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The role of Domestic and International Variables in the Resilience of Iran's Agricultural and Food Exports under Sanctions Condition

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ABSTRACT

The sanctions have Multilateral effects, but the first and most important effect is on foreign trade. Despite many studies in this field, the identification of the aggravating factors on international trade fluctuations was given less attention. The purpose of this paper is to measure and compare internal and external factors affecting the instability of Iran's agricultural and food products exports. Data was collected annually during the years 1992 to 2021. Ten countries, which were the destination of the most exports of Iran's agricultural products in recent years, were selected. Hodrick–Prescott filter was used to measure random fluctuations. Multiple panel regression was used to measure the factors affecting export fluctuations. Most of Iran's agricultural products are exported to neighboring countries. The results showed i) There is extreme instability in Iran's exports and ii) Iran's export instability is a dynamic and asymmetric process. Therefore, for reducing instability there need for continuous and accurate policies to reduce it. iii) The official exchange rate cannot control fluctuations. iv) supportive policies to increase agricultural production can affect unsustainability by increasing export potential.

KEYWORDS: Instability index, Hodrick–Prescott filter, Agriculture export, sanctions, Iran

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1. Introduction

The export-led growth hypothesis (ELGH) postulates that export expansion is one of the main determinants of growth. It holds that the overall growth of countries can be generated not only by increasing the amounts of labor and capital within the economy but also by expanding exports. Export development can lead to specialization and increase employment and productivity. In addition, the followers of the basic growth theory (ELGH) believe that economic growth provides the basis for the development of exports (Heidari and Saeedpour, 2012).

Blockade and sanction is a long old and historical method for surrendering a country with minimal bloodshed. It is considered a tool to pressure countries on each other without traditional war, which was later called one of the types of cold war. In this process, the sanctioning states (sender countries) try to increase life costs on the target countries. When world countries are out of self-sufficiency and trade between them becomes important, restricting trade causes pressure on the target country. In the far past, this sanction included limiting the community's access to food. Therefore, sanctions generally included cutting off access to water and food. After the industrial revolution, sanctions and the development of international trade, sanctions limited the access of target countries to goods and technologies. After the World War and the development of financial markets and currency exchanges, these markets were also subject to sanctions. Today, in a more integrated and globalized world, sanctions are imposed in various additional forms such as restrictions or bans on financial transactions, travel, and trade. Since different sectors and industries have many before and after relationships with each other, even targeted and focused sanctions on a product or service, through direct and indirect effects, influenced the whole of the target country's economy.

In international trade, economic sanctions include various restrictions on the import and export of goods and services (Hakimdavar, 2013, Shiffman and Jochum, 2011). Trade restrictions are supposed to bring an economic cost to the target country. This cost is expected to force the target country to change its behavior. However, trade restrictions may also harm the sanctions-sending country as they reduce the import of the target country from the sanctions-sending country. In addition, the target country may impose counter-sanctions to limit the trade of the sanctions-sending country as a response to the sanctions. The impact of trade restrictions differs depending on the level of trade openness. Countries with weak economic ties are less likely to be hit hard. Therefore, it is not surprising that trade restrictions appear to be ineffective in many cases (Dreger et al., 2016).

Some results of studies about the impact of sanctions on international trade and its fluctuations have shown that sanctions have poor effects. For example, Hufbauer, Schott, and Elliott (2007) found that only 34% of sanctions were partially successful, and even Pape (1998) reported 5% success. Drezner (2003) believed these results should be treated with caution because there are

some biases in these studies, as game theory indicates sanctions to be more efficient at the threat level than when they are imposed.

Several studies have been conducted to show the effect of sanctions and commercial policies impact on exports and their fluctuations. Jäkel et al. (2024) studied how different types of sanctions affect the export behavior of firms to the targeted countries. they examined firms' export behavior in 62 sanctioned countries, amounting to a total of 453 country years with sanctions over the period 2000–2015. they found that, on average, sanctions lead to a significant reduction in firms' destination market. also, they showed heterogeneity in the impacts of sanctions across (i) type and sanction packages, (ii) the objectives of sanctions, and (iii) countries subject to sanctions. Nguyen and Hung (2021) examine the impact of economic sanctions imposed by Western countries on exports of the Russian and the impact of the reaction policy by the Russian state. they gathered data from 49 trading partners in Russian from 2011 to 2018 and employed a gravity modeling approach. they found that (i) economic sanctions against and counter-sanctions from Russia led to declines in both aggregate export and import values. (ii) the effects of sanctions and counter-sanctions are not homogeneous among export and import products. the study results of Kim et al. (2023) showed that the sanctions, reduced the country's manufacturing output by 12.9% and real income by 15.3%. Adeli et al. (2020) investigated the factors affecting Iran's non-oil exports along with restrictions. In a descriptive examination, the structure of Iran's non-oil export was considered in terms of factor intensity of production and the technology level, and the impact of international sanctions was identified as the main export restriction on this structure. finally, the authors estimated the demand for and the supply of Iran's non-oil exports in the period 1987-2017. Their results show that Iran's non-oil exports have decreased as a result of the international sanctions despite the foreign exchange surge in 2012. According to the estimated coefficients in the function of demand for non-oil exports, the price of foreign goods and the revenues of other countries are some of the main factors affecting the demand for Iran's exports. The important point in estimating the demand function is that the coefficient of the dummy variable is different in estimating the impact of the sanctions such that this coefficient is negative and significant for Iran's total non-oil exports indicating the effectiveness of the sanctions in restricting Iran's non-oil exports. Iran's non-oil exports are mainly demand-oriented and some factors such as the world prices, revenues of other countries, and sanctions were more effective in restricting them than the supply factors such as investment or productivity.

Due to its strategic position in the region, and policies inconsistent with the new world order, Iran has always been the focus of Western countries, especially the United States. The first sanctions were imposed by the United States in November 1979 (Haidar, 2017), after capturing the American Embassy in Tehran by revolutionary and radical student students. These limitations were removed in January 1981 after the hostages were released. new sanctions were reimposed by the United States in 1987 because of Iran's actions from 1981 to 1987 against the U.S. and vessels of other countries in the Persian Gulf and support for regional radical groups. (Levs, 2012).

The third round of sanctions was imposed in 2006 due to nonstop the uranium enrichment program by Iran. In this round encompassed banking and insurance transactions, shipping, web-hosting services for commercial endeavors, and domain name registration services. In the following the US and EU, UN also have expanded sanctions against Iran.

After the discovery of oil in 1908 and then its nationalization and finally the increase in the price of oil, which caused rapid economic growth along with changes in the national economic structure and the lifestyle of the society, Iran's economy became highly dependent on international trade, especially oil exports. Today, Iran's agricultural sector is heavily dependent on foreign markets for investment, production, and technology, and to compensate for the domestic food deficit and the need for a market for the mass production of some products. Foreign sanctions rapid changes and sometimes wrong policies of domestic policymakers have caused the export of Iranian agricultural products to fluctuate. The fluctuations in exports itself discourage investors, producers, and exporters. It makes the business environment fully risky. Food security is been worrying. While sometimes statesmen say that sanctions do not have any effect on Iran's economy, somewhere the cause of the country's problems is attributed to sanctions. The purpose of this study is to assess the role and share of internal and external variables on export fluctuations. To achieve this goal, two questions have to be answered: Does the export of agricultural products in Iran fluctuate unpredictably by sanctions (the concept of resilience)? Which of the variables is more effective on the resilience of Iran's agricultural products exports?

2. Theoretical foundations

Resistance economy should be considered a new term that was added to the literature of the Iranian economy for the first time in 2010 by the leadership of the revolution. Since then, different inferences have been made from this term, in such a way that some have considered it as a closed and self-sufficient economy, while others have considered it as a resilient economy interacting with the global economy.

One of the main goals of a resilience economy is risk management, which according to many researchers, resilience is one of the most important issues to achieve this goal. In the dictionary, resilience implies elasticity, returnability, and resilience. In the psychology and physics context, this term is more meaningful. Resilient people can survive and even overcome adversity. Resilience can make a person triumphantly overcome unfortunate events and improve his social, academic, and professional competence despite being exposed to severe tensions (Ghasem and Hosseinchari 2012). In the issue of national resilience, economic-social subsystems, governance, technology and environment, and so on. It should be designed in such a way that it can absorb internal and external risks and adapt itself to the changing environment while maintaining the stability and functions of the system (World Economic Forum, 2013).

To know the resilience of one country, it is necessary to measure some indicators and compare them with other countries. In 2006, Briguglio et al (2006) proposed indicators for economic resilience. They showed that the vulnerability of an economy largely depends on whether the economy is open or closed. The initial suggested index was mainly based on the stability of per capita income. According to them, economic resilience in a country is one of the three aspects: avoiding, tolerating, and recovering the system against external shocks. In 2008, these people measured the level of economic resilience in a group of countries. In this study, Iran ranked 64th among 86 selected countries with a weighted index value of 0.514, which reveals the weakness of the country in this respect. The United States Agency for International Development (USAID), to calculate economic resilience, proposed indicators in the three axes of content analysis, factor analysis, and resilience analysis. In 2013, Jack Borman and et al. proposed a new index for resilience called Centennial. They use sub-indices of financial and monetary policy accuracy, government effectiveness, corporate governance, law, transparency, asset quality, capital base, income risk, export diversity, export independence, foreign power, private debt, and reserves to make their index. they used A total of 52 variables were used to make these sub-indices. Unlike the previous indices, the Centennial index has predictive power and is not merely retrospective.

3. Methodology

any time series variable has fluctuations. Certainly, every fluctuation can not be attributed to instability. It is necessary to separate predictable fluctuations such as trend, cycle, and seasonal changes from the total changes and consider the rest as an unpredictable part. In our study, this part shows the lack of resilience. The Hodrick–Prescott filter (HP) is a mathematical tool used in macroeconomics, to remove the cyclical component of a time series from raw data. The HP filter is a commonly used tool in macroeconomics used to extract a trend component from a time series.

The HP filter is a mathematical approach that is used in analyzing economic data to split the cyclical and trend components from a time series. This approach considers that a time series can be divided into a nonlinear growth or trend component. let series Y_t as the interest time series variable that is made up of a trend component τ_t , a cyclical component c_t , and an error component e_t , such that: $Y_t = \tau_t + c_t + e_t$

the solution of the following standard penalty program derives the trend from a time series by using the HP filter method:

$$\min_{\tau} \left(\sum_{t=1}^T (Y_t - \tau_t)^2 + \lambda \sum_{t=2}^{T-1} [(\tau_{t+1} - \tau_t) - (\tau_t - \tau_{t-1})]^2 \right)$$

where λ is the positive smoothing parameter. The HP filter decomposes two components for a time series: a stationary cycle and a long-term trend, which needs the previous description of the parameter λ , which sets the smoothness of the trend and determines the major period of the cycle

that will produce the filter. However, when it uses a similar λ for a series at various periodicities, the associated frequency with the cycle spectral peak will be acquired. As a result, cycles that are conflicting under the collecting of time will be created (Tchrakian et al., 2011).

Finally, the target of the first part of the minimization function is to find the minimum deviation of the trend component from the real-time series Y_t . The other part of the equation rectification us for having an irregular long-term growth component. This is weighed by the parameter λ , which the researchers should identify (Mohameda and Mohammedb, 2021). Due to the high accuracy of the filter quantities, easier software application, and quicker calculation time and mathematical insight, this filter is used to calculate the instability (lack of resilience) by subtracting the value of the filter numbers from the actual time series of export values.

To increase the degree of freedom and efficiency of the estimation, the data were arranged as a panel. Panel data analysis is a statistical method, that widely is applied in social science and econometrics for analyzing two-dimensional (Maddala, 2001). The data are usually collected over time and the cross-section and then a regression is run over these two dimensions.

Panel data analysis is a powerful tool for studying endogenous variables, and it comes with several advantages that make it an attractive option for researchers. Some of the advantages of panel data analysis are:

- I. Increased efficiency
- II. Controlling for unobserved heterogeneity
- III. Improved causal inference
- IV. Possibility of dynamic analysis

The ten countries that were the destination of the most exports of agricultural and food products of Iran in recent years were identified through the Islamic Republic of Iran Customs Administration (IRICA) website. These countries include UAE, Russian Federation, Germany, Iraq, Turkey, Hong Kong, India, Azerbaijan, Pakistan, and Kuwait. The information on Iran's export value during the years 1992 to 2021 was collected from this website.

After calculating the instability index of the agricultural export time series of Iran, the following multiple regression was used to measure the effective factors for the above index:

$$I_{it} = \gamma_0 + \gamma_1 I_{it-1}^+ + \gamma_2 I_{it-1}^- + \gamma_3 I_{it}^{ex} + \gamma_4 \text{percapiaGDP}_{it}^{\text{partneri}} + \gamma_5 \text{AGREXPOR}_{it}^{\text{IRAN2i}} + \gamma_6 \text{FoodImport}_{it}^{\text{Partneri}} + \varepsilon_{it}$$

Where I_t is instability index at t time, I_{it-1}^+ and I_{it-1}^- is plus and negative deviations from long run path of export in the previous period. $\text{percapiaGDP}_{it}^{\text{partneri}}$ is the per capita GDP of target countries of Iran's agricultural exports. $\text{FoodImport}_{it}^{\text{Partneri}}$ is the total food import of target countries (as market size). γ_i are unknown parameters that are estimated. In this model percapita GDP and FoodImport are external

variables and AGREXPORT and exchange rate fluctuation (I_{it}^{ex}) are internal variables. The lag of instability index was divided into two sections positive (+) and negative (-) to show the effects of the stickiness of the fluctuations separately from positive and negative.

4. Results

According to Table 1, the total export of Iran's agricultural products and foodstuff to these 10 countries during the 30 years under review was more than 78 billion dollars. Meanwhile, Iraq has been the largest export destination with a 37% share. After Iraq, the UAE was in second rank with a share of about 19%. These two countries included more than 56% of Iran's agricultural products export market. According to the coefficient of variation (CV), exports to the markets of India, Turkey, and Hong Kong have been the most volatile and the German market has been the least volatile between 10 countries. Also, exports to Germany, Turkey, Iraq, and UAE have not been stopped in any year.

Table 1. Descriptive statistics of 10 important countries for exporting agricultural and foodstuffs products of Iran

| Partner | Abbreviation | Average* | C.V.** | Min* | Max* |
|----------------------|--------------|----------|--------|------|---------|
| United Arab Emirates | AE | 484.56 | 54.06 | 2.75 | 1181.97 |
| Russian Federation | RU | 207.23 | 75.01 | 0.01 | 764.60 |
| Germany | DE | 174.70 | 55.51 | 0.34 | 487.65 |
| Iraq | IQ | 977.58 | 97.30 | 0.39 | 2614.32 |
| Turkey | TR | 139.11 | 104.83 | 0.38 | 712.19 |
| Hong Kong | HK | 161.92 | 105.55 | 0.00 | 581.95 |
| India | IN | 93.09 | 130.22 | 0.01 | 581.95 |
| Azerbaijan | AZ | 99.08 | 72.09 | 0.01 | 376.48 |
| Pakistan | PK | 136.83 | 99.59 | 0.07 | 428.86 |
| Kuwait | KW | 129.64 | 105.76 | 0.05 | 628.34 |

Source: <https://www.irica.gov.ir>

*Million USD

**Coefficient of variation

In figure 1, the actual values of Iran's exports to 10 selected countries and the long-run path values of this variable are drawn based on the Hodrick–Prescott filter. As stated in the research method, the difference between these two is deviations from the long-run path and indicates instability. In the comparison between 10 countries, the most instability is related to Iraq, UAE, and Kuwait. The lowest instability is related to Russia, Germany, and Hong Kong, which are relatively smaller markets for Iran's exports.

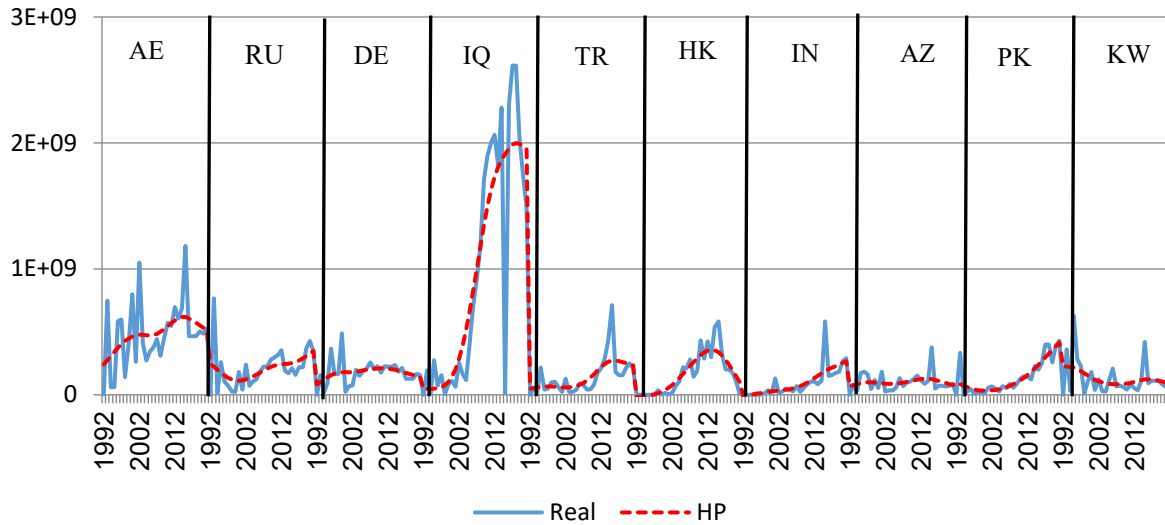


Figure 1. Real and filtered time series of Iran's exports to important destinations countries

The average growth of explanatory variables of the model by country is presented in Table 2. In this table, Iran's data has also been added to complete the comparison. The second column shows the average growth of the local currency unit (LCU) of the selected countries against the USD (official rate). The UAE dirham(AED) has seen the least change against the dollar in the last 30 years and its average value has decreased by only 0.1%. per year. Iran and Turkey experienced the greatest devaluation of their LCU.

From the theoretical point of view, economic growth is one of the attractiveness criteria of target markets. Countries with higher economic growth will be big markets in the future. The third column shows the average economic growth of 11 countries (10+1). The average economic growth of 11 countries is about 8.5%. The greatest economic growth is related to Iraq, which is the most important current market for the export of agricultural products in Iran. Certainly, maintaining this market in the future is one of the policymaker's and exporters' concerns. In addition to Iraq, Azerbaijan has also experienced double-digit growth. Iran ranks 6th in this respect. Although Germany has had the lowest economic growth, the size of its economy is not comparable to other selected countries.

For inferior and essential goods such as cereals, which are consumed by low-income people, a larger population indicates a more attractive market. Population growth shows the attractiveness of the market in the future. During the thirty years under study, Russia has had a negative growth. Due to the low economic growth in this country, it does not seem to be a suitable target market for exports; Nevertheless, the sanctions of other countries and Iran's good political relations with Russia, Today are one of the target markets for Iranian exporters. Food imports in these countries have grown by only 0.13% annually. This shows that market development in each country is

competitive. Iraq, Azerbaijan, Pakistan, and Iran have had the highest growth rates in the agricultural value add.

Table 2: The average growth of some macroeconomic-social variables of the studied countries

| Partner | Exchange rate | GDP | Population | Food Import | Agricultural Value Add |
|---------|---------------|--------|------------|-------------|------------------------|
| AE | 0.001 | 7.269 | 5.263 | -3.727 | 5.756 |
| RU | -5.783 | 4.772 | -0.12 | -1.066 | 2.454 |
| DE | 0.293 | 2.416 | 0.108 | -0.949 | 1.828 |
| IQ | -1.107 | 22.681 | 3.017 | 6.88 | 16.036 |
| TR | 28.008 | 5.828 | 1.421 | 0.265 | 2.26 |
| HK | 0.014 | 4.456 | 0.849 | -1.887 | -4.688 |
| IN | 3.68 | 8.627 | 1.525 | 1.008 | 6.883 |
| AZ | 19.043 | 18.03 | 1.1 | -0.522 | 12.121 |
| PK | 6.664 | 7.005 | 2.221 | -0.545 | 6.903 |
| KW | 0.098 | 6.305 | 3.38 | 0.757 | 5.881 |
| IR | 24.962 | 6.342 | 1.363 | 1.217 | 6.907 |

Source: www.worldbank.org

To avoid Spurious regression, the unit root test is necessary. The test results are presented in Table 3. Based on the results, the research panel data does not have a unit root.

Table3. Result of panel cointegration test

| Alternative hypothesis: common AR coefs. (within-dimension) | | | | |
|--|-----------|-------|-----------|-------|
| Statistic | Weighted | | | |
| | Statistic | Prob. | Statistic | Prob. |
| Panel PP-Statistic | -3.84 | 0.000 | -6.53 | 0.000 |
| Panel ADF-Statistic | -1.786 | 0.037 | -2.507 | 0.006 |
| Alternative hypothesis: individual AR coefs. (between-dimension) | | | | |
| | Statistic | Prob. | | |
| Group PP-Statistic | -9.265 | 0.000 | | |
| Group ADF-Statistic | -2.025 | 0.021 | | |

Source: Research Result

To measure whether the data is panel or pool, Limier's f-test, also known as Chaw test, is used. If the value of this statistic becomes significant, it can be concluded that there is no distinction between cross sections (here countries) and over time, and the economic behavior (here export fluctuations) is the same. In this research, the F-limer value is equal to 14.5, which is quite significant. It can be concluded that the behavior of Iran's export fluctuations is different in different countries.

Hausman's test is used to check the correlation between disturbance terms and explanatory variables. In fact, in the random effect model, the assumption (null hypothesis) is that there is no relationship between the explanatory variables and the random variable [$E(x_{it}u_{it}) = 0$]. If this hypothesis is accepted, the random effects method is more suitable than fixed effects and it is better to use the random effects method to estimate the model. But if the H_0 hypothesis is rejected, then the fixed effects model is used to obtain consistent estimates. In addition to the common Hausman test, the LM statistic can be used for this purpose. Table 4 shows the results of these tests. Based on all the tests, the null hypothesis is rejected and thus the model has fixed effects.

Table 4. Random and fixed effects tests

| Test | Statistic | d.f. | Prob. |
|---------------------------|-----------|---------|-------|
| Hausman Test | 22.156 | 6 | 0.001 |
| Cross-section F* | 2.465 | (9,271) | 0.01 |
| Cross-section Chi-square* | 22.582 | 9 | 0.007 |

Source: Research Result

* Likelihood Ratio

Table 5 shows the model estimation results. The coefficient of instability is significant (about 94% confidence). In other words, the instability of exports in one period affects the instability of the next period. But this effect is not the same in negative and positive deviations. The t-test showed that the effect of negative deviation has a greater effect on the instability of the next period ($t=1.9$). However, the signs of both are positive, which shows that a negative (positive) deviation from the long-run trend in one period causes a negative (positive) deviation in the next period.

Exchange rate volatility has not had a significant effect on export volatility. This result is contrary to most studies (such as Ali(2020), Kassouri and Altıntaş(2020, Ikenna, et al.(2023), de Azevedo et al.(2024) . . .) and in line with the study of Lyimo and Kimaro(2022). Multi-rate currency and variable currency policies during the 30 years studied can justify this unexpected result.

The per capita income of the target countries has not had a significant effect on the instability of Iran's agricultural products exports. In other words, there is no statistically significant difference in the size of instability between countries with different per capita income. The coefficient of the amount of export on its instability is full significant($P<0.01$). Based on this, instability arises in the countries where Iran exports is more. According to Iran's export destinations in the last 30 years, it can be concluded that instability is more in countries like the UAE and Iraq than in countries like Germany, India and Azerbaijan. This result was also observed in the interpretation of Table 1.

In some studies, there is showed that relationship between market size and volatility. Smaller markets are expected to be more volatile (such as Goda and Sánchez González, 2024). In this study, the existence of a relationship between the import volume of the destination country (market size) and the instability index has been rejected. This result can be caused by the low and fluctuating share of Iran's agricultural products and foodstuff exports in the total import market of the target countries.

Table 5. Result of estimation

| Variable | Coefficient | t-Statistic | Prob. |
|--------------------------------|-------------|-------------------|----------|
| INSTABILITY ⁻ (-1) | 0.299 | 3.769 | 0.000 |
| INSTABILITY ⁺ (-1) | 0.131 | 1.879 | 0.061 |
| Long-Run Trend of Exchang rate | -266 | -0.642 | 0.521 |
| Per capita GDP | -190.6 | -0.374 | 0.708 |
| Iran Agricultural Export | 0.127 | 5.77 | 0.000 |
| Food Import of Partner | 473959.4 | 0.321 | 0.748 |
| Intercept | 3.7E+07 | 1.874 | 0.06 |
| R-squared | 0.25 | Mean dep. Var. | 9E+07 |
| Adjusted R-squared | 0.24 | S.D. dep. Var. | 1.57E+08 |
| S.E. of regression | 1.37E+08 | RSS | 5.26E+18 |
| F-statistic | 15.75 | Prob(F-statistic) | 0.000 |

Source: Research Result

5. Conclusion

One of the characteristics of Iran's exports in general and agricultural products in particular is the presence of high fluctuations. The origin of these fluctuations can be internal (economic, commercial and currency policies), external (sanctions) or the result of both (exchange rate). The purpose of this study is to measure the role of each of these three variable groups. The research sample includes 10 countries that imported the most agricultural products and foodstuff from Iran. The time period was selected from 1992 to 2021. Hodrick-Prescott filter was used to measure the degree of instability. Panel data model was used to measure the effects of variables. The variables included the amount of exports by each country, the official exchange rate of the local currency unit(LCU) with the Iranian Rial, population, the total food imports of the target country and the gross domestic product(GDP) of the countries.

The results showed that export instability is a dynamic and asymmetric process. Therefore, for reducing instability there need for continuous and accurate policies to reduce it. The official exchange rate cannot control fluctuations. But supportive policies to increase agricultural production can affect unsustainability by increasing export potential.

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ETHICAL CONSIDERATION

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

CONFLICT OF INTEREST

Author/s confirmed no conflict of interest.