

Survey of the Competitiveness of the Iranian Petrochemical Industry in the Threshold of Joining WTO: Selected Products

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Abstract

One of the specific aspects of our time is the existence of World Trade Organization as an important international center. This organization regulates the commercial laws among the countries, and tries to provide a suitable environment for trade by eliminating the subsidies using protection policies and making a better condition for competition. In order to achieve this objective, the economic sectors of countries should move towards the production of commodities which show the comparative advantages. In order to analyze the economic potential of Iran, those fields which have comparative advantage should be recognized.

One of the driving factors of comparative advantage for the Iranian petrochemical industry is oil and gas resources availability. In this research, the competitive capability, comparative advantage, as well as protection policies of selected petrochemical productions are analyzed by using Policy Analysis Matrix (PAM method).

Keywords: Comparative Advantage, Competitiveness, World Trade Organization, Selected Petrochemical Products, Iran.

1. INTRODUCTION

Since we can observe an improvement in the international trade and globalization, we have to find those industries in Iran which have the comparative advantage. In addition, Iran has been accepted as an observer of

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World Trade Organization and we should provide necessary conditions in order to join the WTO.

According to the theory of obtaining the production factors, one of the reasons of the trade among the countries is the difference among their production factors.

The notion of comparative advantage was introduced for the first time by Ricardo which still can be used effectively and it is one of the theoretical principles of the international trade. According to this theory, one country has comparative advantage in the production of one commodity in comparison to other countries, if the comparative cost of the labors in the production is lower than the other countries. The law of the comparative advantage states that a country on average imports those products which under the self-employment conditions are more expensive and exports those ones which are cheaper and have more quality. This theory has also been considered carefully and improved by some economists after Ricardo.

Considerable changes in the form of the life of human and their huge needs to the more products led into this fact that natural materials must be replaced by artificial ones. One of the industries which has a considerable role in this area is the petrochemical industry. One of the factors of the comparative advantage is the comparative enormity of the production factors. Since the supply of the petrochemical industry is the oily hydrocarbons and because of their huge availability in Iran we can expect a good comparative advantage of the export of the petrochemical products.

This industry emerged for the first time in Europe and then expanded even in the USA. in 1342. Iran opened it's first industry of petrochemical in Shiraz. Today 23 factories are dependent on the national petrochemical industry and they produce petrochemical products. Some of these sectors have been recently privatized.

Petrochemical complex of Arak which is run by a private sector, appeared in 1372 in the line of production. This complex has now a capacity of 1469000 tons in a year after it's development phase.

In this research we have used Policy Analysis Matrix (PAM method) which is one of the appropriate methods to calculate the different indexes of evaluation of the effects of liberalization of trade on industries and economical sectors. We consider the capacity of competitiveness of the petrochemical complex of Arak. In this method, the incomes and costs of a producer will be introduced in the form of a matrix of 3x4, we can analyze the policies of the government and find their effects on the productions of the producer. After expanding this matrix, the different indexes of

liberalization in economic sector should be categorized in three groups: the coefficient of protection, the indexes of comparative advantage and the indexes of the capacity of competitiveness of the costs. All of these will be obtained from this matrix and will be classified (Fang and Beghin, 2000).

2. INTRODUCTION TO POLICY ANALYSIS MATRIX

Policy Analysis Matrix is an analytical frame work which represented in 1981 by Monk and Pearson and completed by Masters and Winter – Nelson (1995). This matrix introduced a frame work that enables us to calculate the indexes of comparative advantage, the capacity of competition, protection coefficients. This matrix enables the researcher to analyze the policies of government and give some useful pieces of advice. The base of policy analysis matrix is profit and disadvantage which can be recognized by those people who work in the economic areas. Policy Analysis Matrix has 12 matrixes which is shown in Table 1.

Table 1: Policy Analysis Matrix

Base of Calculation	Incomes	Costs		Profit
		Tradable	Non-tradable elements	
Prices of market	A_i	B_{ij}	C_{jk}	D_i
Shadow Prices	E_i	F_{ij}	G_{jk}	H_i
Difference	I_i	J_{ij}	K_{jk}	L_i

Source: Masters and Winter – Nelson (1995)

The first row of matrix shows the incomes (A_i), the cost of tradable centers (B_i) and non-tradable centers (C_i) and domestic incomes (D_i). This profiting done with different technology and the polices of government help this process. The second row is the same with elements of the first matrix. Only calculations related to the incomes, costs and profit based on the shadow prices have shown here. If social profit gained from the row (H_i) is positive, it means that this industry has comparative advantage. The third row of this matrix obtained form subtracting the elements of the first and second rows.

$$I_i = A_i - E_i \quad (1)$$

I_i is the difference between the income of market and shadow income of production. The value of this matrix has three states:

$I_i > 0$; it has an indirect subsidy for the domestic producers.

$I_i < 0$; it means the price of market is lower than the shadow price and there is a tax on the producer.

$I_i = 0$; it is a neutral point where there is no financial policy.

Matrix J_{ij}

This matrix is the difference of tradable elements used in the production process based on the shadow and market prices:

$$J_{ij} = B_{ij} - F_{ij} \quad (2)$$

$J_{ij} > 0$; this means that domestic producers buy these things more than the international price, and it is like that it pays indirect tax.

$J_{ij} < 0$; it means that producer buy these things cheaper the international price, it is like that it receives the subsidy.

$J_{ij} = 0$; it is a neutral point and the taxes and subsidies have no effect.

Matrix K_{ik}

This matrix shows the difference between the costs of non-tradable factors for the productions in the shadow and market prices:

$$K_{ik} = C_{ik} - G_{ik} \quad (3)$$

$K_{ik} > 0$; it means the domestic price of these factors for the producers are more expensive than the shadow price, the production will be done by paying indirect tax.

$K_{ik} < 0$; it refers indirectly to paid subsidy to producer.

$K_{ik} = 0$; it is a neutral point.

Matrix L_i

This means the difference of calculated profit based on the shadow and market prices and shows the interference of government in the profit gained from the production:

$$L_i = D_i - H_i = I_i - (J_{ij} + K_{ik}) \quad (4)$$

The first expression includes two elements D_i and $H_i - D_i$ is the profit of business.

$$D_i = A_i - (C_{ij} + B_{ij}) \quad (5)$$

$D_i > 0$; in this case with the interference of government there is a market profit.

$D_i < 0$; the interference of government is harmful.

$D_i = 0$; it is a neutral point.

Matrix H_i shows the shadow income and shows the comparative advantage in the production.

$$H_i = E_i - (F_{ij} + G_{ij}) \quad (6)$$

$H_i > 0$; the production has comparative advantage and the activity in the free trade is profitable.

$H_i < 0$, this shows the system has no capability and has a negative effect on the national income in this condition producer faces with the loss from the activity of free trade. The matrix of L_i has these properties :

$L_i > 0$; in this condition the profit of market is more than the shadow profit. Also the policies of government are justifiable.

$L_i < 0$; in this case the shadow profit is more than the profit of market. It means the interference of government is harmful.

$L_i = 0$; the profits of market and the shadow market are equal and they are neutral.

3. MEASUREMENTS IN THE FRAMEWORK OF POLICY ANALYSIS MATRIX

By using the Policy Analysis Matrix, we can deal with different measurements of comparative advantages, social profits, protection coefficients, etc., which are explained here:

Domestic Resource Cost (*DRC*)

This index is a proxy for comparative advantage estimation, which is measured by:

$$DRC = \frac{G}{E - F} \quad (7)$$

$DRC < 1$; the producer has the comparative advantage.

$DRC > 1$; the producer has no comparative advantage.

$DRC = 1$; the producer has no profit and it is a neutral point.

Unit Costs (*UCs*)

It is an index of comparative advantage based on the unit cost. It is also the advantage of real competition ignoring all government supports and indirect taxes. UCs can be obtained through the following expression:

$$UCs = \frac{F + G}{E} \quad (8)$$

$UCs < 1$; the producer has comparative advantage in it's production.

$UCs > 1$; the producer has no comparative advantage in the production.

$UCs = 1$; it is a neutral point for the producer.

Net Social Profit (NSP)

This criterion calculates the income of production by using the shadow price:

$$NSP = E - (F + G) \quad (9)$$

$NSP > 0$; producer has social benefit.

$NSP < 0$, producer has social disadvantage.

$NSP = 0$, it is a neutral point for the producer.

Nominal Protection Coefficient (NPC)

This criterion measures the relation of market income to shadow income and its formula is:

$$NPC = \frac{A}{E} \quad (10)$$

$NPC > 1$; the price of production's market is more than shadow price, so the indirect subsidy is given to producer.

$NPC < 1$; the shadow price is more than the price of market, so the producer faced with indirect tax.

$NPC = 1$; there is no support for the production.

Nominal Protection Index Coefficient (NPIC)

This index shows the ratio of tradable elements to the production costs: of production:

$$NPIC = \frac{B}{F} \quad (11)$$

$NPIC > 1$; the costs of tradable products in market are more than those of the shadow costs. The producer pays indirect tax.

$NPIC < 1$; the costs of tradable products in market are lower than those of the shadow costs. Producer receives subsidy in this case.

$NPIC = 1$; there is no government support in this case.

Coefficient of Effective Support (*CES*)

This criterion calculates the surplus value from the production in the shadow price. In this calculation the surplus value is considered without considering the domestic factors. By calculating this coefficient, we can consider the effects of government intervention in the markets. This formula obtained by:

$$CES = \frac{A - B}{E - F} \quad (12)$$

$CES > 1$; the governmental policies support the process of production.

$CES < 1$; by using different polices the government makes the process of production harmful.

$CES = 1$; it means there is no government intervention.

Capacity of Domestic Competition (*UCd*)

The calculation of the relative index is obtained by this formula:

$$UCd = \frac{B + C}{A} \quad (13)$$

$UCd < 1$; the producer has the capacity of competition in domestic production.

$UCd > 1$; the producer has no capacity of competition in domestic market.

$UCd = 1$; the production is in a neutral state.

Capacity of Competition in Exports (*UCx*)

The relative index states that if the production of producers can be sold in international markets. This index calculated by:

$$UC_x = \frac{B + C}{E} \quad (14)$$

$UC_x < 1$; the producer has capacity of competition in international market.

$UC_x > 1$; the producer has no capacity of competition in international market.

$UC_x = 1$; the producer is in a neutral condition in international market.

4 . AN OVERVIEW ON THE POLICY ANALYSIS MATRIX OF ARAK PETROCHEMICAL COMPLEX

The necessary information for the Policy Analysis Matrix of the Arak Petrochemical Complex in Iran can be obtained from the reports of the prices of the company's productions and also from the other reports based on the data provided by the company itself. This matrix arises from the performance of this company in the first half of 2007. In order to calculate the shadow prices, we follow these steps:

- 1- Since 2002, due to exchange rate unification, there has no multiple rates in Iran, and the balanced foreign exchange rate has been the same as the official rate. The shadow foreign exchange rate is considered to be the same as the official exchange rate.
- 2- For the tradable shadow prices and the main products, we use the export prices from the Gulf of USA¹. We actually multiply the price by the shadow exchange rate in order to obtain the price in the Iranian currency (Londero and Cervini , 2003).
- 3- In order to calculate the shadow price of the natural gas, we use the export price to Turkey which is about 11 cents in per cubic meter². In order to calculate the shadow price of power we use the price of Turkey which is 10 cents for per kilo-watt.
- 4- Those non-tradable centers such as transportation, servicing, water and construction. Because of the complexity of calculating the shadow prices, we use domestic prices instead of shadow prices (Garivani, 2005).
- 5- In order to calculate the price of the shadow income, we use an adjusting coefficient (Garivani and Kalbasi, 2005). For this reason, some resources in the literature accept the coefficient value of 75% in regard to the real unemployment rate (25% of labor forces).
- 6- Machinery tools, equipments, constructions and so on can be assumed as the capital stock of the company. In order to calculate the opportunity cost of capital, we consider the whole value of the stocks of Arak Petrochemical complex, will be multiplied by the interest rate of capital. We need then obviously to calculate the shadow interest rate.
- 7- The shadow interest rate can be obtained by averaging the two data. First the rate of LIBOR³ (%3.9 in 2007) adjusted by the subtraction of the inflation rate of Iran⁴ (18%) and the average inflation rate of the of

¹ - www.icis.com

² - www.nigc.ir

³ - London Inter-Bank Offered Rate

⁴ - www.TSD.icb.ir

OECD (%2.7)¹, so that the first part of the shadow interest rate is about 19.2%. The next part is the sum of LIBOR and the rate of diminishing the value of domestic currency, totally 8.9%. The rates of %8.9 and %19.2 would be considered as the low and high limit of the shadow interest rate. The shadow interest rate equals to the average of the values of the low and high limit, and it is %14.05.

The computed Policy Analysis Matrix for the Petrochemical Complex of Arak is represented in Table 2. This matrix has been calculated according to these assumptions:

- 1) The sectors of power and gas have been considered as non-tradable sectors.
- 2) Opportunity cost of capital has been ignored.
- 3) The shadow foreign exchange rate based on Iranian currency was equal to 9281 Rials for 2007.

Table 2: Policy Analysis Matrix of Petrochemical Complex of Arak

Incomes	Costs		Profit	Basis of calculation
	Tradable Elements	Non-tradable Elements		
108400472500	885509218500	152167271900	46328234640	Prices of market
863563462200	736524144800	159271592100	-32232274700	Shadow prices
220441262800	148985073700	-7104320200	78560509300	Deviation

Numbers are in Rials.

Source: Authors

According to the table, incomes of Petrochemical Complex of Arak, based on domestic prices, are about 1.25 times more than the shadow incomes. In other words 25% of the firm's income has been obtained from the government support on its products. Accordingly, the costs of the tradable centers are more than those of the shadow centers. In addition, the costs of the non-tradable centers based on domestic prices are lower than those valued by shadow prices. In other words, the government has subsidized this company by a rate of 4.6%. The government actually give subsidy for the power and natural gas. The first column of the matrix reveals the rate of profit according to domestic and shadow prices, while the profit has been positive. It is profitable for the company to sell its products with domestic prices. The second column shows the rate of the profit of the

¹ - www.oecd.org

complex according to shadow price and its products, and it shows the social benefit. In other words in this complex we see a dissipation of the sources. Obviously the government supports the company. In fact the government policies are in the favor of the company and improve the capacity of competitiveness.

5 . THE INDEXES OF COMPARATIVE ADVANTAGE BASED ON THE PAM METHOD

In the form of PAM, we can obtain the comparative advantage and the capacity of competitiveness, in which figures are available in the Table 3.

Table 3:Indexes of comparative advantage based on PAM

Indexes of Comparative Advantage	Abbreviation	Value
The cost of internal sources	<i>DRC</i>	1.25
The cost of social benefit	<i>SCB</i>	1.03
The capacity of internal competition	<i>UCd</i>	0.96

Source: Authors

The index of *DRC* reveals the ratio of the domestic costs to the surplus value, which are all in the shadow costs. The index of domestic costs (due to Equation 7) calculated for Petrochemical Complex of Arak is 1.25, which shows no comparative advantage in this company. It means for the one unit of foreign exchange, 1.25 units of domestic sources will be charged.

The index of *SCB* (or *UCs*) calculated for the Petrochemical Complex of Arak is 1.03, indicating no comparative advantage in the products. It reveals the fact that the *SCB* value does not display a good sign of the company's competitiveness so that it is not fair for the WTO accession. By calculating *UCd*, we can determine the capacity of competitiveness of the company. According to Table 3, the value of *UCd* for the first half of year 2007 is 0.96, which shows that the company is able to compete well in the domestic market.

6 . THE COEFFICIENTS OF SUPPORT

The coefficients of supports show how much support has been done by government to protect the products of the company. Three indexes which are necessary for the calculation of these coefficients, include the coefficients of nominal support for the products (*NPCO*), the nominal support for the company (*NPCI*) and the rate of efficient support (*EPC*). The values of such coefficients for 2007 have been reported in Table 4.

Table 4: The Coefficients of Support in Arak

Coefficients of Support	Value
NPCO	1.25
NPCI	1.20
EPC	1.56

Source: Authors

NPCO shows the ratio of income based on the domestic prices to the income based on the shadow prices. The relative value for Petrochemical Complex of Arak is 1.25. In regard to this fact that this value is more than one, the domestic prices are more than the shadow prices, that is, products of the company has been supported by the government through indirect subsidy.

NPCI is the ratio of the costs of tradable products based on the domestic prices to the costs of tradable goods on the basis of shadow prices. This coefficient is 1.2, It means the prices of tradable products in terms of the domestic price exceed the shadow prices, implying the indirect tax is paid by the government.

The coefficient of effective support (*EPC*) is the ratio of surplus value arising from the production to the surplus value based on the shadow prices. By calculating this coefficient, we can analyze the effects of the government's intervention on the markets. This coefficient for the Arak Complex of Petrochemical 1.56, which shows the support of government is this context.

7 . POLICY ANALYSIS MATRIX FOR THE PETROCHEMICAL COMPLEX OF ARAK AND THE OPPORTUNITY COST OF CAPITAL

This matrix will be calculated considering the following assumptions:

- 1) The section of gas and power will be assumed as the non-tradable sections.
- 2) The rate of shadow gain in 2007 has been 14.05% which is more than the interest rate of about 12% in the same year.
- 3) The shadow foreign exchange rate has been 9281 Rials (Iranian currency).

According to Table 5, the results obtained for the columns of income and the tradable matrix are the same as those of the first section (without calculating the opportunity capital). For the domestic sections, by considering the opportunity cost of capital, the condition is different. Here the costs of

domestic centers would be lower than the costs of shadow ones. The reason relies on the high cost of capital with respect to the shadow prices. According to this matrix, the Petrochemical Complex of Arak by considering the opportunity capital that has lost its profit, the loses of benefit based on the domestic prices are lower than those losses based on the shadow prices.

Table 5: Policy Analysis Matrix Based on the Opportunity Cost of Capital in Arak Petrochemical Complex

Incomes	Costs		Profit	Basis of calculation
	Tradable elements	Non-tradable elements		
1084004725000	885509218500	315463271900	-116967765400	Prices of market
863563462200	736524144800	350463992100	-223424674700	Shadow prices
220441262800	148985073700	-35000720200	106456909300	Deviation

Numbers are in Rials.

Source: Authors

In addition, the results of the indexes of comparative advantage by calculating the opportunity cost of capital are reported in Table 6.

Table 6: Results of Comparative Advantages

Description	Index	Value
Indexes of Comparative Advantage	<i>DRC</i>	2.75
	<i>SCB</i>	1.26
	<i>UCd</i>	1.107
Coefficients of Support	<i>NPC0</i>	1.25
	<i>NPCI</i>	1.20
	<i>EPC</i>	1.56

Source: Authors

According to Table 6, these results can be obtained:

- 1- By considering the opportunity cost of capital, the index of *DRC* becomes 2.75, by which the cost of domestic sources for the one unit of foreign exchange rate is about 2.75. This means that the Petrochemical Complex of Arak has comparative advantage in their production.
- 2- The index of *SCB* is valued by 1.26, through which there is no comparative advantage in Petrochemical Complex of Arak. Because the costs of shadow factors exceed the relative revenues.
- 3- If the opportunity cost of capital presumed by the interest rate of %12, we can show that the index of *UCd* becomes 1.107. Since this value is more than one, the company cannot gain any benefit from domestic markets.

8 . CONCLUSION

This study showed that in the lack of opportunity cost of capital, the *DRC* calculated for Arak Petrochemical Complex was greater one which implied no comparative advantage in this center. Additionally, the index of *SCB* calculated for this company was greater than one which showed again no comparative advantage for the company's products. It is thus expected that this complex by joining WTO, has no capacity of competition with others. Also, the index of capacity of competition was computed less than one indicating no capacity of competition for the company in the domestic markets. The value of *NPCO* showed that the domestic prices of products exceeded the shadow prices, implying the indirect subsidy from the government could help this process. The value of *EPC* coefficient for the Arak Complex was greater than one which showed that the governmental policies supported its production process.

By considering the opportunity cost of capital, the calculated *DRC* and *SCB* were much greater than one which showed again no comparative advantage of the complex in the process of production. Calculated *UCd* for 2007, showed this company had no profit in the domestic markets, while it had no capacity of competition in domestic markets.

According to the empirical findings obtained by this research in order to promote the comparative advantage of the company through strengthening international competitiveness , a gradual fall in subsidies would provide the company with readiness of joining the WTO. Since about 25% of the revenues of the company come from the support of the government, the company should become more self-efficient in order to join WTO, focusing on efficient products in order to compete in the domestic and global markets. This company should use appropriate production and financing strategies in order to bring down the prices and by using advanced technology and educated labor to promote its efficiency in order to enhance the capacity of competition.

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