_{ii}-\rho_{jj}} \quad (16)$$

After estimating the model coefficients and calculating the transition matrix, one can calculate the probability of state j in each period based on the information of the whole sample (studies 1 to T), which is known as smoothed probabilities. Moreover, the probability of state J in each period can be calculated using observations 1 to t (the point examined), known as filtered probabilities. If the model introduced in the previous section has m regimes and P lags, that is, yt is an AR (p) process and st takes the values of m equal to ...., 1,2,3 - then several general states occur depending on which of the components of the equation depends on the state variable [4, 23, 29, 31-33].

In practice, the Markov transition model can be classified into different types depending on which part of the auto-regression model is dependent on the regime and transferred under its influence. What is more important in economic studies is the four modes of MS models on average (MSM), y-intercept (MSI), auto-regression entries coefficients (MSA), and error sentence variance (MSH) or a combination of them. Overall, various Markov-Switching autoregressive (MS-AR) models can be elaborated using the linear autoregressive model, discussed in Table 1. By combining the first and second states with the second and third models, one can obtain a more detailed model where the various components of the equation depend on the regimes. Tables 1 and 2 summarize the different modes of the MS model.

Table 1 Different modes of MS-AR models [34]

Model	Error term distribution	Regime-dependent component
MSM (m)-AR (p)	$\varepsilon_t \sim IID(0, \delta^2)$	Mean
MSI (m)-AR (p)	$\varepsilon_t \sim IID(0, \delta^2)$	Y-intercept
MSH (m)-AR (p)	$\varepsilon_t \sim IID(0, \delta^2)$	Error term variance
MSA (m)-AR (p)	$\varepsilon_t \sim IID(0, \delta^2)$	Auto-regression terms coefficients

Table 2 Summary of different modes of MS-AR models [34]

MSI		MSM			
Constant Y-intercept	Variable Y-intercept	Constant Mean		Variable Mean	
AR Liner	MSI-AR	MAR Liner	MSM-AR	Constant variance	Constant A
MSH-AR	MSIH-AR	MSH-MAR	MSMH-AR	Variable variance	
MSA-AR	MSIA-AR	MSA-MAR	MSMA-AR	Constant variance	Variable A
MSAH-AR	MSIAH-AR	MSAH-MAR	MSMAH-AR	Variable variance	

The variables based on which calculations have been made are as follows:

The value of the exports of the agricultural sector in a million Rials, the value of the imports of the agricultural sector in a million Rials, the added value at a fixed price of the year 2016 in a million Rials, the real exchange rate, the growth of the agricultural sector, liberalization index KOF in terms of percentage.

First, it is necessary to examine the variables used in terms of being stationary or non-stationary to prevent false regression in the study. Various tests have been introduced to test the hypothesis of the presence or absence of a single root in time series, the most important of which is the Augmented Dickey-Fuller (ADF) unit root test, the Phillips-Perron test, and the GLS-de trended Dickey-fuller test, the single root Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) test. After performing the static test using the above tests, the long-term relationship is taken into account to examine the erroneous function. An ARDL model is selected for this purpose. Overall, four steps are taken to be able to choose the optimal model from different MS models.

3.1. Selecting the Test for the Non-Linear Relationship in Data

X2 (q) statistic is used in the analysis with the null hypothesis 7 (there is no regime change), where (q) shows the parameters of constraint and liberalization expressed under the null hypothesis [35].

3.2. Determining the States needed for the Appropriate Characteristics of the Observed Data (Determining the Regimes)

The optimal number of regimes to be used in the MS model should be determined. Given the presence of disturbing parameters (transition probabilities) in the null hypothesis, the LR test will not have a standard distribution, which makes it impossible to use this test to determine the number of optimal regimes [34]. The study conducted by Saradakis and Spagnolo indicates that in cases where the number of the examined observations and changes in the parameters is large enough, using the Akaike criterion determines the correct number of regimes; however, in most experimental studies, the number of regimes is determined based on the researcher's knowledge of the

variables. In this study, first, the model of two and three different regimes was estimated, and then the optimal model was determined using the Akaike statistic.

3.3. Determining the Optimal Degree of AR Delay

The autoregressive degrees and the moving average are determined using the Akaike statistic and the likelihood ratio (LR) test. Different MS models are estimated, and therefore, it is called the best model among the various models with the minimum Akaike value.

3.4. Comparing the Types of Selected Models in Terms of Changes in Parameters

Each of the estimated models in the third step is assessed with a series of diagnostic tests, which are the estimated model, the value of the likelihood function, the mean or the estimated y-intercept in different economic regimes, the significance of the coefficients, and the relationship between the probabilities of regime change.

4. Results

4.1. The Effects of Trade Liberalization on Agricultural Trade

Based on the results, in the export model, the value of the LR test statistic is equal to 5.161970. In the import model, the statistic value is equal to 34.19192, which is 95% greater than the critical value, so it can be concluded that the linear pattern in it. The confidence level is not a good model. Instead of linear models, it is far better to use the non-linear Markov switching method to estimate the model.

Table 3 Characteristics of each regime in the export model (Research findings)

	Number of observations in each regime	The possibility of being in the desired regime	The average period of being in the desired regime
Regime 1	18	0.835940	6.095320
Regime 2	17	0.812248	5.326184

Table 4 Characteristics of each regime in the import model (Research findings)

	Number of observations in each regime	The possibility of being in the desired regime	The average period of being in the desired regime
Regime 1	16	0.803132	5.076549
Regime 2	18	0.946857	18.81709

The characteristics of each regime are illustrated in Tables 3 and 4. The first column shows the number of observations and the second one the probability of staying in the desired regime. For instance, if one of the observations is examined randomly, with a probability of 0.83%, it can be stated that this observation is in regime one. The third column shows the average length of the period, where the observations are successively in the desired regime. In other words, if agricultural exports are transferred from regime 1 to regime 2, they will remain in this regime for an average period of six years. The probabilities of transition from one regime to another are shown in Tables 5 and 6. These tables illustrate the degree of stability and instability of one regime compared to each other.

Table 5 Probability of transition from one regime to another in the export model (Research findings)

	Regime 1	Regime 2
Regime 1	0.835940	0.164060
Regime 2	0.187752	0.812248

Table 6 The probability of transition from one regime to another in the import (Research findings)

	Regime 1	Regime 2
Regime 1	0.803132	0.196868
Regime 2	0.053143	0.946857

The probability of transition in the export from regime 1 to 2 is 0.16, and in the import is 0.19 The probability of transition from regime 2 to regime 1 in the export is 0.18 and in the import is 0.05, so regime 1 is more stable than regime 2 in the export, and regime one is more stable than regime 2 in the import.

Moreover ,in the export, the probability of staying in state 1 is 0.83 and 0.81 in state 2, In the import model, the probability of staying in state 1 is 0.80, and the probability of staying in state 2 is 0.94.Thus, as is shown in the table, export regimes 1 and 2 have relatively high stability with a probability of stability of 0.16 and 0.18, respectively. While in the import model, regimes 1 and 2 have relatively high stability with a probability of stability of 0.19 and 0.05, respectively.

Furthermore, in the export, the probability of transition from regime 1 to 2 is about 84% and the probability of transition from regime 2 to regime 1 is approximately 0.82%. First, the optimal model for agricultural exports MSMH (2)-AR (6) was estimated. However, in the import, the probability of transition from regime 1 to 2 is about 81%, and the probability of transition from regime2 to regime 1 is approximately 0.95%. Probability values show that regime 2 is relatively more stable than regime1. The optimal model for import MSMH (2)-AR (7) was finally selected.

Table 7 The results of the MS model parameters of MSMH (2)-AR (6) export (Research findings)

	Regime 1		
Probability	**Probability**	**Coefficient**	**Variable**
0.0028	0.52	1.56	LKOF
0.0000	0.04	0.66	LRER
0.0000	0.13	1.46	LRVAA
	Regime 2		
0.0035	0.68	2.01	LKOF
0.0000	0.03	0.75	LRER
0.0000	0.13	1.17	LRVAA
	Auto-regressive and common coefficients		
0.9887	0.18	0.002	AR (1)

0.0303	0.16	-0.36	AR (2)
0.0226	0.14	0.33	AR (3)
0.0047	0.10	-0.30	AR (4)
0.2140	0.11	-0.13	AR (5)
0.0012	0.12	-0.39	AR (6)
0.0000	0.15	-2.53	LOG (SIGMA)
	Variables affecting the probability of transition to regime change		
0.0297	0.74	1.62	P11-C
0.0564	0.76	-1.46	P21-C
-0.28			ACI
0.38			SC
-0.05			**Hannan-Quinn criteria**
5.16			**LR-Test**
8.29			**Normality test**

Table 8 The results of the MS model parameters in MSMH (2) -AR (7) import (Research findings)

	Regime 1		
Probability	**Probability**	**Coefficient**	**Variable**
0.0953	4.58	-7.64	LKOF
0.0061	0.53	-1.47	LRER
0.0001	1.26	4.84	LRVAA
	Regime 2		
0.0085	15.1	3.02	LKOF
0.0000	0.07	1.59	LRER
0.0002	0.29	1.11	LRVAA
	Auto-regressive and common coefficients		
0.0004	0.17	0.61	AR (1)
0.7470	0.25	-0.08	AR (2)
0.4144	0.21	-0.17	AR (3)
0.1454	0.16	-0.24	AR (4)
0.1973	0.09	-0.12	AR (5)
0.0502	0.09	0.19	AR (6)
0.0183	0.13	-0.31	AR (7)
0.0000	0.16	-2.22	LOG (SIGMA)
	Variables affecting the probability of transition to regime change		
0.2908	0.33	1.40	P11-C
0.0046	1.01	-2.88	P21-C
-0.05			ACI
0.66			SC
0.19			**Hannan-Quinn criteria**
34.88			**LR-Test**
1.34			**Normality test**

Examination of the estimated standard deviation in the two regimes in both estimates indicates that the variance of regime 2 is more significant than regime 1. The liberalization index in both regimes has a significant effect on exports. Accordingly, if the liberalization index on trade increases by one percent, in the end, exports in the first regime will be 1.56 percent, in the second regime 2.01 percent, and imports in the first regime 7.65 percent, and the second regime 3.02 percent.

In other words, a one percent reduction in export duties leads to a significant improvement in agricultural exports of about 1.56. In contrast, a one percent reduction in import duties makes agricultural exports about 2.01 percent worse. Meanwhile, a one percent increase in customs tariffs decreases imports by about 3.02 percent. In contrast, agricultural imports increased by about 7.65 percent with a one percent reduction in customs tariffs. The results of estimates in the first and second regimes indicate that implementing the trade liberalization policy in the period under review has had a positive effect on trade and foreign exchange. However, this effect is less in the second regime.

The benefit of the agricultural in both regimes and both models had a positive effect on exports and imports. With the increase of the benefit of the agricultural sector, exports and imports in each regime have improved. In other words, the decrease in imports would increase exports, improve productivity and ultimately lead to economic growth, so the results obtained in the two regimes 1 and 2 show a decrease in imports compared to exports.

The real effective exchange rate in both export and import models significantly affected these models, greater in exports in the second regime than in the first regime; however, the exchange rate in the first regime affects imports in the import model. With the increase of the exchange rate, the export of the agricultural sector in both regimes increased. With the decrease of the exchange rate, the import of the agricultural sector in the first regime improves, indicating that changes in the real exchange rate are influential factors in the end.

4.2. The Effects of Trade Liberalization on Agricultural Growth

Based on the agricultural growth model results, the value of the LR test statistic is equal to 19.2340; therefore, it is recommended to use the non-linear method instead of linear models. Thirty-seven observations have been estimated out of the total observations reviewed in the regimens. If the growth of the agricultural sector is transferred from regime one to regime two, it remains in this regime for an average of about 11 years. Table 9 shows these characteristics of the regime in the agricultural growth model.

Table 9 Characteristics of each of the regimes in the growth model (Research findings)

	Number of observations in each regime	**The possibility of being in the desired regime**	**The average period of being in the desired regime**
Regime 1	17	0.915598	11.84803
Regime 2	20	0.523954	2.100635

Table 10 The probability of transition from one regime to another in the growth (Research findings)

	Regime 1	**Regime 2**
Regime 1	0.915598	0.084402
Regime 2	0.476046	0.523954

Tables 10 illustrates that the probability of transition from regime 1 to regime is 0.08, and the probability of transition from regime 2 to regime 1 is 0.47. Thus, regime 1 is more stable than regime 2. Moreover, staying in state one is 0.91, and the probability of staying in state 2 is 0.052. Thus, regimes 1 and 2 have relatively high stability with a probability of 0.08 and

0.47, respectively. The probability of transition from regime 1 to regime is about 92% and approximately 53% from regime 2 to regime 1. Probability values show that regime 1 is more stable than regime 2.

According to the number of regimes, lags, and based on Akaike statistic, the model of 2 regimes with four lags, MSMH (2)-AR (4), was selected for the growth model of the agricultural sector. Estimating the parameters related to the model to extract business cycles affecting agricultural growth indicates that the study period is divided into two regimes of boom and bust, i.e., high agricultural growth and low agricultural growth. Thus, the first regime with an average growth of -32.93% shows a boom, and the second regime with an average growth of -29.44% during the bust period. The probabilities of transition of each regime to another regime are presented in Table 11.

Table 11 The results of MS model in MSMH (2)-AR (4) growth model (Research findings)

	Regime 1		
Probability	**Probability**	**Coefficient**	**Variable**
0.0050	0.70	1.98	LKOF
0.0059	0.05	-0.14	LRER
0.0388	0.18	-0.37	LRVAA
	Regime 2		
0.0021	2.33	7.20	LKOF
0.0000	0.08	-0.38	LRER
0.0032	0.68	-1.98	LRVAA
	Auto-regressive and common coefficients		
0.3359	0.153	-0.14	AR (1)
0.0000	0.151	-0.86	AR (2)
0.3575	0.144	-0.13	AR (3)
0.0000	0.146	-0.63	AR (4)
0.0000	0.147	-1.34	LOG (SIGMA)
	Variables affecting the probability of transition to regime change		
0.0016	0.75	2.38	P11-C
0.9370	1.21	-0.09	P21-C
1.54			ACI
2.11			SC
1.74			Hannan-Quinn criteria
19.23			LR-Test
10.69			Normality test

The Results of estimation coefficients show that the liberalization index in both regimes has a positive and significant effect on the growth of the agricultural sector. Accordingly, if the liberalization index increases by one percent, the agricultural growth in the first regime will increase by about 2% in the end, and the second regime by 7%.

The results of estimates in regimes 1 and 2 show that the implementation of trade liberalization policy in the period under review had a positive effect on the growth of the agricultural sector and the currency gain. This effect was more negligible in regime one and more in regime 2. In other words, with the application of Trade Liberalization in the entire agricultural sector and sub-tax sectors, government and monetary sector expenditures, the volume of production and net exports in the agricultural sector increases in both periods of increase and growth of the agricultural sector.

The real effective exchange rate in both regimes has a negative and significant effect on the agricultural sector's economic growth, denoting that the growth of the agricultural sector in both regimes decreases with the increase of the exchange rate. In other words, if the exchange rate change in a period is against the firm, it suffers, and the profit reduces.

The benefit rate of the agricultural sector in both regimes had a negative and significant effect on the growth of the agricultural sector, denoting that the growth of the agricultural sector in this regime decreases with the increase in the benefit rate of the agricultural sector.

5. Conclusion

Considering that in the studies that have been done so far on the effects of trade liberalization in Iran, it has been a linear method and pattern, but the results have not been very consistent with each other, and also in none of the domestic studies on trade liberalization from Threshold pattern with Markov switching model approach is not used as an alternative. Therefore, in this study, using the Markov Hamilton switching model and the optimal choice of the degree of autoregressive and Also, the number of optimal regimes for the Iranian economy, the effect of changing trade policies, especially trade liberalization by reducing the import tariff rate on agricultural products on trade and growth of this The section has been reviewed.

This study investigated the effects of trade liberalization on the trade and growth of agricultural products from 1978 to 2018. They were estimated using the wide-interruption self-distribution method and the Markov switching model. Data accessibility was the main limitation of the study.

The results showed that the KOF liberalization index variable had a statistically significant and positive effect on exports and growth and a statistically significant negative effect on the imports in the first regime. The benefit of agriculture in both regimes had a positive effect on exports and imports; i.e., the increase in the benefit resulted in the exports in both regimes. Proponents of the export development strategy believe that increased exports will improve productivity and ultimately increase economic growth. They also emphasized positive trade in which exports should outpace imports. Therefore, the results obtained in the import and export model of this research are consistent with the current theories in the field.

The real effective exchange rate in the export model in both regimes had a positive and statistically significant effect on exports, greater in the second regime than in the first. In the import model, the real effective exchange rate in both regimes had a significant effect on imports, but in the first regime, it had negative impacts on imports; i.e., based on the results obtained

and the positive effects of the exchange rate on agricultural exports in the first and second regimes.

Since the effect of the exchange rate increased in the first regime and then decreased in the second regime, it can be concluded that in this period, the case of the J curve is not proper in Iran. The result was consistent with the studies conducted by [36-38] but inconsistent with the research findings by [39]. The real effective exchange rate growth model in both regimes had a negative and significant effect on economic growth in the agricultural sector. This signifies less economic growth at the level of the economy as a whole. Accordingly, if the exchange rate fluctuations cause a decrease in the firm's profit in an agricultural enterprise, the decrease in production in agricultural enterprises leads to a decrease in economic growth in the agricultural sector.

Since the effects of reducing export restrictions on trade and economic growth are much greater than increasing import freedoms, it is recommended first to identify and remove export restrictions. Then, new restrictions will be adopted to increase the economic growth rate for trade freedoms in the consumer import sector.

The relationship between trade liberalization in the export sector and economic growth is positive, and the more trade freedoms in the export sector expand, and its restrictions are reduced, the greater the economic growth. Therefore, it is suggested that more freedoms and incentives are considered for exports to improve further economic growth.

According to the research results, increasing the exchange rate effectively reduces the trade deficit in the agricultural sector, but more successful implementation of such a policy requires the adoption of correct fiscal and monetary policies.

In the third to sixth development plans and vision document, there is much emphasis on trade liberalization in various economic sectors, so the adoption of tariff policies on trade liberalization should align with the program's goals.

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