# A comparative advantage analysis of fishing sector and its impact on Iran's economic development

## Amirnejad H.[1*]; Ahmadzade S.S.[1]; Esfanjari Kenari R.[2]

**Abstract**

The purpose of this study is to evaluate the value added of comparative advantage for fishing sector and its impact on economic development of different provinces in Iran between 2000-2014. At first, the comparative advantage of any province of country was calculated. Then, the effects of fishing comparative advantage on economic development were studied using the generalized Solow model. The model study is based on empirical analysis such as panel unit root tests, panel co-integration test panel and it's estimation of long-term relationships to help least-squares estimators modified (FMOLS). The results showed provinces of Hormozgan, Sistan and Baluchestan, Tehran, Guilan, Golestan and Mazandaran always had the comparative advantage during the study period. Also there was a co-integration long run relationship between variables that showed the value added of comparative advantage for fishing had a significant negative effect on economic development. So for every unit, increasing in comparative advantage of this sector, the economic development decreased 0.033%. This could be due to more important role other economic sectors than fishing sector on the economic development of the provinces and the lack of expertise of comparative advantage in fishing sector. Finally, suggestions were presented such as investment priority in the provinces where they have comparative advantage in the fishing sector and investigate the problems in the provinces that comparative advantage of them has decreased over time.

**Keywords**: The fishing sector, Economic development, Symmetrical revealed comparative advantage, Panel Co-integration, FMOLS

1-Department of Agricultural Economics, Sari Agricultural Science and Natural Resources University, Sari, Iran.

2-Department of Agricultural Economics, University of Guilan, Rasht, Iran.

*Corresponding author's Email: h.amirnejad@sanru.ac.ir; hamidamirnejad@yahoo.com

## Introduction

Agriculture and fishing share many production characteristic, both in terms of their potential to spur growth and employment, and they confront to institutional constraints in achieving this potential (UNCTAD, 2008; Brenton *et al.*, 2009; Golub and Varma, 2014). The agricultural sector provides food needs of the population and even the industry and also it used to produce goods in the other economic sectors. Fisheries sector is also one of sub-sector of agricultural that plays an effective role in the country's food needs. Aquatic animals as a source of human feed, have high protein and calories (11 to 24 %), digestibility of 69% and also omega-3 unsaturated fats. So they are very important to the diet of people in the world (Ghaffari *et al.*, 2014). The consumption growth rate in Iran from 40 years ago up to 2005, that states the 6.8% growth rate which starts from 0.5 Kg and approaches 6.9 Kg. but, in contrast, this rate for the world consumption is 1.2% which starts from 10.1 Kg and approaches 16.4 Kg (FAOSTAT, 2005). Although, fish per capita in Iran is lower than the international standard, but the growth rate of fish consuming has been improved during these past years based on the living conditions in Iran (Adeli *et al.*, 2011). According to the Ministry of Agriculture- Jahad, production of aquatics animals in 2014 was equal to 947.229 thousand tons and compared to 2013 increased at a rate of 7.04 percent. However, fisheries export in 2014 was 64.42 thousand tons valued at 204.27 million dollars and declined compared to 2013 at a rate of -12.92 (Ministry of Agricultural Jahad, 2014). Since Iran's marine resource trying to improve exports and per capita consumption of fish seems necessary in the country. Therefore, by identifying profitable products with high competitiveness can be improve the country's economic situation through more efficient allocation of resources. This goal is possible through the identification of comparative advantage. Comparative advantage refers to the ability to produce goods and services at a lower opportunity cost. If a country produces goods cheaper than any other goods it has comparative advantage in produce of that goods. Moreover, a country has comparative advantage in the export if it produces goods cheaper than other countries (Anviah Tekieh, 2007).

Comparative advantage is an important factor in business and it shows the profit of business and its path. Considering the comparative advantage of production activities is one of the most important aspects of economic planning (Noori, 2001). Of course, any comparative advantage is not permanent, so static may have change. But the process of this transition is gradual and can be maintained or strengthened with favorable policies (Azizi and Zibaei, 2000). So identification of the comparative advantages of each province provides the ways of better use from available resources and by achieve this will be accelerated development of the provinces and then country (Akbari *et al.*, 2008). Comparative advantage is often

confused with absolute advantage. Absolute advantage refers to an entity's ability to produce a good or service at a lower cost per unit than the cost at which any other entity produces that good or service. Under absolute advantage, one entity can produce more output of a good or service per unit of productive input as compared to other entity, but lack of comparative advantage (the determinant of specialization and trade) in the same good or service produced.

With comparative advantage, even if one producing entity has an absolute (dis) advantage in every type of output, it can benefit from specializing in and exporting those products in which it has a relative advantage (that is, a lower opportunity cost) and importing the goods in which it has a relative disadvantage (higher opportunity cost). What matters is not the absolute cost of production but the relative opportunity cost, which measures how much production of one good or service is reduced to produce one more unit of the other good or service. In sum, the concept of comparative advantage has two useful applications. First, it serves as a descriptive (or "positive") concept that provides "a basic explanation of the international pattern of specialization in production and trade". Second, it "plays an important role in prescriptive (or "normative") economics" by "providing guidelines for government policies on resource allocation and trade" (UNIDO, 1986). Thus, information on a country's comparative advantage in different activities is important for both commercial and policy decision making processes.

One of the ways for increasing fish consumption is more accessibility and easier to get it. So pay attention to the problems of fish production in cities that have a comparative advantage in this sector and resolving them is very important. Iran has aquatic animals' resources and these resources have important roles to supply national and currency resources and a part of society protein and also there is no review on the value added of fish and its effects on economic development currently. So this study had been done to help government decision-makers in identification which provinces have most potential for commercial aquaculture. Other implications of this study are the optimal use of production resources and planning appropriate and specialized for the export of fish and its products.

The most important methods to examine the relative regional advantage in different economic sectors are revealed comparative advantage index (RCA) or symmetric revealed comparative advantage index (SRCA), Domestic Resource Cost (DRC), Social Cost to Benefit (SCB), Net Social Profit (NSP) and Location Quotient (LQ). DRC index calculates the cost of foreign and domestic production factors used to produce a unit of commodity in terms of international prices. Each country has advantages in production of a commodity whenever domestic resource cost for that commodity is lower than shadow price of the currency. This index is highly

dependent on domestic resources. SCB index is a ratio of total costs to social benefits. This index can be used to rank products. In this way, the product has the first rank if have minimum of SCB. NSP index calculates the difference between shadow value of product and its real costs. A commodity has advantage if DRC and SCB indices are less than one, LQ index is greater than one and NSP index is greater than zero. LQ index defines the contribution of a particular activity from total activity of a region divided by the contribution of the same activity in the total activity in the national economy. Each of the above methods can be used to measure regional advantage. In this study revealed comparative advantage index (RCA) and symmetric revealed comparative advantage index has been used. The reason for choose this index is availability of information for value added in fishing sector and other information needed for this study.

Many studies are done about comparative advantages in the Iran and other countries. Suresh and Mathur (2016) analyzed the comparative advantage of India's exports, through revealed comparative advantage (RCA). The RCA was improving in case of cotton, maize, and certain fruits and vegetables over time, but declining in case of some spices, rice and wheat. Golub and Varma (2014) study the fishing exports and economic development of least developed countries. They state that monitoring fish stocks and superintendence of fishing need resources and capacities that most less developed countries,

lack. Thus, many of these countries do not have a good knowledge of local fish stocks and are unable to prevent illegal fishing. Also Domestic governments cannot generally control foreign ships operating offshores. Global assistance can play an important role for maritime fishing. Bashier and Siam (2014) studied Immigration and Economic Growth in Jordan by FMOLS Approach. The empirical findings showed that real capital and Domestic labor variables have positive and significant impacts on economic growth, while Guest workers variable has positive but insignificant impact on economic growth. Tavassoli *et al.* (2013) studied the comparative advantage of rapeseed in Sistan region in Iran. Nominal protection coefficient index of rapeseed showed that indirect tax has been imposed on producers. EPC index represented that there were nonsupport of input and output market in Sistan region. NSP index was positive in Sistan. Result supports this idea that Sistan has comparative advantage in rapeseed production. Chakraborty and Ghosh (2011) studied the relationship between financial development and economic growth empirically with panel data from five Asian countries by a FMOLS analysis. They found that the relationship between financial development and growth has been not affected much by the Asian crisis. Cai *et al.* (2009) examined the comparative advantage in aquaculture for developing countries. In this study were compared revealed comparative advantage export of shrimp and fishes such as carp, catfish

and tilapia. Jafari-Samimi *et al.* (2008) investigated the relationship between revealed comparative advantage of value-added agricultural sector and economic development of Khorasan province, Iran. Results showed that Khorasan province has enjoyed comparative advantage in agriculture during the period under consideration. Also there is a positive and significance relation between comparative advantage as well as economic development indices in agriculture sector. Also there are some study about comparative advantage such as XinHua (2009), Navarro *et al.* (2010), Akhtar *et al.* (2013), Rizwan-ul-Hassan (2013) and Solieman (2016). We can gain more fish per capita with accurate planning and qualifying the health level of the society and establishing new occupations by supporting the special researches (Adeli *et al.*, 2011).

*Methodology*
The first study about comparative advantage was done entitled "Common Market of Europe and the UK industry" by Liesner in 1958. Liesner index had flaws including exports of England compared with only one of the European countries, on the other hand this comparison studied on a particular commodity and other export goods or other industries of England was not considered. Therefore, this calculation did not show the relative contribution of England exports correctly (Yousefzadeh, 1999).

Balassa index has an advantage compared to Liesner index. Balassa index expresses export performance relative to total trade for a particular commodity (Balasa, 1965). Variation range of this index is between 0 to $\infty$. Numbers larger than 1 indicates the comparative advantage and numbers between 0 to 1 refers to lack of comparative advantage about production of desired product. Number 1 indicates that the "i" country is indifferent compared to total of countries in export of ''a'' commodity.

*Expanded Balassa index*
Walras (1991) developed the Balassa index to reflect global comparative advantage and includes all countries and commercial goods. This index is in the form of equation:

$$RCA_a^i = \frac{X_a^i / X_t^i}{X_a^w / X_t^w} \qquad (1)$$

i, t and w represents study country, all commercial goods and the world, respectively. The variables are defined as follows: $X_a^i$: Export value of ''a'' commodity in the ''i'' country, $X_t^i$: Total export value in the ''i'' country, $X_a^w$: Export value of ''a'' commodity in the world, $X_t^w$: Total export value in the world. To determine the comparative advantage of value added in fishing sector need to be created change in the index of revealed comparative advantage. Therefore, we used from value-added of fishing sector (a), province (p) and country (k) instead of export, country and world, respectively. So the value added of revealed comparative advantage for fishing sector in ''p'' province is:

$$RCA_a^p = \frac{VA_a^p \big/ GDP_t^p}{VA_a^k \big/ GDP_t^k} \qquad (2)$$

So VA and GDP show value-added of fishing sector and value-added of total economic sectors (GDP), respectively. Variation range of this index is between 0 to ∞. This index can be symmetrical using equation (3), (Brasili et al, 2000).

$$SRCA = \frac{RCA-1}{RCA+1} \qquad (3)$$

Therefore, it will change to the range of -1 to +1. So Positive values indicate the comparative advantage and negative values indicate the lack of comparative advantage.

*Panel data model*

One of the best methods to evaluation changes in individuals' behavior and control of the bias in calculations is panel data (Ruiz, 2004). The general form of this model is as follows:

$$y_{it} = \alpha + x'_{it}\beta + u_i + \varepsilon_{it} \qquad (4)$$

First we test unit root in the panel models to estimate of reliable regression coefficients. If one of the variables is not stationary, in the second step is examined the co-integration between variables. Usually researchers are useing Kao and Pedroni tests (Kao, 1999) to test panel data co-integration (Baltagi, 2005). The Pedroni `s method is considered to be heterogeneous between the individual components of the panel; therefore, it is more reliable than other existing methods. This test is almost similar to the Im *et al.* (2003) tests, with this regards that the Pedroni's Co-integration test considers different individual effects in cross-sectional dependencies. So this method has been used in this study.

Pedroni (2000) has offered 7 statistics including 4 tests for within groups and 3 tests for among groups. The first group checks the heterogeneity within the sectors and second group among the sectors (Alavi Rad and Kanvar, 2014):

$$1\text{-}\ Z_v = \left( \sum_{i=1}^{N} \sum_{i=1}^{T} \hat{L}_{1\,1i}^{-2} \hat{e}_{i,t-1}^2 \right)^{-1} \qquad (5)$$

$$2\text{-}\ Z_\rho = \left( \sum_{i=1}^{N} \sum_{i=1}^{T} \hat{L}_{1\,1i}^{-2} \hat{e}_{i,t-1}^2 \right)^{-1} \times \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{1\,1i} \left( \hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i \right) \qquad (6)$$

$$3\text{-}\ Z_{pp} = \left( \sigma^2 \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{1\,1i}^{-2} \hat{e}_{i,t-1}^2 \right)^{-1/2} \times \sum\sum \hat{L}_{1\,1i}^{-2} \left( \hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i \right) \qquad (7)$$

$$4\text{-}\ Z_t = \left( \hat{S}^{*2} \sum_{i=1}^{N} \sum_{i=1}^{T} \hat{L}_{1\,1i}^{-2} \hat{e}_{i,t-1}^{*2} \right)^{-1/2} \sum_{i=1}^{N} \sum_{i=1}^{T} \hat{L}_{1\,1i}^{-2} \hat{e}_{i,t-1}^* \Delta \hat{e}_{i,t}^* \qquad (8)$$

5- $\widetilde{Z}_{\rho} = \sum_{i=1}^{N} \left( \sum_{t=1}^{T} \hat{e}_{i,t-1}^2 \right)^{-1} \sum_{t=1}^{T} \left( \hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i \right)$          (9)

6- $\widetilde{Z}_{pp} = \sum_{i=1}^{N} \left( \hat{\sigma}^2 \sum \hat{e}_{i,t-1}^2 \right)^{-1/2} \sum_{t=1}^{T} \left( \hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i \right)$          (10)

7- $\widetilde{Z}_t = \sum_{i=1}^{N} \left( \sum_{t=1}^{T} \hat{S}_i^{-2} \hat{e}_{i,t-1}^{*2} \right)^{-1/2} \sum_{t=1}^{T} \left( \hat{e}_{i,t-1}^* \Delta \hat{e}_{i,t}^* \right)$          (11)

In the third step if there are co-integration relationship or a long-run equilibrium relationship among variables, the ordinary least squares method (FMOLS) is used in order to examine the co-integration vector and to estimate the economic model (Pedroni, 2000; Bashier and Siam, 2014). Other method is dynamic ordinary least squares (DOLS) that has been introduced by Stock and Watson (1993). We used the first method in this study.

FMOLS estimator corrects the dependent variable using the long-run covariance matrices and then applies simple OLS estimation method to the variables corrected for endogeneity (Chakraborty and Ghosh, 2011). In fact, the FMOLS takes into account the presence of the constant term and the possible correlation between the error term and the differences of the re-gressors. To adjust for these factors, nonparametric adjustments are made to the dependent variable and then to the estimated long-run parameters obtained from regressing the adjusted dependent variable on the regressors (Maeso-Fernandez *et al*., 2004).

Accordingly, the FMOLS long-run coefficient estimators are defined as:

$\hat{\beta}_i = \left( \sum_{t=1}^{T} x_{it}' x_{it} \right)^{-1} \sum_{t=1}^{T} \left( x_{it}' y_{it}^* - T\hat{\lambda}_i \right)$          (12)

Where $y_{it}^*$ the regressands are adjusted for the covariance between the error term and the $\Delta x_t$ and $T\hat{\lambda}_i$ is the adjustment for the presence of a constant term. The associated statistic for testing the significance of the parameters needs to be similarly adjusted. In the panel setting, the mean-group FMOLS long-run coefficients are obtained by averaging the group estimates over

$N : \hat{\beta}_{MG}^{FMOLS} = N^{-1} \sum_{i=1}^{N} \hat{\beta}_i$          (13)

and the corresponding t-statistic converges asymptotically to a standard normal distribution (Maeso-Fernandez *et al*., 2004):

$t_{MG}^{FMOLS} = N^{-1/2} \sum_{i=1}^{N} t_i \rightarrow N(0,1)$          (14)

To study the effective factors on economic growth is Solow model that modified by Levine and Renelt (1992) and Barro (1991). This model is showed in equation (6):

$g_{it} = \beta_{0t} + \beta_{1t} I_{it} + \beta_{2t} M_{it} + \beta_{3t} Z_{it} + U_{it}$          (15)

So the model used in this study will be in the form of equation:

$$\ln g_{it} = \beta_{0t} + \beta_{1t} PR_{it} + \beta_{2t} \ln CoB_{it} + \beta_{3t} \ln CuB_{it} + \beta_{4t} \ln SRCA_{it} + U_{it} \qquad (16)$$

Indices i and t show the province and time respectively. g: growth of GDP per capita in year for provinces (2000-2014), CoB: construction budget, CuB: current budget, PR: economic participation rate, SRCA: value added of symmetric revealed comparative advantage for fishing sector and U is error term.

Information needed for this study in the period 2000-2014 was taken from the Statistical Center of Iran and Islamic Parliament Research Center of the Islamic Republic of IRAN. To calculate the indices have been studied, the software Eviews 8 and Excel is used.

**Results**

The comparative advantage pattern for any country depends on many factors, like intrinsic and invariant such as geographic position, natural resources and climate while others can be changed or developed farming technology and human resources.

This study tries to develop a systematic framework for estimating comparative advantage of value added in fishing sector. The framework is based on one of the common approaches (RCA approach) used in economics for comparative advantage assessment.

Value of SRCA in fishing sector is showed in Table 1. Based on the results Bushehr, Sistan and Baluchestan, Guilan, Golestan, Mazandaran and Hormozgan provinces always has comparative advantage in the fishing sector during 2000-2013. In Bushehr and Hormozgan provinces in 2000, Hormozgan in 2001 and Hormozgan and Sistan-Baluchistan provinces in 2002 has been the most comparative advantage in the fishing sector. Sistan and Baluchestan Province is in the first rank. In addition, the highest advantage obtained in this province was in 2003 and 2013 equal to 0.91. These results confirmed the results of Pahlavani study in Sistan and Baluchestan (2017). Bushehr province has lost more than half of its comparative advantage and fell from first rank in 2000 to fifth rank in 2013. Comparative advantage of Golestan, Guilan, Mazandaran and Hormozgan provinces decreased to 0.45, 0.23, 0.12 and 0.09 during years' study, respectively. The Chaharmahal and Bakhtiari province from 2001 and the Lorestan province from 2002 had positive growth in comparative advantage and their comparative advantage increased 0.49 and 0.28, respectively in 2013. In recent years, Khuzestan, Tehran, Qom, Western Azarbaijan, Kermanshah and Kohkiluyeh-, Boyer Ahmad also gained comparative advantage in the fishing sector but the advantage gained was not desirable. According to the results we can say that comparative advantage is a continuous rating and may change from one province to another during the time.

**Table 1: Symmetric revealed comparative advantage index for the fishing sector in different provinces.**

| Provinces of the country | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Eastern Azarbaijan | -0.92 | -0.90 | -0.80 | -0.76 | -0.74 | -0.70 | -0.55 | -0.59 | -0.59 | -0.62 | -0.67 | -0.67 | -0.69 | -0.70 |
| Western Azarbaijan | 0.06 | -0.19 | -0.03 | -0.06 | -0.02 | -0.04 | 0.07 | 0.13 | 0.19 | 0.18 | 0.13 | 0.08 | 0.05 | -0.07 |
| Ardabil | -0.71 | -0.71 | -0.47 | -0.47 | -0.44 | -0.41 | -0.39 | -0.40 | -0.35 | -0.35 | -0.40 | -0.36 | -0.45 | -0.38 |
| Esfahan | -0.89 | -0.91 | -0.88 | -0.87 | -0.80 | -0.81 | -0.78 | -0.76 | -0.78 | -0.70 | -0.72 | -0.64 | -0.87 | -0.42 |
| Elam | -0.75 | -0.63 | -0.19 | -0.16 | -0.25 | -0.36 | -0.33 | -0.34 | -0.29 | -0.23 | -0.43 | -0.39 | -0.28 | -0.34 |
| Bushehr | 0.86 | 0.83 | 0.79 | 0.62 | 0.59 | 0.62 | 0.66 | 0.57 | 0.61 | 0.56 | 0.38 | 0.45 | 0.41 | 0.40 |
| Tehran | -0.87 | -0.88 | -0.82 | -0.87 | -0.87 | -0.88 | -0.93 | -0.92 | -0.91 | -0.93 | -0.95 | -0.88 | -0.83 | -0.83 |
| Chahar Mahal- Bakhtiari | -0.22 | 0.02 | 0.44 | 0.52 | 0.54 | 0.51 | 0.59 | 0.60 | 0.64 | 0.60 | 0.51 | 0.63 | 0.56 | 0.51 |
| Khorasan | -0.95 | -0.93 | -0.89 | -0.86 | -0.79 | -0.81 | -0.79 | -0.75 | -0.74 | -0.70 | -0.75 | -0.74 | -0.76 | -0.75 |
| Khuzestan | -0.14 | -0.07 | -0.08 | -0.12 | -0.19 | -0.14 | -0.22 | -0.10 | -0.01 | 0.00 | -0.08 | -0.10 | 0.05 | 0.01 |
| Zanjan | -0.73 | -0.71 | -0.61 | -0.67 | -0.55 | -0.46 | -0.45 | -0.31 | -0.29 | -0.24 | -0.13 | 0.13 | 0.05 | 0.09 |
| Semnan | -0.94 | -0.91 | -0.81 | -0.78 | -0.74 | -0.76 | -0.76 | -0.79 | -0.78 | -0.75 | -0.75 | -0.78 | -0.83 | -0.78 |
| Sistan and Baluchestan | 0.79 | 0.81 | 0.84 | 0.91 | 0.91 | 0.90 | 0.90 | 0.85 | 0.86 | 0.89 | 0.86 | 0.88 | 0.88 | 0.88 |
| Fars | -0.72 | -0.77 | -0.58 | -0.54 | -0.38 | -0.42 | -0.46 | -0.35 | -0.36 | -0.53 | -0.52 | -0.50 | -0.58 | -0.49 |
| Qazvin | -0.91 | -0.91 | -0.83 | -0.79 | -0.75 | -0.70 | -0.63 | -0.46 | -0.26 | -0.12 | -0.21 | -0.15 | -0.21 | -0.17 |
| Qom | -0.85 | -0.85 | -0.76 | -0.72 | -0.67 | -0.60 | -0.49 | -0.30 | -0.04 | 0.10 | -0.03 | 0.03 | -0.03 | 0.03 |
| Kurdistan | -0.54 | -0.49 | -0.35 | -0.31 | -0.18 | -0.23 | -0.28 | -0.19 | -0.06 | -0.11 | -0.23 | 0.00 | -0.03 | -0.11 |
| Kerman | -0.95 | -0.94 | -0.92 | -0.88 | -0.89 | -0.88 | -0.83 | -0.84 | -0.91 | -0.83 | -0.83 | -0.70 | -0.81 | -0.82 |
| Kermanshah | -0.86 | -0.86 | -0.75 | -0.67 | -0.61 | -0.57 | -0.51 | -0.32 | -0.08 | -0.08 | -0.11 | 0.06 | 0.11 | 0.07 |
| Kohgiluyeh Boyer Ahmad | -0.93 | -0.90 | -0.77 | -0.71 | -0.66 | -0.66 | -0.55 | -0.42 | -0.21 | -0.21 | -0.21 | -0.07 | 0.05 | 0.05 |
| Golestan | 0.72 | 0.74 | 0.65 | 0.51 | 0.60 | 0.57 | 0.57 | 0.56 | 0.40 | 0.43 | 0.38 | 0.38 | 0.34 | 0.27 |
| Guilan | 0.68 | 0.63 | 0.64 | 0.46 | 0.56 | 0.60 | 0.60 | 0.57 | 0.55 | 0.56 | 0.58 | 0.60 | 0.54 | 0.45 |
| Lorestan | -0.47 | -0.29 | 0.08 | 0.12 | 0.19 | 0.23 | 0.20 | 0.45 | 0.36 | 0.46 | 0.34 | 0.41 | 0.33 | 0.36 |
| Mazandaran | 0.53 | 0.52 | 0.50 | 0.49 | 0.49 | 0.51 | 0.56 | 0.64 | 0.55 | 0.52 | 0.48 | 0.52 | 0.48 | 0.44 |
| Markazi | -0.95 | -0.93 | -0.85 | -0.74 | -0.62 | -0.62 | -0.58 | -0.34 | -0.28 | -0.28 | -0.68 | -0.51 | -0.56 | -0.60 |
| Hormozgan | 0.86 | 0.85 | 0.84 | 0.83 | 0.80 | 0.84 | 0.85 | 0.85 | 0.82 | 0.81 | 0.80 | 0.75 | 0.73 | 0.74 |
| Hamedan | -0.83 | -0.82 | -0.66 | -0.58 | -0.58 | -0.58 | -0.58 | -0.37 | -0.36 | -0.26 | -0.34 | -0.29 | -0.25 | -0.26 |
| Yazd | -0.91 | -0.91 | -0.85 | -0.78 | -0.77 | -0.78 | -0.80 | -0.80 | -0.77 | -0.81 | -0.85 | -0.83 | -0.85 | -0.82 |

Source: Research founds

Results of stationary tests showed in Table 2. The tests used in this study include Levin *et al*. test (2002), Im *et al*. test (1997), Augmented Dickey-Fuller test (1981) and Phillips and Perron test (1988). The results showed that all variables were stationary except economic participation rate and GDP per capita in provinces that are integrated of order 1.

**Table 2: Unit root test results.**

| Test Method / Variables | PP-Fisher chi-square | ADF-Fisher chi-square | Im, Pesaran, Shin | Levin, lin Chu t* |
|---|---|---|---|---|
| gdp | 28.13 (0.99) | 39.29 (0.95) | 1.18 (0.88) | 1.13 (0.87) |
| Dgdp | 193.52 (0.00) | 88.40 (0.00) | -3.12 (0.00) | -2.41 (0.00) |
| PR | 58.84 (0.37) | 56.95 (0.43) | - | -1.55 (0.06) |
| dPR | 140.09 (0.00) | 148.48 (0.00) | -4.64 (0.00) | -4.79 (0.00) |
| CoB | 172.63 (0.00) | 115.69 (0.00) | -5.42 (0.00) | -9.92 (0.00) |
| CuB | 100.58 (0.00) | 85.87 (0.00) | -2.65 (0.00) | -7.13 (0.00) |
| SRCA | 93.53 (0.00) | 95.46 (0.00) | - | -5.79 (0.00) |

Source: Research founds

Due to the lack stationary of two variables were used Pedroni (1999) test to examine the co-integration because in this condition if there is a co-integration relationship between variables we can be trusted to long run relationship between variables.

Based on the Pedroni test results in Table 3 null hypothesis -based on lack of co-integration vector- is rejected and long run relationship between variables is confirmed.

**Table 3. Results of Pedroni co-integration test.**

| Statistical tests | Intergroup | Intergroup |
|---|---|---|
| | **Intercept and trend** | **Intercept & trend** |
| Panel v-Statistic | - | 74.46 (0.00) |
| Panel rho-Statistic | 7.41 (1.00) | 4.53 (1.00) |
| Panel PP-Statistic | -3.00 (0.00) | -3.45 (0.00) |
| Panel ADF-Statistic | 0.90 (0.81) | 1.32 (0.70) |

Source: Research founds

The results of co-integration test supported the existence of long-run equilibrium relationships among the model's variables. Since, the next step is to estimate the long run elasticities using FMOLS method (Table 4).

According to the results of equation 16, all variables were significant at different levels. The comparative advantage of value added in fishing sector had a negative effect on economic development and it is significant at the confidence level of 99%. Actually a 10% increase in the

relative advantage of the value added in fishing sector decreases GDP by 0.33%. Economic participation rate and the current budget variables had significant and positive impact on economic development at 5 % level and 10% increase in economic participation rate and current budget increase GDP per capita of provinces by 0.06% and 0.41%, respectively. Construction budget had positive and significant effect on economic development at 1% level.

**Table 4: Results of co-integration long run relationship by FMOLS method.**

| Variables | Coefficients | SD | t statistics | Possibility |
|---|---|---|---|---|
| PR | 0.006 | 0.002 | 2.48 | 0.01 |
| CoB | 0.030 | 0.018 | 1.67 | 0.09 |
| CuB | 0.041 | 0.019 | 2.16 | 0.03 |
| SRCA | -0.033 | 0.010 | -3.15 | 0.00 |

Source: Research founds

## Discussion

In this paper revealed comparative advantage in the fishing sector in 28

provinces and its impact on the economic development of each province was studied. According to the

results, Bushehr, Sistan and Baluchestan, Guilan, Golestan, Mazandaran and Hormozgan provinces had always comparative advantage in the fishing sector during study. But between these provinces only Sistan-Baluchistan province has been able to maintain its advantage in this sector and retain First place in the country from 2003. However, the comparative advantage of Bushehr, Hormozgan, Guilan, Golestan and Mazandaran decreased. Based on the results comparative advantage of value added in fishing sector had negative impact on economic development. So excessive use of fish resources in each province had inverse relationship with the development of the province. It is may be due to more important role of other economic sectors than fishing sector in the economic development of the provinces. On the other hand, due to the comparative advantage of fishing is not specialized in some provinces of the country. In order to specialize comparative advantages in this section can be offered suggestions such as investment priority in the provinces where they have comparative advantage in the fishing sector. Check out the problems in the provinces where comparative advantage has reduced through time, Raise awareness of people about outcomes of overfishing and strict enforcement of laws related to illegal fishing in illegal season, increase the release of fish larvae in the sea and increasing low-interest and easy facilities to increase fish production can improve the situation of comparative advantage to have a favorable effect on

the economic development of the provinces. Positive impact of participation rate on economic development of the province shows if the number of fishermen increase in the fishing sector has a positive effect on the economic growth in provinces. So is suggested government increase participation rates by capturing the unemployed and increase support of fishermen through motivate, increasing job security and provide modern facilities of fishing. A significant and positive impact of construction budget shows the importance of this variable in economic development and if it increases, it will play a greater role in development. Generally, the government can improve economic growth of provinces by investing more in physical infrastructure of the fishing sector. Also government can prevent from decrease of fishing activities in the provinces which have comparative advantage and maintaining the level of fishing activities by more allotment of current costs to this sector and even can improve it. Coefficients obtained from model estimation are small because the fishing sector's role is low in development of provinces but since there is necessary potential in the fishing sector in our country and according the positive coefficients obtained in this model, government must accurately assesses current capabilities and disadvantages and try to use the higher technology and prepares optimal exploitation in this sector.

A general principle of industrial policy, appropriate to the fishing

industry is that countries should be contribute to help the private sector, but focus on areas in which they have comparative advantage (Stiglitz *et al.*, 2013).

Government must also balance income and employment growth with sustainability of fishing. Although overfishing is an essential problem for developing countries, however under some conditions improving the efficiency of domestic industry can be complementary to sustainable resources use, for example by increasing capture of fish where stocks are not in danger of over-exploitation and increased value added through reduced losses and greater aquaculture.

## References

**Adeli, A., Hasangholipour, T., Hossaini, A., Salehi, H. and Shabanpour, B., 2011.** Status of fish consumption per capita of Tehran citizens. *Iranian Journal of Fisheries Sciences*, 10(**4**), 546-556.

**Akbari, N., Asari, A. and Mortazavi, S.A., 2008.** Determining comparative advantages export of agricultural products (Case Study: Isfahan Province). *Isfahan University Research Journal*, 31(**3**), 1-20.

**Akhtar, W., Akmal, N., Shah, H., Niazi A.M. and Tahir, A., 2013.** Export competitiveness of Pakistani horticultural products, Pakistan. *Journal of Agricultural Research*, 26(**2**), 87-96.

**Alavi Rad, A. and Connor, R., 2014.** effects of energy consumption on value added of economic sectors of agriculture, industry and services in Iran: an analysis based on panel cointegration approach. *Agricultural Economics Research*, 6(**3**), 1-19.

**Anviah Tekieh, L., 2007.** Comparing the comparative advantages of apple exports by major exporting countries of this product. *Agricultural Economics and Development,* 15(**58**), 177-203.

**Azizi, J. and Zibaei, M., 2000.** The determination of comparative advantage of Iran's rice; a case study of the provinces of Gilan, Mazandaran and Fars. *Agricultural Economics and Development*, 34, 71-96.

**Balassa, B., 1965**. Trade liberalization and revealed comparative advantage. *School of Economics and Social Studies, Manchester*, 33(**1**), 99-123.

**Baltagi, B.H., 2005.** Econometric analysis of panel data. Third Edition, Wiley Publisher. 366 P.

**Barro, R., 1991.** Economic growth in a cross-section of countries, quarterly. *Journal of Economics*, 106(**2**), 407-444.

**Bashier, A.A. and Siam, A.J., 2014.** Immigration and economic growth in Jordan: FMOLS approach. *International Journal of Humanities Social Sciences and Education*, 1(**9**), 85-92.

**Brasili, A., Epifani, P. and Helg, R., 2000.** On the dynamics of trade patterns. CEPRI, working paper, No. 115, Italy. 148(**2**), 233-257.

**Brenton, P., Newfarmer, R. and Walkenhorst, P., 2009.** Avenues for export diversification: Issues for low-income countries. *Commission*

*on Growth and Development Working Paper,* 47, 1-40.

**Cai, J., Leung, P. and Hishamunda, N., 2009.** Assessment of comparative advantage in aquaculture: framework and application on selected species in developing countries. FAO Fisheries and Aquaculture Technical Paper. No. 528. Rome, FAO. 2009. 73 P.

**Chakraborty, C. and Ghosh, S., 2011.** The relationship between financial development and economic growth and the Asian financial crisis: An FMOLS analysis. *International Journal of Economics Research*, 2(**3**), 88-101.

**Dickey, D. and W, Fuller., 1981.** Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica*, 49, 1057-1072.

**FAO Statistical Databases., 2005.** Agriculture, Fisheries, Forestry and Nutrition. https://shop. un. org/ books/ faostat,fao-statistical-data-27775.

**Ghaffari, T., Adeli., A., Ogagh, M. and Vahedi, M., 2014.** Examines the importance of fish consumption market in the country, First Conference on Mariculture, Challenges and Opportunities, Gorgan University of Agricultural Sciences and Natural Resources. 30 October and 1 November. Mariculture. pp. 1-11.

**Golub, S. and Varma, A., 2014**. Fishing exports and economic development of least developed countries: Bangladesh, Cambodia, Comoros, Sierra Leone and Uganda

Paper Prepared for UNCTAD, Swarthmore College. 67 P.

**Im, K.S., Pesaran, M.H. and Shin, Y., 1997.** Testing for unit roots in Heterogeneous panels. *Discussion Paper, University of Cambridge, Cambridge*, 115, 53-74.

**Im, K., Pesaran, M.H. and Shin, Y., 2003.** Testing for unit roots in Heterogeneous panels. *Journal of Econometrics*, 115(**1**), 53-74.

**Jafari-Samimi, A., Larimi, S.J. and Hosseini, S.M., 2008.** American-Eurasian. *Journal of Agricultural and Environmental Sciences,* 2(**1**), 113-117.

**Kao, C., 1999.** Spurious regression and residual-based tests for cointegration in panel data. *Journal of Econometrics*, 90, 44.

**Levine, R. and Renelt, D., 1992.** A sensitivity analysis of cross-country growth regressions. *The American Economic Review*, 82(**4**), 942-963.

**Levin, A., Lin, C. and Chu, C., 2002.** Unit root tests in panel data: Asymptotic and finite sample properties. *Journal of Econometrics*, 108, 1-24.

**Liesner, H.H., 1958.** The European common market and British industry. *Economic Journal*, 68(**270**), 302-16.

**Maeso-Fernandez, F., Osbat, C. and Schnatz, B., 2004.** Towards the estimation of equilibrium exchange rates for CEE acceding countries: Methodological issues and a panel cointegration perspective, *Working Paper Series*, 353, 1-49.

**Ministry of Jihad-e-Agriculture, 2014, Statistical Databases,**

Agriculture, Fisheries, **https://www.maj.ir.**

**Navarro, A., Losada, F., Ruzo, E. and Dı́ez, J., 2010.** Implications of perceived competitive advantages, adaptation of marketing tactics and export commitment on export performance. *Journal of World Business,* 45(**2010**), 49–58

**Noori, K., 2001.** The determination of production comparative advantage of the major groups of rice in Gilan and Mazandaran. *Agricultural Economics and Development*, 40(**1**), 25-46.

**Pahlavani, R., Ghahremanzadeh, M. and Dashti, G., 2017.** Dynamic comparative advantage analysis of rural and pastoral systems of small ruminant husbandry. *International Journal of Advanced and Applied Sciences,* 4(**11**), 81-87.

**Pedroni, P., 1999.** Critical values for cointegration tests in heterogeneous panels with multiple regressors. *Oxford Bulletin of Economics and Statistics*, 61, 653–670.

**Pedroni, P., 2000.** Fully modified OLS for Heterogeneous cointegrated panels, *Advances in Econometrics*, 15, 93-130.

**Phillips, P.C.B. and Perron. P., 1988.** Testing for Unit Roots in Time Series Regression, *Biometrika*, 75, 335-346.

**Rizwan-ul-Hassan, M., 2013.** An analysis of competitiveness of Pakistan's agricultural export commodities, IOSR. *Journal of Business and Management*, 11(**5**), 29-34.

**Ruiz, T., 2004.** Panel survey approach to measuring season ticket use, University of South Florida. *Journal of Public Transportation*, 7(**4**), 85-100.

**Solieman, N.Y., 2016**. The comparative advantages of meat production in the Arab world. *International Journal of Agricultural Science and Research*, 4(**1**), 75-80.

**Stiglitz, J., Lin, J., Monga, C. and Patel, E., 2013.** Industrial policy in the African context. World Bank Policy Research. 6633 P.

**Stock, J.H. and Watson, M.W., 1993.** A simple estimator of cointegrating vectors in higher- order integrated systems, *Econometrica*, 61(**4**), 783–820.

**Suresh, A. and Mathur, V.C., 2016.** Export of agricultural commodities from India: Performance and prospects. *Indian Journal of Agricultural Sciences,* 86(**7**), 876–83.

**Tavassoli, A., Mobasser, H.R. and Rastegaripour, F., 2013.** Applications of comparative advantage method case study: Rapeseed in Sistan region-Iran, *International Journal of Farming and Allied Sciences*, 2(**18**), 678-682.

**UNIDO, 1986.** International comparative advantage in manufacturing: Changing profiles of resources and trade. Publication Sales No. E86 II B9. Vienna, United Nations Industrial Development Organization. 86 P.

**UNCTAD, 2008.** Export competitiveness and development in LDCs: Policies, issues, and priorities

for least developed countries. pp. 1-78.

**Walras, T., 1991.** Trade liberalization and revealed comparative advantage. *School of Economics and Social Studies, Manchester*, 10(**3**), 99-127.

**XinHua, Y., 2009.** Comparative advantage analysis of shrimp production in Asia. *Aquaculture Asia Magazine*, 13(**1**), 33-41.

**Yousef Zadeh, K., 1999.** Determining comparative advantages industries in Iran, Master's thesis, University of Isfahan. pp.1-128.