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SECTORIAL ANALYSIS: GROWTH ACCOUNTING OF SECONDARY INDUSTRIES

Case
Study

Keywords

Growth accounting,
Secondary sector,
Economic industries,
TFP,
UAE

JEL Classification

C23; E23; E24

Abstract

The modern economic system of any nation is divided into three major producer's sectors called primary, secondary, and tertiary. These sectors reform a chain of production as a continuum, ultimately in the end provide goods and services. In UAE, economy share divided by each sector of the current GDP in year 2015 were 1%, 48%, and 51%, for the primary, secondary, and tertiary sectors, respectively. The purpose of this empirical study is to analyze the economic industries of the secondary sector by projecting the contribution growth share of factors of production through using the growth accounting model for time series from 1990-2015. The methodology employed a quantitative description and data sourced from FCSA. We find the manufacturing industry the main key contributor to sector growth share, followed by the construction industry, where the mining and quarrying subsectors have less impact compared to the rest. We observed that the TFP performance improved positively in line with a declining size of labor.

INTRODUCTION

The globe is made up of mixed economies in which countries vary, where there are developed and developing countries (Oláh & Pakurár, 2013). The main cause for this is primarily the uneven possession of natural resources of each country. So, some countries have relied on the agricultural sector, others on the industrial sector, and others mostly nowadays on the service sector, although some countries are currently wealthy by oil and gas resources. Therefore, oil and gas resources have become a big part in the economies of these countries. However, the shortage or absence of these natural resources is no longer a major obstruction to the growth progress of some countries, and thus no longer possess the resources of the factors that lead to the progress of nations by taking advantage of all the factors of production (such as physical, capital, human resources, technology, environmental, and natural resources). Thus, the United Arab Emirates (UAE), as a case study used here, is located in the middle east and is a member of Gulf Council Countries (GCC). The country achieved a progress in its growth by reducing the reliance of oils shares to GDP through enhancing the strategy to diversify its economy. It seems that the country's success in its progress is based on enhancing the other economic sectors. Consequently, the researcher took this initiative to analyze the process of past growth through using growth accounting exercise in sectorial approach, and in particular the secondary sector in order to understand the main factors that had contributed to its growth, why and where this sector continued the production of oil.

The secondary sector includes four economic activities (sectors or industries) and these are: mining and quarrying, manufacturing industries, electricity, gas and water, and construction, where these activities essentially transform raw materials to physical goods (or production of goods). Ultimately, the term of sector is used as a major break up of economy and the term industry or economic activity is used for subsectors in the secondary sector. Also, in this study the term service sector refers to the tertiary sector and the manufacturing sector refers to the secondary sector. The analysis of these sectors will help understanding the extent of the oil industry in comparison with other industries in terms of contribution growth share. According to **Figure 1** illustrating the aggregate sector's output for the years 1990,1995,2000,2005, 2010, and 2015 it shows the output generated from the oil industry, which contributed to a high portion of aggregate output to the secondary sector. But, nevertheless the average growth rate for mining and quarrying, manufacturing industries, electricity, gas and water,

and construction were 3.42%, 8.61%, 2.84%, and 6.32%, respectively in the period analyzed.

The aim of this empirical study is to project the contribution share of growth due to factors of production like capital, labor, and TFP. Also, within this study the annual average growth rate for each factor is generated to understand more in depth the change taken place throughout a long-term series analysis from 1990-2015, and broken down to three period of times like 1990-2000, 2000-2010, and 2010-2015. The empirical study gives answers to the question: what is the main economic activity (industry), that has a significant impact on the growth share to the secondary sector by diversifying the economy? This work is divided in sections where section (1): literature review, section (2): data and methodology, section (3): empirical results, section (4): discussion, and section (5) conclusion.

The findings of growth accounting are analyzed, where the MFG industry was the main contributor to the share of growth of the secondary sector from the 1990-2015 due to the share growth of production factors. It can be stated that labor has a significant impact on growth of some economic industries, however, the vice versa relationship between the size of labor to the performance of TFP can also be witnessed. If there is a decline in the size of labor, the performance of productivity becomes better.

LITERATURE REVIEW

Economic sector.

The first attempt to clarify definitions, characteristics, and economic industries under each category of primary, secondary, and tertiary sectors was back to the Wolfe, Martin in his work published in 1955 "The concept of economic sectors". The growth of primary, secondary, and tertiary sectors and shifts among them in terms of labor was given fame and importance from the well-known work "The Conditions of Economic Progress", for *Colin Clark* (Clark & Others, 1967; Kenessey, *The Primary, Secondary, Tertiary and Quaternary Sectors of the Economy*, 1987; Wolfe, 1955). According to *Morris A. Copeland* that's not meant to criticize or making a comparison between two sets of measurements, but rather to interpret the difference between each sector as he stated in his chapter "Dividing the Economy into Sectors" (Morris, 1952).

Manufacturing sector is considered a key sector that assists the countries to make a rebound in economic development. In most Asian economies, specifically in the initial stage of development the manufacturing sector plays a significant role in accounting for more than 20% of total value-added. This sector before 1990s absorbed employment

especially for people displaced from agriculture sector, but after 1990s it has not been attracting employment regardless its sound growth and expansion. In contrast, China and India started different development paths where their economies based on service contribution share (service-driven) switched from the former sector, where their economy relied more on manufacturing-driven growth. From 2000 to 2012, the sector contribution was 35% and 44% for manufacturing and service sectors, respectively (APO, 2014). Inside the context of manufacturing employment, a study stated that over the last 43 years the developed countries reduced the share of manufacturing employment in the total employment, where statistics showed the similar trend in developing countries (Haraguchi, Cheng, & Smeets, 2017). A study by Jorgenson and Timmer (2011) indicated that the share of manufacturing sector declined in all regions (Europe, Japan, and United States (US)), where it accounted for 15% of GDP in year 2005 (Jorgenson & Timmer, 2011).

According to Jorgenson and Nomura (2007) who stated that in the Japanese economy the manufacturing sector was the main contributor in the 1960s, but by 1990s this importance almost disappeared, which had less impact to output growth (Jorgenson & Nomura, 2007). A study stated that the decline of both value-added and employment shares in the manufacturing sector in a large number of developing countries was not due to sector's potential development but due to decline an importance of manufacturing development of small numbers of countries (Haraguchi, Cheng, & Smeets, 2017). Fagerberg and Verspagen (1999) stated that the manufacturing sector acted as an engine in the developing countries growth in the 1970s and 1980s, but not for developed countries (Fagerberg & Verspagen, 1999).

A study of cross-sectional regression between 1990-2000, which comprised 48 developing countries, indicated that the manufacturing sector played a key role for growth while tertiary sector played the similar function to grow within this period (Dasgupta & Singh, 2006). Another study highlighted that the manufacturing sector was a major factor to growth between 1973 and 2004 beside the construction and service sector (Chakarvarty & Mitra, 2008). Thus, it can be concluded that the secondary sector played a major factor for growth, where it has had a quite good share for contribution to output. On the other side, this sector absorbed no more than a high share of employment than between 1980s and 2000s. And, some of developing countries changed their path with more focus on service sector.

Productivity.

The productivity growth from the past ten years was driven by the manufacturing and service

sectors, where the first reflected the higher growth rate (McCausland & Theodossiou, 2012). The measurement of productivity among countries in terms of sectoral level is more obvious, where typically, the manufacturing sector deserved the highest increase rate and some of activities in the service sector. For instance, the increase rate of the manufacturing sector was between less than 1% and 11% from 2001 to 2013, for Italy and the Slovak Republic, respectively (OECD, 2015). A sectorial cross-country study found that the productivity was large in difference among countries, where it was large in the agriculture and service sectors and smaller in the manufacturing sector (Duarte & Restuccia, 2010).

A study stated in reference to the contribution of TFP in the UAE that growth of GDP comprised of factors of production (labor, capital, and TFP) and oil rent pushed the use of capital and labor recourses (Haouas & Heshmati, 2013). According to Paul Romer an increase in labor force leads to slow the change in TFP, while pushing the increase in capital (Romer, 1990). A study in reference to the source of growth in MENA countries indicated that the main source of growth was capital accumulation and not TFP (Senay, Ben Ali, & Mert, 2017). A study examined the TFP with allocation of labor inside the three sectors in 45 developing countries and found that the agriculture (primary) was the least productive sector followed by the service and manufacturing sectors (El-hadj, 2013).

A time series study indicated that the manufacturing, water and electricity, and construction sectors contributed the most to UAE's GDP, followed by trade and service between 1975-1998. Furthermore, the same study underlined the massive dominance of labor over capital in growth contributions, where the labor's contribution was 104%, capital contribution was 30%, and TFP was -32% (Elhiraika & Hamed, 2006). According to Soto and Haouas (2012) the UAE's economy is labor-intensive, where employment grew more than production and capital with disregards of cycle of the economy in the early 1980s to 2000s.

In conclusion, there is a benefit to analyse the productivity in terms of sectors or industries, because it's more obvious. Another fact is that overuse of resources such as capital and labor cause an effect in other factors such as TFP.

DATA AND METHODOLOGY

The economic sectors are classified into three large categories : (1) Primary sector, (2) Secondary sector, and (3) Tertiary sector. The primary sector uses natural resources to produce goods such as livestock, fishery, agriculture. The secondary sector refers to manufacturing industry, where physical

goods are transformed to another one such as electricity, gas, water supply, and contraction. The tertiary sector refers to the service industries such as banking, insurance, transportation, communication, trade, health, and education (Kenessey, 1987). The purpose of this study is to analyse in depth the secondary sector which includes industries like mining and quarrying (MQ), manufacturing industries (MFG), electricity, gas and water (EGW), and construction (CN) according to the international standard industrial classification (ISIC) (Nations, 2008; Bosworth & Collins, 2008).

The study sourced three variables: industry's output (share of GDP), capital accumulation, and the number of workers. The data was generated from the UAE Federal Competitiveness and Statistics Authority (FCSA, 2016). Nevertheless, the data uses the number of workers from 2011 to 2015, estimated by the researcher based on the ratio of active workers to the population and labor force based on the year 2010 data, and then generated to each year. The data uses population and labor force sourced from the World Bank databank (WB, 2016).

The methodology used in this study was Cobb-Douglas production function based on the model used by Solow (1956) to measure the contribution of production factors and their role in productivity (Solow, Technical change and the aggregate production function, 1957). The growth accounting equation (1) was calculated on three inputs that expressed the output growth. The function of this model, where it has primary and secondary inputs, such as capital and labor, is the calculation of primary and total factor productivity (TFP) as secondary input. TFP denoted in equation as [A], and called "Solow residual" or "technical progress". TFP calculated the improvement in production process, skill, technology, knowledge, management practice (Miles, Scott, & Breedon, 2012). And, according to Solow (1957), TFP considered in long-term a significant factor to achieve sustained growth trend.

$$Y = A(K, L) \quad (1)$$

growth accounting model helps to deserve the contribution by factor of production, but nevertheless provides the main reason behind the growth (Hulten, 2010). The method used in this study was quantitative and descriptive based on the calculation of variables. Production function model used to analyze the contribution of inputs in term of long-run growth analysis (Wolff, 1994), and divided in group period of times. As expressed in equation below which respects the time [t], [Y]: denoted to sector's output, [A]: denoted as TFP, [K]: denoted as capital accumulation, [L]: denoted as labor (number of workers), [a]: denoted the capital's share, and [1-a]: denoted as labor's share. The study assumed constant return to scale,

competitive market (Solow, A Contribution to the Theory of Economic Growth, 1956), and diminishing return to scale where the capital's share equaled to 0.3 and 0.7 for labor's share (Piketty, 2014).

$$Y_t = A_t K_t^\alpha L_t^{1-\alpha} \quad (2)$$

We described the practice equations (2), and rewrote it in logarithm form as log-liner, where it has three variables, where any change at any proportional amount either capital, labor, or TFP, was considered an increase in output. The equation is given below:

$$\ln \frac{\Delta Y}{Y_t} = \alpha \ln \frac{\Delta K}{K_t} + (1 - \alpha) \ln \frac{\Delta L}{L_t} + \ln \frac{\Delta A}{A_t} \quad (3)$$

The first variable was capital: $\alpha \cdot \Delta K / K_t$, the second variable was labor: $(1 - \alpha) \cdot \Delta L / L_t$, and the third variable was TFP: $\Delta A / A_t$. Therefore, each part of equation's variables represents the contribution share of growth.

EMPIRICAL RESULTS

Table 1 presents the results of growth accounting excises of the secondary industries from 1990 to 2015, where results were divided into groups of period of times (1990-2015, 1990-2000, 2000-2010, and 2010-2015). The secondary sector included four economy industries, namely mining and quarrying (MQ), manufacturing industries (MFG), electricity, gas and water (EGW), and construction (CN). The results as described, are divided in two dimensions: average annual growth rate related to industry output, capital, labor, and TFP, and share of growth due to capital, labor, and TFP.

From 1990 to 2015, in term of average annual growth rate of industry's output recorded 9.05% as the maximum and 5.38% as the minimum. The MFG industry indicated that the highest growth rate was 9.05% compared to CN, MQ, and EGW, where they deserved 7.96%, 5.94%, 5.38%, respectively. From 1990-2000 the MFG showed the highest annual growth rate with 12.76% compared to EGW, CN, and MQ industries, where they recorded 6.29%, 5.54%, and 4.10%, respectively. From 2000-2010, the MQ deserved the highest average growth with about 15.09%, followed by the EGW with 13.70% and CN with almost 12%. From 2010-2015 the MFG deserved better average growth rate with about 7.47% compared to MQ, and CN unlike the EGW recording negative growth with -11.36%.

The annual average growth rate in capital fluctuated between 2.55% in the MQ and 3.85% in the CN, in labor it was between 2.99% in EGW and 6.28% in CN, and the TFP was moving between -2.17% in the CN and -0.31 in the MFG. In general, the capital average growth rate deserved high figures in MFG and CN in most of the group of period of times, the CN deserved high average

growth in all groups of period of times in term of labor, where unlike from 2010-2015, all secondary industries declined in the labor's figures. The average growth for the TFP from 2010-2015 showed a better performance unless the EGW deserved negative growth with -12.36% compared to 1.67%, 4.20%, and 0.53%, for MQ, MFG, and CN, respectively.

From 1990 to 2015 the share of growth of capital fluctuated between 60% as the highest in EGW and 38% as the lowest in the MFG. The share growth contributed by labor was 88% in MQ and 56% in the EGW. The contribution growth by TFP was between -3% in the MFG and -31% in the MQ. Therefore, it can be concluded in long-term analysis that EGW, MQ, and MFG contributed more by inputs in sequence to capital, labor, and TFP, respectively.

From 1990-2000, the growth share to labor was the highest in MQ and followed by CN, where results were 138% and 97%, respectively. In general, the CN and MFG achieved a relatively high growth rate due to the labor at most of group periods of times (Table 1). It is worth mentioning that the TFP performance was positive in all industries from 2010-2015 with 42%, 56%, 109%, and 16% for MQ, MFG, EGW, and CN, respectively along with the decline in share growth of labor at all sectors. Thus, the suggestion here is that proper management of the size of labor will help to improve the performance of TFP.

To sum up, in the long-term analysis, the MFG as contributed significantly to sector's output as it resulted in average annual growth rate of 9.05%, 12.76%, 8.25%, and 7.47%, for 1990-2015, 1990-2000, 2000-2010, and 2010-2015, respectively. Also, the average annual growth rate for MQ was less compared to MFG or even CN, where the rates were 5.94%, 4.10%, 15.09%, and 3.98%, for 1990-2015, 1990-2000, 2000-2010, and 2010-2015, respectively. Thus, the diversification strategy of the country gained its benefit by decreasing dependence of the oil industry, and the MFG witnessed its contribution to secondary sector's output. In addition, the results showed that there is an inverse relationship between TFP and the percentage of the increasing number of workers, where the lower the number of workers, the better the TFP performance and vice versa. Therefore, the management of the number of workers will help the performance of TFP as suggestion.

DISCUSSION

This study presented the main contributor to the secondary sector's output, the main sector that impacted the share of growth, and presented the relationship between TFP performance and labor inputs. These factors are considered the main

findings by this empirical study of long-term series analysis.

CONCLUSION

As the aim of this study is to analyse the secondary sector that included four economic industries according to UN (2008), where growth accounting model were used. Four group periods of times were the study's division, where it can be said that the diversification strategy by UAE gained its benefits. The study witnessed clearly that the MQ is not the main player such the MFG and CN. The average annual growth rate for MFG showed the highest contribution to the secondary sector's output, even at other period of time. Furthermore, the average annual growth rate for capital, labor, and TFP were between maximum and minimum as follow: (3.85% - 2.55%), (6.28% - 2.99%), and (-0.31 - (-2.17%)).

The contribution growth shares due to the labor had a higher impact in comparing to capital and TFP, where in general in MFG, MQ, and CN. The study showed that there was a vice versa relationship between the size of labor to TFP performance. If the number of workers decreased, the performance of TFP improved. This observation was presented in the calculation results from 2010-2015.

In conclusion, the study illustrated that the MFG industry was the main contributor to the secondary sector's output followed by CN. In addition, the oil industry contributed less to the secondary sector's output. The TFP performance was positive specifically from 2010-2015.

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BIOGRAPHICAL

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ANNEXES

Table 1. Growth accounting results of the secondary sectors.

Average Annual Growth Rates					Share of Growth Due to:		
MQ Industry	Y	K	L	A	K	L	A
1990-2015	5.94%	2.55%	5.22%	-1.83%	43%	88%	-31%
1990-2000	4.10%	0.65%	5.67%	-2.21%	16%	138%	-54%
2000-2010	15.09%	5.00%	5.42%	4.67%	33%	36%	31%
2010-2015	3.98%	1.22%	1.09%	1.67%	31%	27%	42%
MFG Industry	Y	K	L	A	K	L	A
1990-2015	9.05%	3.45%	5.91%	-0.31%	38%	65%	-3%
1990-2000	12.76%	2.67%	7.77%	2.32%	21%	61%	18%
2000-2010	8.25%	5.00%	6.09%	-2.85%	61%	74%	-35%
2010-2015	7.47%	2.17%	1.10%	4.20%	29%	15%	56%
EGW Industry	Y	K	L	A	K	L	A
1990-2015	5.38%	3.24%	2.99%	-0.85%	60%	56%	-16%
1990-2000	6.29%	1.84%	2.45%	2.00%	29%	39%	32%
2000-2010	13.70%	5.45%	4.29%	3.96%	40%	31%	29%
2010-2015	-11.36%	-0.09%	1.09%	-12.36%	1%	-10%	109%
CN Industry	Y	K	L	A	K	L	A
1990-2015	7.96%	3.85%	6.28%	-2.17%	48%	79%	-27%
1990-2000	5.54%	4.18%	5.38%	-4.02%	75%	97%	-73%
2000-2010	11.52%	4.74%	8.96%	-2.18%	41%	78%	-19%
2010-2015	3.34%	1.74%	1.08%	0.53%	52%	32%	16%

Source: (FCSA, 2016), and own calculations.

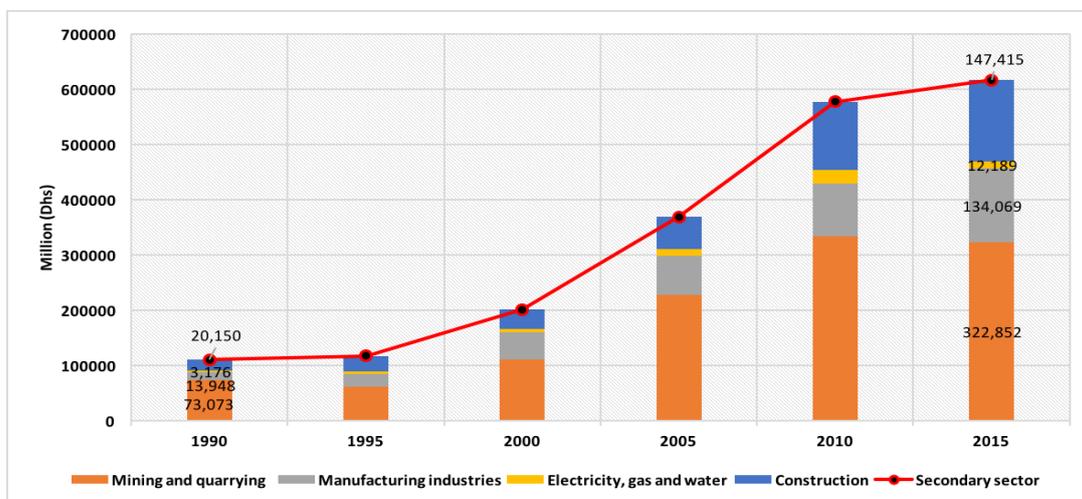


Figure 1. Industries output for 1990-2015).

Source: (FCSA, 2016), own created figure.