J Biochem Tech (2018) Special Issue (2): 188-198
ISSN: 0974-2328

Investigation of Hormozgan Gas Company's Productivity Status Aimed at Its Level Promotion

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Received: 05 Junuary 2018 / Received in revised form: 29 Jun 2018, Accepted: 06 July 2018, Published online: 05 September 2018

Abstract

Productivity has been very attractive for researchers and workmen since long time ago. Recently, a lot of papers and books have been written about its importance. There are different methods for evaluating and measuring productivity that can be used in different international, national, industry and organization level. This paper tried to compute the productivity index (workforce productivity, invest, material, energy and total factor productivity (TFP)) in Gas company of Hormozgan during organization activity. For computing total factor productivity index Cobb-Douglas production function is used. In addition to mathematical definition, productivity computations and data extraction method, the mathematical model of productivity fraction in economic growth of company and productivity promotion of total factors will be presented. The results showed: workforce productivity index follows an increasing process the main reason of which is experienced and skilled staff during time. Invest productivity index showed that per each invest unit almost one added value is created and material productivity index expresses that each computed material cost (direct material) is about 1.5 unit of added value. But energy production index has a lot of fluctuation and it descending process because of company development and organization activity development and energy consumption according to the number of areas. Total factor productivity index is increasing gradually and it is predicted to be continued in future. In general, attention to promoting income level of company through increasing productivity is a key solution for organization development.

Keywords: Total Factor Productivity (TFP), Workforce, Invest, Production Factors, Gas Company, Hormozgan

Introduction

Nowadays, according to constrain of different production factors, more productivity in different systems, increasing productivity is focused. E. Clagure (1948) considers high life level of American people as a direct result more productivity of American economic (Clague, 1952).

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What brings competition to organizations is productivity. Productivity means applying and combining resources available in organization. It is a criterion for evaluating functions and evaluates the relationship between inputs (what is used during production) with output or production or (what is received). Inputs are classified in different forms which are: machinery, material, tools, human resources, invest, field, energy, management, time, etc. outputs are volume or value of product produced by organization as good or service. It is obvious that according to resource constrains available, desirable application can be provided by productivity management system (Phusavat, 2013).

Productivity index is often used for evaluating progress and success in organization and determining strength and weak points. Analyzing index makes it clear the possibility and opportunity of productivity improvement. Productivity measurement helps to detect noneconomic activities of loss and waste and determine potential capacities and planning for optimal resource detection. Improving productivity is essential for organization work such as other software process embedded in its nature, so it have be improved and modified (Blanchard, 2008). Productivity improvement management needs serious intentions and operational works should be designed. Before designing, production pathology may cause suitable operation works to be designed with conditions and practical solutions can be used such as internalizing productivity in thought, saving internalizing, productive structure designing, human resource development, productivity research system design and operation management (Tabidian, 2015).

The main activity of national Gas Company of Hormozan has been started since 1388 and the legal office has been independent from Kerman Company and delivered to Bandar Abbas since 1389. In initial years after establishment, most of organization activity were in investment and infrastructure so the added value was negative for 2 first years and low for 1390. In present study, productivity index evaluated and analyzed for promoting income level of Gas Company in Hormozgan. So, the results related to workforce, invest, material, energy and total factor productivity computation has been computed for Hormzgan Gas Company and the reasons of changes and fluctuations were explained.

Literature

In order to promote productivity, a lot of studies have been carried out for evaluating and detecting factors effective on productivity

growth and relationship with macro-economic index. Here are some studies:

Van Ser Eng (2009) estimated the total factor productivity growth for 1970 to 2007 in Indonesia that fraction of invest was 70% and workforce was 34%. Also, total factor productivity growth was 40%. The researchers in this paper used Cobb-Douglas function for estimation and considers investment as the main reason of economic growth in Indonesia (Van Ser, 2009).

Jajri (2007) measured total factor productivity growth and effective factors on them during 1971-2004 in Malaysia. The results showed that Malaysia economic needs dealing with improving total factor productivity for achieving economic growth. Of other factors effective on total factor productivity can be named as education, economic structure, investment, demand, etc. (Jajri, 2007).

Claude Nachega & Fontaaine (2006) computed the total resources and total factor productivity determination in Nigeria for 1963 to 2003 using Cobb-Douglas function. The fraction of invest was 35% and physical invest fraction was 29.4% and total factor productivity was 70.6% (Claude et al., 2006).

Ullah Khan (2005) estimated total factor productivity for the first time in Pakistan and after that TFP using accounting framework since 1960 to 2003. The results showed that macroeconomic, direct foreign investment and financial development plays an important role in total factor productivity (Safdar et al., 2005)

Mehrara & Ahmadzadeh (2010) investigated the part of total factor productivity in developing workforce and invest in production of main parts of economic and non-oil economic during 1345 to 1383. The results showed that the mean fraction of total factor productivity in developing non-oil economic production during first, second and third plan were 39.5, 12.2 and 24.8, respectively. it is predicted that it will promote to be 32.6% in fourth plan. The estimated production function in this paper was Cobb-Douglas (Mehravar & Ahmadzade, 2010).

Khavari nezhad (2007) measured and evaluated total factor productivity in economic for 1375 to 1384. The mean TFP index in this study was estimated 0.6% (Khavarinezhad, 2007)

Azarmand (2006) computed the total factor productivity using Solo method and determined its fraction from impure production growth. The results showed that the part of total factor productivity from mean impure production was 1% during 1360 to 1380 and during the same period, the growth of other factors such as human and physical investment of impure production growth were 1.2 and 1.6%, respectively. The results of computations showed that total factor productivity had a lot of fluctuations during recent two decades (Azarmand, 2006)

Productivity index and its types

Productivity in general means the ratio of receives to data. In other words, productivity means the average of production per each unit of all units so that if the average increases, productivity increases and vice versa. According to the type of unit used in production process, the types of productivity index can be defined.

In general, productivity index is divided to two categories: micro and macro productivity. in micro productivity index, the relationship of received with a unit is considered but in macro productivity index, the relationship with all factors is considered (Moghadam, 2010)

a) Micro index of factor productivity

This index are estimated by dividing added value to a determined value and it is necessary for exiting inflation, the added value put on constant price of year. The most well-known micro productivity index are workforce and invest productivity. There are other index such as material and energy productivity index. In following, workforce and invest productivity index will be explained.

1. Workforce productivity index

For measuring workforce productivity in economic level, the ratio of added value to number of staff can be used. If in addition to number of staff, the information about the hours of job or payments is available, each information can be used for the number of staff and finally workforce productivity can be achieved more accurate (Moghadam, 2010).

Workforce productivity is the most common scale used for economic, industry or production unit. Of the reasons of this is the almost high cost of workforce in value of products and information available for workforce in comparison to statistic and information to other factors such as invest (Moghadam,2010).

The changes of workforce productivity is because of different reasons such as change of quality level of workforce using education, experience and skill, change of work condition, skill in management, etc. detecting the reason or reasons of change in workforce productivity is very important because it change be changed desirably (Moghadam, 2010).

2. Invest productivity index

For measuring invest productivity in a part of economic, the ration of added value to invest is used. It is usually computed but converting the added value and existing value of constant invest, from current prices to fixed prices of year and then it is resulted from dividing added value to invest. The main problem the most of developing countries have is lack of statistic related to invest. Mostly research institutes compute it using special definition and different models. PIM method is recommended by regional and international organizations. Using this method can compute fixed invest value and then invest productivity index. Invest includes the sum of investment during a period minus the loss of investments at the same period. PIM is a method for computing invest of the recommended method by United Nations. This method is for countries with better and more advanced statistic facilities. The method is based on which the loss of a identified good should be computed in a way that the sum of value of annual loss for useful years of goods is equal to purchase value of goods. For applying PIM, first impure constant invest in a long-term period should be

distinguished based on several investment goods. It is obvious that the more comparative the goods and more factual the estimation of goods lifetime, the more accurate the loss estimation (Moghadam, 2010).

In practice, investment goods including the capital of a country or different economic fractions are divided into machinery and construction (Moghadam, 2010).

The invest productivity changes can be carried out because of several reasons such as: technical advancement, the employment rate of workforce, technical advancement through introducing new and high-efficiency machinery and so on (Moghadam, 2010).

b) Total factor productivity (TFP):

Total factor productivity index (workforce, invest together) means the ratio of received to data. It fact it expresses the mean production per each unit of total production resources. The mentioned index expresses the total workforce and invest productivity conventions. The interior impure production growth in national level or added value in each economic parts can be carried out through two resources:

1. *Organization increase (workforce and invest)*
2. *Structure improvement (machinery, equipment, workforce quality improvement, management, etc.)*

It is worth to mention that in present situation that because of high competition among countries for achieving more part of global commerce, they attempt to provide the interior production growth or added value through improving structures. On the other hand, instead of increasing the number of human force, they attempt to increase the skill level of employees by performing specialized short-term educational plan or instead of creating new capacities, try to equip the existing capacities to the latest modern technology and produce high-quality products and increase their competitive potential (Moghadam, 2010).

The computations

1. Added value: the received value minus intermediate consumption value is called added value. Added value is the criterion of evaluating individual producers' engagement, industry or interior impure production.
2. Intermediate consumptions: intermediate consumptions are referred to total value of goods and service used, consumed or deformed as data in production process. Therefore, the fixed assets summited as fixed invest consumption cannot be investigated in intermediate consumption concept.
3. Output value: the sum of values of produced goods and service in an organization for supplying to outside of organization and the value of produced goods and service for consuming in the same organization is called output value. The total output value of an economic is achieved from output values of active organizations in an economic.
4. Compensation of employees: total payable cash or uncashed cost to employees for carried out job during an accounting period is called compensation. It includes salary, wage and other cash and uncashed advantages payable to employees, social insurance.
5. Workforce productivity: for computing workforce productivity, the ratio of added value on the number of workforce in the same period of time was computed by eviews software. (equation 1), where LP is workforce productivity, Va adjusted added value and L is the number of workforce.

$$LP = \frac{Va}{L} \qquad (1)$$

(equation 2) is acceptable for a level more than 99% for past years

$$LP = 156.8627 \times L \qquad (2)$$

6. Invest productivity: for computing invest productivity, the adjusted added value is divided on adjusted asset values. This relationship is demonstrated in equation 3 where LK is invest productivity, Va is adjusted added value and K is adjusted asset value.

$$KP = \frac{Va}{K} \qquad (3)$$

Equation 4 is the equation of workforce productivity estimation of company capital between 1391 and 1395 that expresses the little effect of capital growth on invest productivity (it has to be mentioned that equation 4 gives no accurate estimation because of few studied years and its demonstration is only for showing the dependence rate of two parameters to eachother).

$$KP = 2.3417 \times 10^{-6} \times K \qquad (4)$$

7. Material and energy productivity: material and energy productivity computation is the ratio of adjusted added value to cost of each adjusted energy and material and equations 5 and 6 show the relationships where MP and EP expresses the material and energy productivity, respectively and M and E are the costs of material and energy, respectively.

$$MP = \frac{Va}{M} \qquad (5)$$

$$EP = \frac{Va}{E} \qquad (6)$$

8. Total factor productivity (TFP): in order to compute TFP, Cobb-Douglas function is used as in equation 7:

$$Va = AL^{\alpha}K^{\beta} \qquad (7)$$

Where Va is adjusted added value, A is total factor productivity, L is active workforce and K is adjusted invest value (fixed asset value), α the fraction of workforce from added value and β is the fraction of invest factor from added value.

By logarithm at the basis of Nipper score from equation 7, the relationship will be as equation 8:

$$(Va) = (A) + \alpha(L) + \beta Ln(K) \qquad (8)$$

Where each parameters expresses the growth rate. Finally for computing total factor productivity rate, equation 9 is used:

$$(A) = (Va) - \alpha(L) - \beta Ln(K) \quad (9)$$

In this relationships the output is one according to the ratio of considered constant scale, the sum of α and β (equation 10 is the way of computing α and equation 11 is the way of computing β).

$$\alpha = \frac{compensation\ of\ employees}{Va} \quad (10)$$

$$\beta = 1 - \alpha \quad (11)$$

as in short term periods and since there is no particular change technologically or other events in studied industry, the actual fraction of work and invest is fixed. So the common method in computing the fraction of each production organization is to use the mean recent years.

9. Productivity growth in economic growth: this index is computed by dividing TFP on added value growth (equation 12)

$$\text{the productivity growth fraction from economic growth} = \frac{G(TFP)}{G(Va)} \quad (12)$$

Where G(TFP) is the total factor productivity growth and G(Va) is the added value growth.

10. The relationship between added value and productivity: after computing added value regression equation (Va) on total factor productivity (TFP), it is identified that the possibility of unacceptability for intercept is high (0.1589). So, the estimation of regression equation is without intercept that equation 13 shows it.

$$Va = 203.031/276 \times TFP \quad (13)$$

TFP coefficient in this equation shows the increase rate of added value for increasing a TFP unit in million rials during this period. In other words, for increasing a total factor productivity how much added value should be created that it used for predicting added value?

11. Purchase share and intermediate consumption in productivity: for computing TS and IC on total factor productivity the share of each item is computed on added value. Therefore, the sell share or intermediate consumption in each year is divided on its sum (sell plus intermediate consumption) (equations 14 and 15).

$$TS\ percent\ in\ added\ value = \frac{TS}{TS+IC} \times 100 \quad (14)$$

$$IC\ percent\ in\ added\ value = \frac{IC}{TS+IC} \times 100 \quad (15)$$

The main aim of estimating equation 16 and 17 is to achieve the total share of sell and intermediate consumption in added value computation (and productivity). However, equation 16 expresses that based on past, per each unit of total sell how much added value is created. Also, equation 17 shows the added value created per each unit of intermediate consumption as past.

$$Va = 0.591839 \times TS \quad (16)$$

$$Va = 1.434185 \times IC \quad (17)$$

Equation 18 is obtained by sum of equation 16 and 17.

$$2 \times Va = 0.591839 \times TS + 1.434185 \times IC \quad (18)$$

By dividing two sides on 2 the equation 19 is obtained

$$Av = 0.295919 \times TS + 0.717092 \times IC \quad (19)$$

12. Prediction of productivity index: in this part workforce productivity, invest, and total factor productivity values are predicted based on predicting Gas sell measure and year in 1396, 1397 and 1400. For this reason the regression equation of each productivity equation is computed on gas sell measure and the year using data of 1392 to 1395.

Equation 20 and 21 are the workforce productivity regression equation base on sell measure and year, respectively.

$$LP = -6813.810 + 3.138 \times SM \quad (20)$$

$$LP = -2702550.8 + 1945.3 \times Y \quad (21)$$

Invest productivity regression equation on sell measure and year are demonstrated in equations 22 and 23

$$KP = 2/042 \times 10^{-4} \times SM \quad (22)$$

$$KP = 7/149 \times 10^{-4} \times Y \quad (23)$$

Equations 24 and 25 are total factor regression on sell measure and year, respectively table 183 shows the prediction of total factor productivity using these equations for 1396, 1397 and 1400.

$$TFP = 4/204 \times 10^{-4} \times SM \quad (24)$$

$$TFP = 1/467 \times 10^{-3} \times Y \quad (25)$$

Methodology

For computing productivity index in different parts in Gas company of Hormozgan, the prices are based on price index of 1390 (base year) to eliminate the inflation effects from computations. Also, according to the activity start since 1388, the adjusted added value was negative in initial years so the productivity index in these years are negative. Then by continuing the activity of company this number became positive and it is always increasing. Table 1 and figure 1 demonstrate the adjusted added value of company during 1388 and 1395.

Table 1: output value, intermediate consumption, adjusted rates and added value (million rials)

1395	1394	1393	1392	1391	1390	1389	1388	Year
1.884.1 55	1.436.2 04	972.3 83	506.1 95	491.8 91	505.1 98	3.627.4 87	126.2 10	Output value
194/6	177/7	158/3	135/7	112/9	100	84/6	78/8	Adjusted index
968.219	808.218	614.2 66	373.0 25	435.6 87	505.1 98	4.287.8 10	160.1 65	Adjusted output value
1.090.5 56	812.277	536.5 00	285.6 34	274.4 54	484.6 05	3.658.0 58	125.1 57	Intermedi ate consumpti on
264/2	246/9	226/2	201/2	141/8	100	78/5	68/9	Adjusted index
412.777	328.990	237.1 80	141.9 65	193.5 50	484.6 05	4.659.9 46	181.6 50	Adjusted intermedi ate consumpti on
555.443	479.228	377.0 87	231.0 60	242.1 37	20.59 3	372.136 -	21.48 -5	Added value

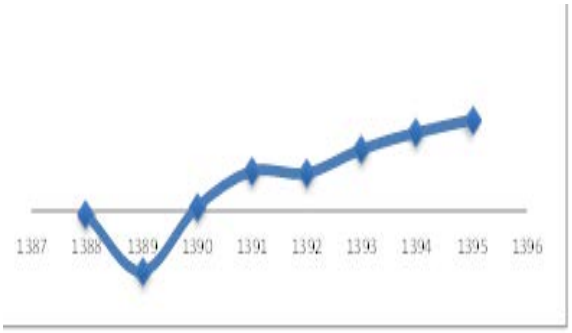

Figure 1: adjusted added value (million rial)

Results

1. Workforce productivity

Table 2. Workforce productivity during organization activity

Workforce productivity growth prcent	Workforce productivity	Added value growth percent	Adjusted added value	Workforce growth percent	Mean number of workforce	year
-	-2.149	-	-21.485	-	10	1388
1.183/00	-27.556	1.632/07	-372.136	35	13/5	1389
-103/47	958	-105/53	20.593	59/26	21/5	1390
612/13	6.821	1.075/82	242.137	65/12	35/5	1391
-30/15	4.764	-4/57	231.060	36/62	48/5	1392
63/20	7.775	63/20	377.087	0	48/5	1393
25/79	9.780	27/09	479.228	1/03	49	1394
8/18	10.850	15/90	555.443	7/14	52/5	1395

According to the few studied years (young organization), the workforce productivity linear equation on workforce cannot be estimated with a good accurate. However, the estimated equation shows a direct relationship between workforce and productivity increasing which is acceptable in a level more than 99% for past years.

The important point here is that micro productivity index cannot be achieved by increasing a factor. This estimation is just for showing the direction of workforce changes with productivity. The most important reasons are skill and experience increase of staff during time.

2. Capital productivity

As it can be observed after the initial years of company establishment in which the added value is negative or little, the capital productivity index has been in fluctuation in a constant level (about 50%) since 1392 to 1395. According to the asset increase during the years, it is observed that this increase may not lead to invest productivity. But attention to the type of organization activity (the main dependence of income and added value of

organization to invest) is not out of mind. Table 3 shows the data related invest productivity computation.

Table 3. Invest productivity computation (million rials)

Percent of invest productivity value	Invest productivity	Percent of adjusted added value	Adjusted added value	Percent of Adjusted assets value growth	The value of adjusted assets	year
-	-0/492	-	-21.485	-	43.634	1388
914/86	-4/997	1.632/07	-372.136	70/67	74.470	1389
-101/21	0/060	-105/53	20.593	357/10	340.402	1390
1.316/44	0/857	1.075/82	242.137	-16/99	282.580	1391
9/79	0/941	-4/57	231.060	-13/08	245.608	1392
7/64	1/013	63/20	377.087	51/61	372.374	1393
2/74	1/040	27/09	479.228	23/70	460.609	1394
-4/70	0/991	15/90	555.443	21/63	560.220	1395

Equation 4 is the invest productivity estimation equation on capital of company between 1391 and 1395 expressing the little effect of invest growth on invest productivity (it has to be mentioned that equation 4 is not accurate because of few studied years and its display is only for showing the dependence rate of two factors to each other).

$$KP = 2/3417 \times 10^{-6} \times K \quad (4)$$

3. Material and energy productivity

Table 4 and 5 shows the results

Table 4. Computation of material productivity (million rials)

Material productivity growth percent	Material productivity	Added value growth percent	Adjusted added value	Adjusted material cost growth percent	Adjusted material cost value	year
-	-0/111	-	-21.485	-	193.004	1388
-28/10	-0/080	1.632/07	-372.136	2.309/12	4.649.701	1389
-145/50	0/044	-105/53	20.593	-89/85	472.069	1390
3.081/51	1/388	1.075/82	242.137	-63/04	174.470	1391
36/97	1/901	-4/57	231.060	-30/33	121.547	1392
-5/82	1/790	63/20	377.087	73/29	210.627	1393
-11/67	1/581	27/09	479.228	43/87	303.039	1394
-7/22	1/467	15/90	555.443	24/93	378.580	1395

Table 5. Energy productivity computation (million rials)

Energy productivity growth percent	Energy productivity	Added value growth percent	Adjusted added value	Adjusted energy cost growth percent	Adjusted energy cost value	year
-	1.764	1.075/82	242.137	-	137/3	1391
27/90	2.256	-4/57	231.060	-25/39	102/4	1392
-50/07	1.126	63/20	377.087	226/86	334/8	1393
5/45	1.188	27/09	479.228	20/51	403/5	1394
-28/73	846	15/90	555.443	62/64	656/2	1395

As it can be seen, material productivity have a little fluctuations (about 1.5) since 1391. But the main point is that there is a smooth slope toward reducing material productivity during these years.

About energy productivity, this period had descending and fluctuation process so that increasing this index during this year faced with more decrease next year that in practice the decrease overcome the increase on each year and in general it may lead to material productivity decrease.

The main reason of these changes are development of activities because of developing company and increasing areas in recent years. So that the projects performing each year (because of long time of productivity) don't come to productivity the same year. So the spent material and energy are applied to the computation of productivity index the same year and created added value by these projects are achieved the coming years.

4. Total factor productivity (TFP)

Table 6 shows the added values, compensation employees, and workforce and invest share from 1388 to 1395.

Table 6. Data and results of computation of the share of each production factor (million rials)

Invest (β)share	Work (α)share	Adjusted compensation employees	Service adjust rate	Compensation employees	Adjusted added value	year
1/236	-0/236	5.080	78/8	4.003	-21.485	1388
1/017	-/017	6.439	87/2	5.615	-372.136	1389
49/4	0/506	10.410	100	10.410	20.593	1390
0/936	0/064	15.493	117/6	18.220	242.137	1391
0/891	0/109	25.280	146/9	37.136	231.060	1392
0/911	0/089	33.436	177/0	59.182	377.087	1393
0/934	0/066	31.438	205/3	64.543	479.228	1394
0/939	0/061	33.743	229/5	77.441	555.443	1395

As company activities in first 3years after establishments include infrastructure and investment activities for productivity in future years, the numbers achieved for α and β will be totally unusual and ignored in computations. Therefore, in order to compute each share, the average of 1391 to 1395 will be computed which 8% for work force and 92% are for invest factor considering decimal for computation precision. Table 7 and figure 2 show the results of total factor productivity computation.

Table 7. The results of total factor productivity computation

Total factor productivity growth (percent)	Total factor productivity	Year
-	-0/963	**1388**
1.564/26	-9/955	**1389**
-438/81	0/131	**1390**
1.086/24	1/758	**1391**
4/53	1/861	**1392**
15/71	2/071	**1393**
5/20	2/163	**1394**
-4/56	2/082	**1395**

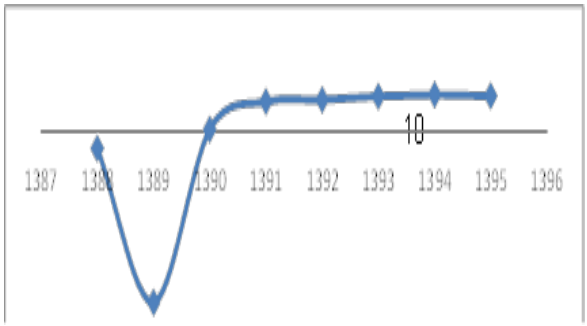

Figure 2- the diagram of total factor productivity changes

Total factor productivity has been growing smoothly since 1391 (the initial year after infrastructure and investment activities) and we have witnessed a little decrease in productivity in 1395.

In 1395, the investment had been carried out for transferring the line to Saba Folad and Setare Khalij Fars plant which has no considerable decrease in TFP index with productivity of transfer line to Setare Khalij Fars Plant since the middle of year. On the other hand, by ending the project of gas transfer in 1396 we are going to witness the increase of productivity index in organization.

5. Productivity growth share in economic growth:

Based on fourth program of economic development, it was planned to provide 5.5 percent of new capacities in human force field and 2.5 percent from workforce and invest productivity promoting of 8 percent economic growth of country. The result of this aim were workforce, invest and total factor productivity rates that were 3.5, 1 and 2.5% respectively, but the achieved scores are 1.9, -1.2 and -0.1 that are so different for plan. It has to be mentioned that here, the economic growth rate hasn't been reached to 4% but it was planned to be 8% (Economic world, 2017)

In fifth plan, the economic growth was predicted to be 8% whose one third was planned to be resulted from productivity that this plan had no desirable conditions in economic growth and productivity (Tabatabaii, 2017). But based on sixth plan it is planned to achieve 2.8% of productivity growth from 8% economic growth. In other words 35% of total economic growth should be of productivity promotion (The sixth, 2018).

The productivity growth share in economic growth of Hormozgan Gas Company with the fixed price of base year in 1390 was 95.84% in 1389, 24.87% in 1393 and 19.22% in 1394 that only these 3 years were the only positive value during 1389 to 1395. The average of productivity share in added value of Hormozgan Gas Company during 1389 to 1395 is almost 20%.

Table 8. Change process of productivity share in economic growth of Hormozgan Gas Company

Productivity growth share in economic growth	Total factor productivity growth percent	Added value growth percent	year
95/84	1.564/26	1.632/07	**1389**
-	-438/81	-105/53	**1390**
More than 100	1.086/24	1.075/82	**1391**
-	4/53	-4/57	**1392**
24/87	15/71	636/20	**1393**
19/22	5/20	27/09	**1394**

-	-4/56	15/90	**1395**

6. Relationship between Added value and productivity

Table 9 shows the ration of added value to total factor productivity since 1392 to 1395 expressing the increase rate of added value for increasing a TFP unit each year. In fact, the ratio of $\frac{Va}{\text{TFP}}$ in table expresses that each year how much added value is created for creating a
TFP unit.

Table 9. the ration of added value to total factor productivity

$\frac{Va}{\text{TFP}}$ **ratio**	**(TFP)Total factor productivity**	**(Va) Added value**	**year**
124.131/56	1/861	231.060	**1392**
182.037/47	2/071	377.087	**1393**
221.555/08	2/163	479.228	**1394**
266.748/81	2/082	555.443	**1395**

7. Sell share and intermediate consumption in productivity:

The share of each sell items and intermediate consumptions in added value has been demonstrated in table 10.

Table 10. Intermediate consumption and sell and the share of each in added value

Intermediate consumption (percent)	**Sell share (percent)**	**Adjusted intermediate consumption**	**Adjusted sell**	**Adjusted rate (percent)**	**Pure sell**	**year**
27/60	72/40	141.965	372.382	112/9	505.322	**1392**
27/87	72/13	237.180	613.765	135/7	971.590	**1393**
28/94	71/06	328.990	807.977	158/3	1.435.776	**1394**
30/03	69/97	412.777	961.870	177/7	1.871.798	**1395**
28/91	71/09	280.228	688.999	166/6	1.196.122	**The mean of period**

Although the computation of added value regression equation based on total sell and intermediate consumption showed that the possibility of unacceptance of intercept for both relationship are high (for added value regression equation based on total sell is 0.1388 and based on intermediate consumption is 0.1242). So, these equations are estimated without intercept (equations 16 and 17).

In equation 19, added value is 1 and intermediate consumptions is 0. Then, the sell value is computed 3.379303. By dealing added value as 1 and sell as 0, the intermediate consumption was counted as 1.394521. Using equation 14 and 15 and given values here, the sell share and intermediate consumption will be 70.79 and 29.21%, respectively that were fitted the values with previous method.

8. Productivity index prediction

Table 11 shows the workforce productivity based on sell measure prediction (for 1396, 1397 and 1400 that are 5900, 6000 and 10000, respectively) and year.

Table 11. Workforce productivity prediction

1400	1397	1396	Prediction type
24.566	12.014	11.700	**Based on sell measure (equation 20)**
20.869	15.033	13.088	**Based on year (equation 21)**

The predicted value is only according to the productivity change process in past years using equation 21 but achieved values are more possible from equation 20.

Table 12 shows the invest productivity prediction for 1396, 1397 and 1400 based on sell measure prediction and year.

Table 12. Invest productivity prediction

1400	1397	1396	Prediction type
2/042	1/225	1/205	Based on sell measure (equation 22)
1/001	0/999	0/998	Based on year (equation 23)

According to the high possibility of unaccepting invest productivity regression equation on sell share and year, these equations are estimated without intercept. Based on these estimation of equation 23, invest productivity process is computed very slowly in future years. It shows the slow process in pass too. But equation 22 gives more value for this index each year that if the sale prediction is right, each year it will more probable to happen. Table 13 shows the total factor productivity values prediction for 196, 1397 and 1400.

Table 13. Total factor productivity prediction

1400	1397	1396	Prediction type
4/204	2/522	2/480	Based on sell measure (equation 24)
2/054	2/049	2/048	Based on year (equation 25)

According to the obtained values here, it is predicted that estimated values by equation 24 have less deviation.

9. Confidence interval estimation for intermediate consumption

Table 14 shows the ratio of intermediate consumption to sell in an annual process. In fact, achieved values in this table expresses that each year how much intermediate consumption is used for each sell unit.

Table 14. The ratio of intermediate consumptions to sell

The ratio of intermediate consumption to sell	**Adjusted intermediate consumption**	**Adjusted sell**	**year**

0/444	193.550	435.687	**1391**
0/381	141.965	373.025	**1392**
0/386	237.180	614.266	**1393**
0/407	328.990	808.218	**1394**
0/426	412.777	968.219	**1395**

By computing the mean of these ratios using t-student distribution function a confidence interval of 95% is stated for this ration. The equations 26 and 27 demonstrate the minimum and maximum of this interval:

$$\bar{x} - t_{n-1,\frac{\alpha}{2}} \times \frac{s}{\sqrt{n-1}} = 0.446095 \quad (26)$$

$$\bar{x} + t_{n-1,\frac{\alpha}{2}} \times \frac{s}{\sqrt{n-1}} = 0.371633 \quad (27)$$

In fact the estimated range in this relationship expresses that 95% this interval includes intermediate consumption per each sell. In this relationship, $\bar{x}$ is the computed mean of table 14, n is the number of samples, S the standard deviation $t_{n-1,\frac{\alpha}{2}}$ is the t0student distribution function with n-1 degree of freedom (n is the number of samples) and right confidence is $\frac{\alpha}{2}$.

Based on definition, for computing added value, the intermediate consumption is fractioned the sell. So, using relationship 26 and 27 (the minimum and maximum of intermediate consumption per a sell unit), minimum and maximum values of added value (95% confidence interval for added value) is computed per sell unit (table 15).

Table 15. 95% confidence interval of intermediate consumptions and added value per a sell unit.

Bottom limit	Upper limit	Explanation
0/371633	0/446095	**Intermediate consumptions**
0/553905	0/628367	**Added value**

Now using minimum and maximum computed added value per sell unit and using equations 1, 3 and 7, the minimum and maximum of workforce, invest and total factor productivity per sell unit is computable. Table 16 shows this value based on invest and workforce computed for 1395.

Table 16. Minimum and maximum value of productivity index per sell unit.

minimum	maximum	Explanation
$2/076503\times10^{-6}$	$2/355651\times10^{-6}$	**Total factor**
$0/988728\times10^{-6}$	$1/121644\times10^{-6}$	**Invest**
0/010550	0/011969	**Workforce**

Using the values in table 15 and based on invest and workforce values in 95 added value and minimum and maximum values (in million rials and million meter cube based on sell 370 rials) for increasing 0.1% productivity promotion is computable (table 17).

Table 17. Added value and 95% confidence interval for selling for 0.1% productivity promoting.

Minimum	maximum	explanation
266/749		**Added value**
424/511	481/579	**Sell (million rials)**
1/147	1/302	**Sell (million meter cube)**

10. The comparison of productivity confidence with regression prediction

For predicting confidence intervals each productivity index for 1396 and 1397 needs estimating adjusted rate at the same years. So by computing the fifth root each adjusted rates related to 95, the mean of adjusted rate growth was computed since 1390 to 1395. Then, by computing the sixth and seventh root of growth rate were obtained for 1396 and 1397. Table 18 shows the results f computations.

Table 18. The estimation of adjusted rates for 1396 and 1397.

Estimation of 1397	Estimation of 1396	Annual growth (percent)	1395	Explanation
254/0	222/3	14/2	194/6	**Inhibition, water, power, gas and other fuels**
320/0	271/0	18/1	229/5	**Service**
389/7	320/9	21/4	264/2	**Good**

According to the values achieved from equations 26 and 27, the prediction of 1396 and 1397 (5900 and 6000 million meter cube with 370 rials per meter cube) the adjusted rates in table 18 and prediction of budgets for 1396 and 1397, the confidence interval for invest and total factor productivity can be computable.

On the other hand, equations 22 and 24 are invest and total factor productivity regression equations based on sell, respectively. These equations predict the productivity index based on sell.

Table 19 shows invest and total factor productivity index based on table 18 and recommended budget for 1396 and 1397 and these index are demonstrated based on regression equations (22 and 24).

Table 19. Invest and total factor productivity index prediction

1397	1396	explanation	row
2.220.000	2.183.000	Sell prediction (million rials)	**1**
254/0	222/3	Sell adjusted rate	**2**
874.084	981.934	Sell (adjusted)	**3**
825.025	811.274	Minimum intermediate consumption	**4**
990.331	973.826	Maximum intermediate consumption	**5**
389/7	320/9	Adjusted intermediate consumption	**6**
211.720	252.841	Minimum intermediate consumption(adjusted)	**7**
254.141	303.502	Maximum intermediate consumption(adjusted)	**8**
619.943	678.432	Minimum added value (adjusted)	**9**
662.364	729.093	Maximum added value (adjusted)	**10**

3.625.603	2.230.055	Invest prediction	**11**
389/7	320/9	Adjusted rate of invest	**12**
930.410	695.018	Invest prediction(adjusted)	**13**
52/5	52/5	Workforce mean	**14**
1/457	2/086	Minimum total factor productivity	**15**
1/557	2/241	Maximum total factor productivity	**16**
0/666	0/976	Minimum invest productivity	**17**
0/712	1/049	Maximum invest productivity	**18**
2/522	2/480	Total factor productivity regression prediction	**19**
1/225	1/205	Invest productivity regression prediction	**20**

The achieved value for invest and total factor productivity using regression equation and sell prediction in 1396 and 1397 shows an ascending process according to the ascending process of predicted sell during years (it has to be mentioned that in these equations only sell is considered as variable for predicting productivity index).

But predicting the confidence interval for these index based on sell and invest prediction shows a very significant decrease. The main reason is the increase f capital toward sell and then added value. In fact, this significant decrease shows that increasing predicted invest during these years will add less value to sell and added value.

Conclusion

In this paper the productivity index analyzed and investigated for promoting the income level of Hormzgan Gas Company. After computing different productivity index (workforce invest, material, energy and total factor productivity) observed that workforce and total factor productivity index are growing smoothly only in some periods of time had little decrease. The main reasons were performing investment projects and productivity in future. Invest productivity had fluctuation that was predictable according to the high share of invest in productivity computation.

Material and energy productivity had some fluctuation and the main reason was company development and activates in recent years. So that projects performing each year are not produced the same year. So the consumed material and energy are applied for ending these projects in computing productivity at the same year and the added value is obtained.

Productivity index study are analyzed during Hormozgan Gas Company and change process and the changes were identified in each level. But as the development direction and productivity improvement is always open, the organization is always considered this field.

Recommendation

Based on the studies carried out in order to promote the productivity, we recommend:

- Although workforce share are estimated on total factor productivity but the positive effect of this factor on productivity improvement cannot be ignored. Therefore, attention to education of staff and quality improvement of them according to the needs of different parts can lead to service improvement and then increase productivity.
- Based on studies carried out by Julfson and Hit (2000), Eliz and Sichel (2002), Heshmati and Shiva(2006) and Basanini and Sckartpa (2002), investment in Information and communication technology was introduced an effective factor in growth and promoting productivity.
- As the type of organization activity is capital center, the share of invest in productivity improvement of total factor is more than workforce (as two factors in productivity promotion), decision making about priority and selecting desgins using systematic methods can help in invest direction more accurately.
- In order to promote productivity in organization, attention to research and development in different fields are effective, so that all of the organization activities have valid scientific background.

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