

Is Financial Development a Driver for Agricultural Export?

(Application of Wavelet Analysis on Iran's Data)

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Abstract

Agriculture is one of the sectors with a considerable share in the economy of countries. Due to the single-product nature of products and the imposition of oppressive international sanctions, the export of this sector is considered as one of the options for foreign exchange earnings. In this regard, evaluating the factors affecting export is of particular significance. Therefore, the present study aimed to investigate the relationship between financial development and agricultural sector export in the Iranian economy during 1979-2017. For this purpose, this study used two indicators of credits and the number of branches of Agricultural Bank as a representative of financial development. The results of using continuous wavelet transform and time-frequency analysis showed that financial development can only be associated with the increase of export through granting credits in the short term. In the long term, no significant relationship was found between the two variables as rooted in the policy-making and requirements of the Iranian economy. Significant policy implications were provided by analyzing the results.

Keywords: Financial development, export, continuous wavelet transform

1. Introduction

The Iranian economy depends on oil rental revenues and is considered as one of the most fundamental problems of the economy. In addition, it affects other sectors directly and indirectly since oil price fluctuations are reflected in the government budget and due to the large size of the government. Since oil is the main source of currency in the country, oppressive international sanctions block the country's currency path by restricting the sale of oil and achieving their goals. As a result, the economic growth, employment, and other variables, as well as economic and social determinants change in the opposite direction. Thus, abandoning the single-product economy is one of the current necessities of the Iranian economy. In this regard, the diversification of

foreign exchange earnings through other sectors of the economy becomes significant. The agricultural sector is one of these sectors. A strong and efficient agricultural sector enables countries to feed their growing population, create jobs, and provide the industrial raw materials by foreign exchange earnings. The vitality of the agricultural sector has an increasing effect on the economic, social and industrial structure of societies due to its multi-purpose nature (Salami et al., 2013). While strengthening the foreign trade, the export development of this sector can lead to increased production and positively affect the level of productivity by allocating the products which are exported. Thus, identifying the factors affecting the different dimensions of the agricultural sector such as export is of particular significance to the

Iranian economy. Due to the nature of the agricultural sector, the need for liquidity and the promotion of the financial system is highly sensitive in developing countries and has been introduced as the drivers of production in this sector. However, the role of these variables in the development of the agricultural sector export is vague. In the Iranian economy, the credits and financial dimensions related to the agricultural sector have been considered by governments and monetary authorities, while the share of export in this sector has not grown significantly and could not be considered as an essential source of currency. Accordingly, the present study aimed to evaluate the relationship between financial development and agricultural sector export in the short, medium, and long terms. Due to the shortcoming in traditional econometric methods to identify the dynamic relationship between variables, the present study used continuous wavelet transform to describe the relationship between the above-mentioned variables in the time-frequency horizon.

For this purpose, the credits granted to the agricultural sector and the number of branches of Agricultural Bank were used as the representatives of financial development. Based on the aforementioned content, the next section presents the review of the literature. Then, the methodology is briefly reviewed. In the following, the research results are explained with the help of the introduced tools. Finally, the conclusion and research and policy suggestions are presented.

2. Review of the literature

In this section, the theoretical foundations and studies related to the research subject are reviewed. The first section evaluates the theoretical links between financial development and export.

2.1. Theoretical foundations

Financial development has been introduced as the potential source of comparative advantage and its relationship with business has been developed theoretically. From this perspective, it is assumed that the countries with the desirable degree of financial development experience a large volume of international trade.

The theory of international trade suggests that the difference between countries in natural resources, technology, and economic benefits is the source of comparative advantage by which business models are formed. In addition to the traditional factors affecting the comparative advantage, financial development has recently been raised as a potential resource, which was raised in a study by Kletzer and Bardhan (1987) and Baldwin (1989). Based on these studies, the countries which are relatively developed in terms of finance have a comparative advantage in the industries and sectors of the economy which depend on out-of-firm financing. Accordingly, such countries experience a large volume of international trade.

There are different channels through which financial development can become a comparative advantage. For instance, liquidity constraint is considered as an important issue for most firms. Based on this argument, when the domestic financial institution is weak and inefficient, the firms in export-oriented sectors are significantly affected by liquidity constraints to prevent them from entering the foreign markets (Chaney, 2005). On the other hand, if firms face less restrictive credit constraints as a result of financial reforms, investment can increase in response to lower export costs and all of the companies which have a higher productivity than a certain level

become exporters (Melitz, 2003). Thus, the main prediction of theoretical studies is that financial development can promote production and trade.

The relationship between financial development and trade may be different according to the level of development in the financial sector so that the high level of financial development can provide the basis for entering the international market (Berthou, 2007). Beck (2007) believed that the relationship between financial development and international trade depends on the economies of scale. The sectors which have the economies of scale benefit more from financial development. The countries which are financially developed have a comparative advantage in the sectors with the economies of scale and are pure exporters. Finally, the relationship between financial development and international trade theoretically depends on the country's previous conditions such as economic, historical, cultural, and geographical characteristics (Apoteker and Crozet, 2003).

The financial sector was one of the sectors subject to government intervention in developed and developing countries until the 1980s. This was possible in different ways such as applying interest rate ceiling, restrictions on credit allocation, restrictions on the inflow and outflow of international capital, and limited funds in firms (Abiad et al., 2010). Thus, providing firms with better access to financial resources and better capacity to pay the cost of entering the field of production is associated with the increase of the number of firms and the value of export by the current companies (Susanto et al., 2011).

Some theoretical studies explained the relationship between financial development

and international trade in the early framework of the study by Kletzer and Bardhan (1987) and Baldwin (1989). Using the Heckscher-Ohlin framework, Kletzer and Bardhan (1987) and Baldwin (1989) compared the two models of international trade with similar internal factors and differences in foreign financing. They indicated that a country with less credit constraints is allocated to the part which uses foreign funds. A country with more credit limits finds a specialty in a sector where there is no need to working capital or foreign financing. Based on their analysis, the appropriate development of the financial sector can theoretically lead to a comparative advantage in the industries which are more dependent on external financial resources. Accordingly, they explain the variance of the structure of trade in countries. On the other hand, Baldwin (1989) indicated that the countries with developed financial markets will perform better in risk diversification due to their more diverse facilities. As a result, the above-mentioned countries specialize in the production of high-risk products at risk premium.

Based on the study by Kletzer and Bardhan (1987) and Baldwin (1989), Beck (2002) studied the relationship between financial development and trade theoretically and empirically. Beck's theoretical model indicates that the part of the economy with higher economies of scale benefits more from financial development. Accordingly, the countries with developed financial systems tend to specialize in the sectors of the economy with high economies of scale are due to comparative advantage. In his experimental section, Beck provided empirical evidence for his hypothesis by evaluating cross-sectional data. In another study, Beck (2003) explained the relationship between financial development and the

structure of trade and indicated that the countries with more developed financial systems have better export status and trade balance in the industries which require foreign financing. Overall, his study indicated that increasing the level of financial development has a positive effect on the value of export, which is more evident in the industries which have a higher level of dependence on foreign financing.

Svaleryd and Vlachos (2005) stated that economic factors have more savings in a developed financial system. As a result, the liquidity constraint for companies decreases and more financial resources are available. Feng and Lin (2013) believed that export-oriented firms encounter high fixed costs and are more dependent on external financing. Thus, if the financial development is not in a desirable condition and the financial status becomes severe, these firms will suffer more than the firms which focus on the domestic market. Korhan et al. (2015) argued that financial development may indicate a certain degree of comparative advantage at least for the industries which heavily depend on external financial resources. As a result, such industries have a greater share of exports and gain more profit from trade in the countries with high levels of financial development. Bilas et al. (2017) introduced another potential source for the relationship between financial development and export, according to which financial development leads to a reduction in export. Accordingly, the relationship between financial development and international trade is established through the relationship between debt-based financing and import. The sharp growth of domestic demand is met by foreign loans and the domestic currency is stimulated in line with imported products increase its domestic consumption in the direction of imported

goods due to increase in the value of domestic currency. Finally, this process is accompanied by the current account deficit. Thus, if the dependence of consumption of products in a country is high, the financial development of export decreases and import overcomes such a dependency.

Do and Levchenko (2004) stated that financial development can affect export under certain conditions. In other words, they describe the flow of causality from exports to financial development. As long as trade causes specialization in the products related to the financial sector, the financial system will improve. On the contrary, the financial system will be destroyed if trade increases the import of financially dependent products.

2.2. Previous studies

Susanto et al. (2011) studied the effect of financial development on trade in the agricultural and industrial sectors of 49 developing and developed countries. The results indicated that financial development had a positive effect on international trade in these sectors during 1980-1980 and the intensity of this effectiveness was reported more strongly in developing countries.

Evaluating the relationship between financial development, export of agricultural raw materials, degree of openness, and economic growth was the subject a study by Khan and Lodhi (2014). For this purpose, they used the data of the period 1980-1980 and the Vector Auto Regressive method. The obtained results indicated that agricultural export and financial development are bilaterally related, explaining that the effectiveness of financial development is weak. Sare et al. (2019) used panel data from 46 countries to indicate that financial development had a negative effect on international trade variables such as export during 1980-2016.

Using the Generalized Method of Moments, Caporale et al. (2020) evaluated the direct and indirect effects of financial development on international trade in Eastern and Central European countries. The results indicated that

3. Methodology¹

Wavelet analysis is considerably different from most of the conventional mathematical methods such as time-domain methods including correlation analysis and Granger causality, which is not able to recognize short-run and long-run relationships between time series, and frequency domain methods such as Fourier analysis, which fails to find how such relationships change over time. In addition, expanding time series into a time-frequency space is possible by which the local and casual relationship can be read off intuitively. Therefore, it is more appropriate for evaluating whether the relationship changes across frequencies over time simultaneously. Further, a wavelet analysis plays a significant profit over the well-known Fourier analysis, especially when the time series under work are locally stationary or non-stationary (Jiang et al, 2015).

Similar to the previous studies (Torrence and Compo, 1998 and Grinsted et al., 2004), our wavelet method includes multi-resolution analysis and feature extraction in which wavelets are defined as follows.

$$\psi_{u,s}(t) = \frac{1}{\sqrt{s}} \psi\left(\frac{t-u}{s}\right) \quad (1)$$

Wavelets are supposed be the square-integrable function, i.e. $\psi(\cdot) \in L^2(\mathbb{R})$. In Eq. (1), $1/\sqrt{s}$ indicates the normalization factor ensuring the unit variance of the wavelet, $\|\psi_{u,s}\|^2 = 1$. u is considered as the location parameter which can determine the exact

exports have a positive effect on financial development in the long term so that it is more severe for the agricultural sector than other sectors.

position of the wavelet, and s shows that the scale dilatation parameter of the wavelet and defines the way of stretching the wavelet. Accordingly, the higher scale refers to more stretched wavelet which is suitable for detecting lower frequencies.

The Morlet wavelet is considered as an analytic or complex wavelet within a Gaussian envelope with good time-frequency localization. Formally, the Morlet' wavelet is given as follows

$$\psi^M(t) = \frac{1}{\pi^{1/4}} e^{i\omega_0 t} e^{-t^2/2} \quad (2)$$

Where ω_0 indicates the central frequency of the wavelet. In addition, we set $\omega_0 = 6$ following Grinsted et al. (2004), Rua and Nunes (2009), and Barunik et al. (2011). This selection of value for ω_0 can create a good balance between time and frequency localizations. According to Agiar-Conraria et al. (2008), the Morlet wavelet is centered at the point $(0, \omega_0/2\pi)$ in the time-frequency domain. Further, they reported that almost exclusive uses of the discrete wavelet transform is considered as one feature of using wavelets to economics, which is difficult to understand since the same type of analysis may be done more easily and straightforwardly by applying the continuous wavelet transform. Following Rua and Nunes (2009), the continuous wavelet transform is as follows.

$$W_x(u, s) = \int_{-\infty}^{\infty} x(t) \frac{1}{\sqrt{s}} \overline{\psi\left(\frac{t-u}{s}\right)} dt \quad (3)$$

Specifically, $W_x(u, s)$ is calculated by projecting the specific wavelet $\psi(\cdot)$ on the selected time series. The ability of decomposing and then reconstructing the

¹ The contents of this section are adapted from the study of Seifi Khodashahri et al. (2021).

function $x(t) \in L^2(\mathbb{R})$ are considered as the main advantages of the continuous wavelet transform as follows.

$$x(t) = \frac{1}{c_\psi} \int_0^\infty \left[\int_{-\infty}^\infty W_x(u, s) \psi_{u,s}(t) du \right] \frac{ds}{s^2}, \quad s > 0 \tag{4}$$

It is worth noting that the energy preservation of the selected time series is regarded as the main feature of the wavelet transform, which is used for analyzing the power-spectrum which determines the variance as follows (Hathroubi and Aloui, 2016):

$$\|x\|^2 = \frac{1}{c_\psi} \int_0^\infty \left[\int_{-\infty}^\infty |W_x(u, s)|^2 du \right] \frac{ds}{s^2} \tag{5}$$

3.1.1. The wavelet coherence

Based on the Fourier spectral approaches, wavelet coherence (WTC) is defined as the ratio of the cross-spectrum to the product of the spectrum in each series and can be behave as the local relationship between two time series based on time and frequency. Accordingly, the wavelet coherence means the ratio of the cross-spectrum to the product of the spectrum in each series (Aguiar-Conraria et al., 2008). Thus, we define the WTC of two time series is defined as follows based on Torrence and Webster (1999):

$$R_t^2(s) = \frac{|S(s^{-1}W_{xy}(u,s))|^2}{S(s^{-1}|W_x(u,s)|^2)S(s^{-1}|W_y(u,s)|^2)} \tag{6}$$

Where S means a smoothing operator. Regarding the study of Aguiar-Conraria and Soares (2011a), the present study focused on the wavelet coherence instead of the wavelet cross spectrum since the wavelet coherence represents the advantage of normalization by the power spectrum of the two-time series (Tiwari et al, 2014).

3.1.2. The cross wavelet phase angle

Negative and positive correlations cannot be recognized because the wavelet squared coherence ranges between zero and one. The phase difference is used for solving this problem. The phase difference provides important information on the causal relationship by lead – lag interactions, the value of which for the two time series x and y is as follows:

$$\phi_{x,y} = \tan^{-1} \left(\frac{\Im \{W_n^{xy}\}}{\Re \{W_n^{xy}\}} \right), \text{with } \phi_{x,y} \in [-\pi, \pi] \tag{7}$$

Where \Im and \Re are considered as the imaginary and real parts of the smoothed cross-wavelet transform, respectively. In the present study, the values of $\phi_{x,y}$ are interpreted in terms of angular arrows. Fig.1 displays the phase difference analysis.

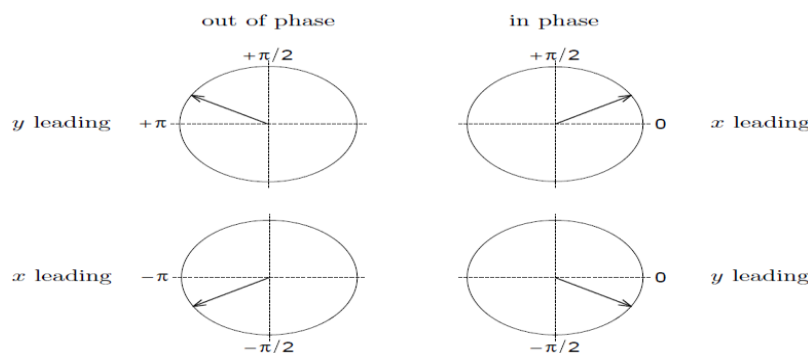


Figure 1. Phase-differences and their interpretation (Rösch and Schmidbauer,2016)

Based on a phase-difference of zero, the time-series move together at the specified

time – frequency. The series move in phase

if $\phi_{x,y} \in \left(0, \frac{\pi}{2}\right)$ However, the time series x leads to y . if $\phi_{x,y} \in \left(-\frac{\pi}{2}, 0\right)$, then it is y leading to a phase-difference of π (or $-\pi$) which indicates an anti-phase relation. y is leading if $\phi_{x,y} \in \left(\frac{\pi}{2}, \pi\right)$. Time series x is leading when $\phi_{x,y} \in \left(-\pi, -\frac{\pi}{2}\right)$ (Aguilar-Conraria and Soares, 2011b).

4. Results

4.1. Variables

In the present study, two variables were used as the indicators of financial development. The above-mentioned variables were the growth of credits granted by Agricultural Bank to this sector and the number of branches of Agricultural Bank. Based on the maximum available data, the time period for the above-mentioned variables was 1979-2017 and annual data 1985-2018, respectively. In addition, annual data in the above-mentioned periods were used for export. Table 1 presents the descriptive statistics of research variables.

Table 4. Descriptive statistics of research variables

	Agricultural credits growth	Branches of Agricultural Bank	Agricultural export growth
Mean	25.95	1411.94	11.42
Median	26.69	1812	7.55
Maximum	74.3	1927	110.43
Minimum	-29.41	306	-46.6
Standard deviation	19.61	636	32.24
Skewness	-0.07	-0.87	1.19
Kurtosis	3.88	1.94	5.18

As shown in Fig. 2 and 3, the horizontal axis of time and the vertical axis to the left represents the time scale in terms of years while the vertical axis to the right shows the wavelet correlation coefficient. By increasing the time scale, the analysis is conducted in the long term while it studies the fluctuations of the short term by decreasing the time scale.

The scale is considered 0-4 years for the short-term interpretation, the scale is 4-8 years for the medium-term interpretation, and the scale is more than eight years for the long-term interpretation. As the vertical axis on the right indicates, red shows the strength of the strong correlation and blue the slight correlation of the time series indicated in Figs. 2 and 3 at any given time and in each scale. In time series conversion, the random

values replace the actual values obtained from the conversion due to the oscillation of wavelet moments. This issue causes a skewed conversion error and is known as the edge effect, increasing with an increase in series conversion scale. The areas of the spectrum where the edge effect reaches the peak are called the core of influence. The results obtained from the time-scale analysis of wavelet transducers in the edge areas are unreliable and the results should be interpreted more carefully (Torrance and Campo, 1998). For this purpose, the interpretable spaces in Figs. 2 and 3 are limited by a thin black line in the form of parabola. In addition, only the areas which can be interpreted are surrounded by the bold black lines. The above-mentioned areas are the statistically reliable area of estimates at

95% significance intervals obtained using Monte Carlo simulations. The direction of the angled arrows shows the leading variable and can be interpreted as in Fig. 1. In this way, the results in the form of quasi-three-dimensional figures provide the analysis of time and frequency, as well as the intensity of correlation and present a comprehensive image of the structural changes of time series.

4.2. Wavelet analysis results

Using the wavelet coherence, the relationship between financial development and agricultural export growth is analyzed through the number of branches and credit growth.

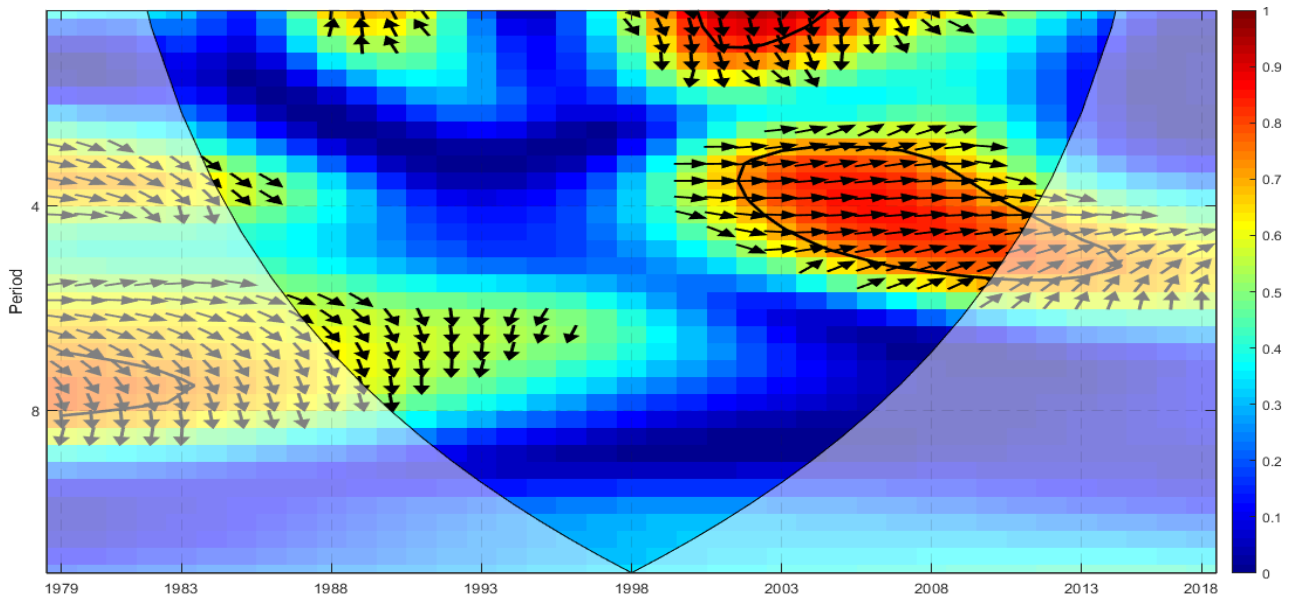


Fig. 2. Wavelet correlation space and phase difference between agricultural export growth and credit growth

Fig. 2 shows the relationship between credit growth and export growth at different horizons and over time. Credit growth had a significant effect on agricultural export within less than four years in the short term. This happened during the period 1999-2005. The causal relationship and the variable changed direction in the medium term. Thus, the flow of causality in the horizon of 4-8 years is from the growth of export to the growth of credits.

In the long term, there is no relationship between the two above-mentioned variables. Thus, if credits are used as the indicator of financial development, there is a bilateral causality relationship between agricultural export and financial development such that this relationship is positive and the improvement of financial development is accompanied with an increase in export and vice versa.

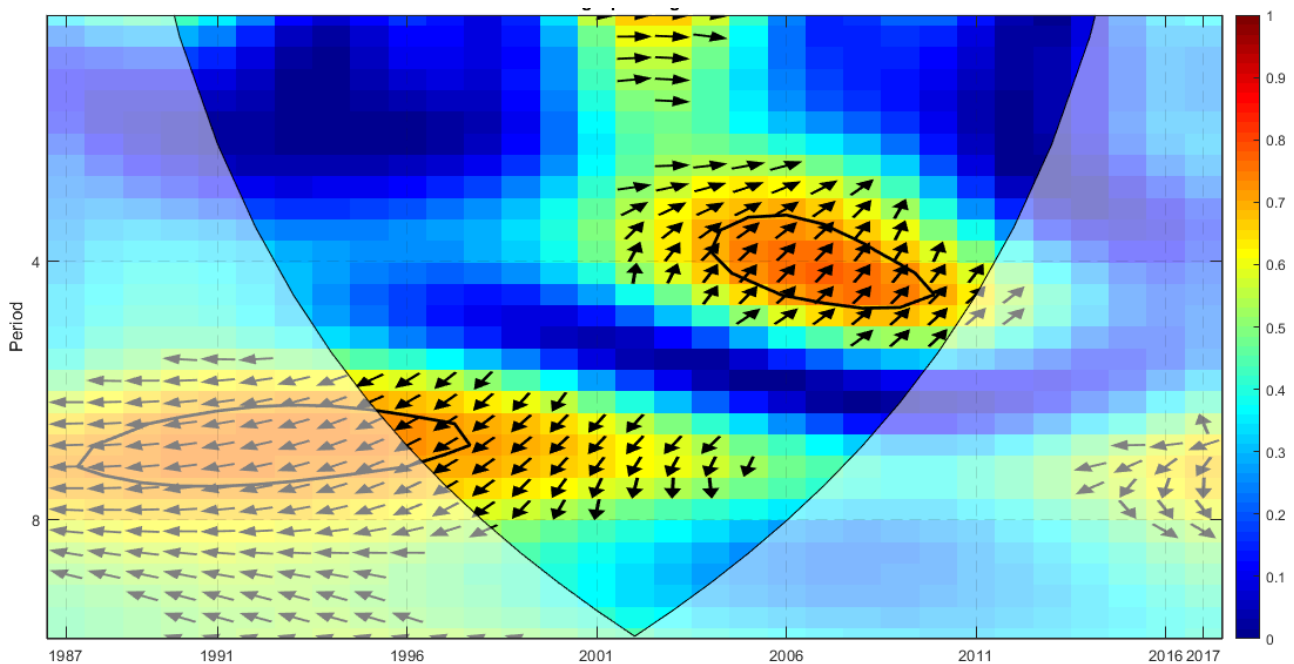


Fig. 3. Wavelet correlation space and phase difference between the agricultural export growth and the number of branches of Agricultural Bank

As displayed, the number of branches of Agricultural Bank has no effect on the export of this sector. The number of banks is affected by export growth in the short and medium terms. However, there is no relationship between the two variables in the long term. Analysis over time indicates that the number of branches has increased (decreased) during the period 2004 - 2010 with the increase (decrease) in export growth.

Considering what was raised in the theoretical foundations section, in the medium term, Do and Levchenko's hypothesis (2004) as the effect of financial development of export on the agricultural sector of Iran is true. In the short term, the main theories on the positive effect of financial development on exports are relevant in this area. No relationship was observed between financial development and agricultural sector export in Iran with both indicators in the long term, which may be related to several factors which have affected the structure of the Iranian economy. The restrictions imposed on international trade due to oppressive international sanctions, constant changes and regulations in the field of export

and its prevention to meet domestic needs, price controls, and suppression of production incentives, lack of competition for some types of agricultural products in the world level due to poor marketing and branding, drought and water shortage, etc.

5. Conclusion

Economic development is the central goal of non-developed countries and export is considered as the main fuel in this way. Foreign trade is a stimulus which drives the economies of these countries in the right way. The literature of economic studies confirms the role of export in promoting economic development and introduces international trade as one of the main sources of economic growth and foreign exchange earnings. In the meantime, the agricultural sector is highly significant for the Iranian economy. Thus, studying the issues related to the export of the agricultural sector reveals significant policy implications. The literature suggests that financial development is one of the issues which can pave the way for export. Thus, the present study aimed to investigate the

relationship between financial development and agricultural export in Iran. In this way, continuous wavelet transform was used for time-frequency domain analysis. The results indicated that an improvement in financial development can help and increase export using the credits granted to the agricultural sector. In the medium term, the status of financial development improves and vice versa with increasing export. However, there is no correlation between the two variables in the long term. Based on the results obtained due to the economic conditions in Iran, policy-makers are suggested to improve the performance of the agricultural sector, increase export, provide credits, and do not

consider the increase of credit as a necessary and sufficient condition for realizing this goal. In addition, it is necessary to avoid restrictive laws which prevent export for the sustainability of export and not to forbid the export of agricultural products in the face of cross-sectional price fluctuations. Another issue which has affected different sectors of the Iranian economy is the suppression of the exchange rate and the events indicated that it is not an appropriate nominal anchor for controlling inflation. In other words, the suppression of exchange rate is one of the factors which can reduce the competitiveness of export products, which is suggested to be revised.

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