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The Role of Technological Progress in the Distribution sector: Evidence from Saudi Arabia Wholesale and Retail Trade Sector*

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Abstract

Purpose: This study aims to identify the role of technological progress in the distribution sector in Saudi Arabia. **Research design, data, and methodology:** The study applies the Autoregressive Distributed Lag (ARDL) approach to estimate the Cobb Douglas production function of the wholesale and retail trade sector in Saudi Arabia, relied on annual data from the General Authority for Statistics from 2005 to 2019. **Results:** The results show that there is a long run relationship between the production of the wholesale and retail trade sector in KSA and the factors of production labour, capital and technology progress. The elasticity of the wholesale and retail trade production with respect to capital and labour are 0.26 and 0.78 respectively; the coefficients are positive and statistically significant. The wholesale and retail trade sector is operating under increasing returns to scale. The main result indicates that the elasticity of the wholesale and retail production with respect to the technology progress is 4.62%, which is positive and statistically significant. **Conclusions:** The study concluded that technological progress has a positive contribution to the growth of the distribution sector in KSA. Therefore, the technological progress can improve the productivity and efficiency of the resources allocated to the dis.

Keywords : Saudi Arabia, Wholesale & Retail Trade, Total Factors Productivity, Technological Progress, Distribution Sector.

JEL Classification Code: C13, D24, L15, M21, O12.

1. Introduction

The distribution sector (wholesale and retail trade) considered as one of the important economic activities that contribute to increasing the employment of labour force and raising the gross domestic product (GDP) in the economy, the wholesale and retail trade forms the bridge between producers and consumers. Wholesalers collect, store and distribute products and retailers specialize in providing services to consumers and producers. Wholesale and retail trade plays a crucial role in the distribution and exchange of goods from producers and importers to widely dispersed consumers. With this important role, it is sometimes referred to as distributive trade (Johnston et al., 2000)

The distribution sector (wholesale and retail trade) makes an important contribution to the economic growth in Saudi Arabia, about 10% of gross domestic product (GDP) in 2019 compared to 9 % in 2018. In 2019 the Wholesale and retail trade activity grew by 6.27 %, compared to a growth of 0.95 % in 2018 (Saudi Central Bank, 2020). The results of the study by Alzyadat (2021) suggest that the bank credit facilities provided by commercial banks to the Wholesale and Retail sector contribute to stimulating growth in Saudi Arabia's non-oil GDP.

Employment growth in the wholesale and retail trade sector in Saudi Arabia economy has outstripped the market sector as a whole. Female employment increased strongly

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over the period, in keeping with broader market trends. The number of Saudi female workers in the wholesale and retail trade activity increased by 4% by the end of 2018, and the number of workers in the wholesale and retail trade sector in the KSA reached about one million and 693 thousand by the end of 2018, of whom about one million and 255 thousand non-Saudi workers. The number of Saudis working in the same sector is about 438 thousand workers (General Authority for Statistics, 2018).

Competitive pressures encouraged companies in the wholesale and retail trade sector to improve the total factors productivity (TFP) by adopting the modern technology and the inclusion of the technological factor in production. Retailers and wholesalers increasingly use technology to optimize sales (Johnston et al., 2000). Moreover, technological progress and its impact on factor prices and the ability to further change the allocation of distribution functions among the various participants. The advent of e-commerce and the Internet changed the structure of distributive trade. In addition to the advent of online retail trade, despite its expansion at the time of the COVID-19 Pandemic, it is in line with the objectives of the Kingdom's comprehensive strategies. As a part of the financial sector development program, which in itself is part of the Kingdom's long run development plan (Vision 2030), the government hopes to increase the proportion of electronic transactions to 70% by 2030. To stimulate this growth and ensure the long run sustainability of this sector, the Kingdom has also sought to improve its regulatory frameworks. The government has implemented an e-commerce system, which is designed to regulate electronic transactions and improve transparency. The Kingdom recorded an advanced position among the ten fastest growing countries in the field of e-commerce. The size of the e-commerce market in the Kingdom exceeded the range of twenty billion riyals in 2019, with a growth rate of 17.7 % from the previous year, as e-commerce represented 4.3 % of total commercial operations in the retail sector, and it is expected to reach 6.5% by 2023 (Saudi Central Bank, 2020).

A key component of total factors productivity (TFP) is technological progress, which produces continuous growth in the economy through two channels. First, technological progress enables more output to be produced from a given stock of capital and labour. Second, technological progress enables a country to support a larger steady state capital stock and thus a higher level of output. With technological progress, we can produce more output from the same level of inputs. Also after technological progress, the production function shifts out. Technological progress leads to substantial increases in productivity. If the marginal product of capital declines with the level of the capital stock, the economy must reach a steady state in which investment equals depreciation and the capital stock is constant (Abouzeid, 2016). Therefore, technological progress and product innovation positively related to the increase of (TFP) in the short-run and total output growth in the long-run (Lee & Xuan, 2019). Moreover, TFP is associated with the application of technical advances, technological innovations, improvement of management methods, and skilled workers (Ngo, & Nguyen, 2020).

The development of the information technology sector, particularly during the past two decades contributed to the promotion of economic development in various forms. Numerous studies have shown that these developments have led to a significant improvement in economic growth and productivity. This also led to an increase in job opportunities and Consumer surplus along with developing the efficiency of business enterprises. The Internet business sector has expanded dramatically over the past years, as has the number of consumers doing significantly, the online buying and selling of products (Al Koufahi & Warad, 2020). Therefore, this study aims to highlight the importance of technological progress in the distribution sector (the wholesale and retail trade) in Saudi Arabia, using appropriate economics and statistical methods.

2. Literature Review

Economic growth can be viewed as countries' movements toward the production possibility frontier (PPF). The increase in overall inputs or a technological progress will allow the PPF to shift out and increase the potential outputs. Given its resources, a country might fall short of producing the maximum possible output, a phenomenon popularly known as technical inefficiency (Kumbhakar & Wang, 2005). Microeconomic theory implies that not all producers are able to utilize the minimum quantity of required inputs in order to produce the desired quantity of output given the available technology (Constantin, et al. 2009). From the theoretical point of view, producers do not always optimize their production functions. The production frontier shows the minimum quantities of the necessary combinations of inputs to produce various products, or the maximum outputs with different combinations of inputs and a particular technology. Producers operating above the production frontier considered technological efficiency, while those who operate under the production frontier are denoted technically inefficient (Constantin et al., 2009).

Neoclassical economists assured that long run economic growth can only be sustained by external factors, namely technological progress that affect the increase in the efficiency of physical and human capital. Under the neoclassical growth model, the long run sustainability of growth in the absence of technological change depends critically on whether the substitution elasticity is greater or smaller than one. On the other hand, the recent literature brought about by technological progress has developed models that present different effects depending on the particular value of elasticity of substitution (Antras, 2004).

Most empirical economic studies have used the Cobb-Douglas production function to analyze the production process, not because it appears to be a simple tool that can be easily dealt with or considered a remedy for estimation problems, but because of the advantages it possesses (Murthy, 2002). Within the Cobb–Douglas framework, it weighs evidence of the two alternative explanations of total factor productivity differences: the inefficiency view and the appropriate technology view. To accomplish these tasks, the world production frontier was estimated using a nonparametric deterministic approach known as data envelopment analysis (Jerzmanowski, 2007).

Productivity growth can be decomposed into technological change (TC) and technological efficiency (TE). TC evaluates the effect in productivity from the adoption of new production practices (Bravo-Ureta et al., 2007). Technological efficiency (TE) measures the ability of producers to achieve the maximum output with given technology (Khai & Yabe, 2011). In other words, gains in TE are related to a host of variables including knowledge, experience and education (Bravo-Ureta et al., 2007). To measure technological efficiency, production frontiers need to be estimated. Both economic and operations research literature offer two approaches to estimate production frontiers parametric and nonparametric models (Mizala et al., 2002). Empirical literature widely estimated the technological efficiency using both cross sectional and panel data. using a Cobb Douglas stochastic frontier production function approach, like (Thiam et al., 2001; Alvarez, & Crespi, 2003; So, 2003; Binam et al., 2004; Baten et al., 2006; Barros & Dieke, 2008; Binam et al., 2008; Khai & Yabe, 2011; Assaf et al., 2011; Kumbhakar et al., 2014; Majumder et al., 2016; Alropy et al., 2019; Bahta, 2020). The study by Thiam, et al. (2001) tested the specific characteristics of the data and econometric specifications account for systematic differences in the efficiency estimates. The study used the two-limit Tobit procedure and the results indicate that factors such as primal versus dual, number of fixed inputs and number of variable inputs increase average TE estimates. On the other hand, using the Cobb-Douglas functional form and cross sectional data yields a lower level of TE. Some researchers make a distinction between technical and technological change; technological change is "change in knowledge" and technical change is "change in technique (Godin, 2015). Technological progress is a shift in the production technology that favors skilled over unskilled labour by increasing its productivity. Traditionally, there are three types of technological progress viewed as (Alloush, 2015):

1- Technical progress that supports the productivity of labour, which from Harrod's point of view is called Harrod-neutral technology or labour augmenting. The formula for its input is:

$$Y = f(K, AL) \tag{1}$$

2- From Solow's point of view, technical progress that supports the productivity of capital is called Solow-neutral technology or capital augmenting. Its connotative form is:

$$Y = f(AK, L) \tag{2}$$

3- Technical progress that supports the productivity of both labour and capital from Hicks' point of view, called Hicks-neutral technology or factor augmenting. Its connotative form is:

$$Y = A.f(K, L) \tag{3}$$

Romer (1990) considered Technical progress as an internal factor that results from the production of knowledge through research and development, as (A) here expresses the accumulation of knowledge through research and development and not technological progress:

$$Y = K^{a}(AL_{Y})^{1-a} \tag{4}$$

Empirical literature estimated the technological progress using Cobb Douglas as the study by Uri (1984) and Enaami et al. (2011) examined both disembodied technological progress and embodied technological progress in the capital stock and in the labour force in the United States. The results suggest that disembodied technological progress has been about 3% per year, embodied technological progress in the capital stock is approximately 4% per year and educational attainment significantly enhances labour productivity. Al-Abdulrazag, (2004) measured the impact of technological change in the construction sector in Jordan, using production functions. The results indicated the sector was affected by the technological change; moreover, technological change was biased towards the labour component at the expense of capital. AL-Refai et al. (2016) identify the effects of technological development on the industrial sector in Jordan used Cobb Douglas production. The study concluded that technological development has a positive impact on the industrial sector in Jordan. Al-Fahdawy and Al-Jumaily (2017) measured the impact of technological change in agriculture of Iraq. The finding suggests the sector was affected by the technical change. There is no partiality of technological change to production bolstered by technological working in Iraq's agriculture sector. Levius et al. (2018) explored the information and communication technology (ICT) strategies that managers of Barbados's wholesale trade businesses use to improve international competitiveness in Barbados. Data analysis revealed four themes that helped to understand the findings. These themes included competitive position and response, internal factors, IT-specific factors, and ICT experiences. The study by Nassar (2019) discussed the influence of intellectual capital on corporate performance of the Wholesale and Retail trade companies listed in Borsa Istanbul. The study findings indicated that Turkish wholesale and retail trade companies are paying good attention to the use of the Intellectual capital components, especially human capital in the company value added. Doms et al. (2004) examined the relationship between investments in information technology (IT) and retail firm performance. The study confirmed the significant relationship between IT investment intensity and retail firm productivity. Dastane (2020) proved that technological change and IT infrastructure positively and significantly affects the organization's productivity. Muchdie and Narmaditya (2019) revealed the positive and strong relationship between technology index and domestic trade in Baltic States. On the other hand, a study by Kim and Yoo (2014) analyzed the efficiency of retail businesses, by using data environment analysis to analyze how input elements such as store area, parking lot area, number of employees, and sales management expenses for the convenience of customers positively affect retail business performance. In addition, Bae (2012) evaluated the management performance of small and medium size retail businesses. Small or medium sized retail businesses face difficulties regarding the economies of scale.

3. Methodology and model specification

Charles Cobb and Paul Douglas in 1928 introduced the simplest production function used in economics; it is known as Cobb-Douglas production function CDPF, Cobb and Douglas (1928). CDOF considers a simplified view of the economy in which production output (*Q*) is determined by the amount of labour (*L*) involved and the amount of capital (K) invested, (Chisasa & Makina, 2013). This is a two-input production function, and can be formulated as follows:

$$Y = A.f(K,L) \tag{3}$$

Robert Solow in 1956 introduced a simplified model of growth. Solow relied on the production function of Cobb-Douglas to develop an analytical framework for the causes of growth and its movement over time (Solow, 1956). Then, in 1957, he added new ideas in this field, noting that the rate of growth occurs due to a set of growth rates in other factors of production beyond physical and human capital, which is technical progress (Solow, 1956). Solow model was built according to the following formula (Solow, 1956):

$$Y = A.f(K,L,T) \tag{5}$$

The variable T for time appears in the function to allow for technical progress. It is convenient to begin with the special case of neutral technical change. Shifts in the production function are defined as neutral if they leave marginal rates of substitution untouched but simply increase or decrease the output attainable from given inputs. In this case, the production function takes the special form:

$$Y = A(t)f(K,L) \tag{6}$$

When the formula is derived with time, we obtain the growth rates as follows:

$$\frac{\partial Y}{\partial t} = Y^* \qquad \frac{\partial A}{\partial t} = A^* \qquad \frac{\partial L}{\partial t} = L^* \qquad \frac{\partial K}{\partial t} = K^* \tag{7}$$

The time factor measures the impact of Disembodied Technological Change, which was intended to proceed in the productive process over time. Technical efficiency was defined as the maximum amount of goods and services produced by using the available economic resources at the lowest cost, as follows:

$$Q = TL^{\alpha} K^{\beta} \tag{8}$$

Q: The wholesale and retail trade sector production in Saudi Arabia.
T: Technological progress.
L: Number of Labour employed in the wholesale and retail trade sector in Saudi Arabia.
K: Gross Fixed Capital Formation in the wholesale and retail trade sector in Saudi Arabia.

α, β: Elasticity of the wholesale and retail trade production with respect to labour and capital, respectively. ($\alpha+\beta$) represent the return to scale if ($\alpha+\beta > 1$: Increasing return to scale (IRS)) or ($\alpha+\beta < 1$: Decreasing return to scale (DRS)) or ($\alpha+\beta = 1$ Constant return to scale (CRS))

The study relied on annual data from the General Authority for Statistics in Saudi Arabia, during the period from 2005 to 2019, to estimate the parameters (α, β, T), the function can be converted the linear logarithmic form as follows:

$$Log\ Q = Log\ T + \propto Log\ L + \beta Log\ K + \varepsilon \quad (9)$$

The Solow model has been widely used after its development by many researchers, especially with regard to methods of calculating material and human capital, and it is the developed model, on which the applied framework will be built in light of this study.

Following Abdel Hamid and Abdul Latif (2018), this study uses the Autoregressive Distributed Lag (ARDL) approach**.** The ARDL approach preferred to examine variables with small samples of time series data. Moreover, ARDL can be applied regardless of whether the variables are I (0), I (1), or both; the ARDL can distinguish between dependent and explanatory variables. That is, the ARDL assumes that only a single reduced form equation relationship exists between the dependent variable and the exogenous variables (Pesaran, et al., 2001). Pesaran and Shin, (1998), introduced ARDL model as follows:

$$\Delta Y_t = \delta_{0i} + \sum_{i=1}^{q} \alpha_1 \Delta y_{t-i} + \sum_{i=1}^{k} \propto_2 \Delta X_{t-i} + \delta_1 Y_{t-i} + \delta_2 X_{t-i} + \varepsilon_{it} \quad (10)$$

Where Xs are the explanatory variables, and Y is the dependent variable, `q and k are the numbers of maximum lag order in the form of ($ARDL$) model. δ is the coefficients of the long run relationships, and α is the coefficients of short run relationships between the variables in the model. Moreover, ε is the error correction term (ECT) which is the speed of short run adjustment of the model's convergence to long run equilibrium (Nkoro, & Uko, 2016). In this study ARDL model can be specified as:

$$\Delta Q_t = \delta_{0i} + \sum_{i=1}^{q} \alpha_1 \Delta Q_{t-i} + \sum_{i=0}^{k} \alpha_2 \Delta K_{t-i} + \sum_{i=0}^{k} \alpha_3 \Delta L_{t-i} + + \delta_1 Q_{t-1} + \delta_2 K_{t-1} + \delta_3 L_{t-1} + \varepsilon_{it} \quad (11)$$

Table 1: Augmented Dickey-Fuller Test

Variable	Level		1st difference		Order stationary
	Intercept	Trend and Intercept	Intercept	Trend and Intercept	
Q	- 1.045938	-0.847776	-2.728979*	-2.858801*	I(1)
K	-1.787828	-1.695975	-3.325248*	-3.184760*	I(1)
L	-7.18132*	-3.387178*	-3.002346**	-4.992279*	I(0)

* Means that it is significant at the level of 5%,
** Means that it is significant at the level of 10%

F- Statistic is carried out irrespective of whether the variables are purely $I(0)$, purely $I(1)$ or mutually cointegrated (Pesaran, et al., 2001). Test the coefficients of the lagged to differentiate the long run relationship between the underlying variables in the model.

The null and alternative hypotheses are as follows:

H_0: $\delta_1 = \delta_2 = \delta_3 = 0$ no long run relationship exists

Against the alternative hypothesis

H_A: $\delta_1 \neq \delta_2 \neq \delta_3 \neq 0$ the long run relationship exists

4. Empirical Results and Interpretations

ARDL cannot be applied when the underlying variables are integrated of order I (2), pretesting the model variables for unit roots becomes necessary to determine their order of integration and avoid spurious results. Therefore, the study used the Augmented Dickey-Fuller Test (ADF) to examine stationarity of the variable. The null hypothesis is that the variable has a unit root, the alternative hypothesis that the variable has no unit root. Table (1) shows the unit root tests using the ADF, all variables are stationary in the first difference, with trend and intercept which means that the time series used in the study are stationary from the first time lag (1). The null hypothesis was rejected because of the non-stationary and the unit root test from the first difference of time series data at a significant level (5%, 10%). ARDL technique is adopted irrespective of whether the underlying variables are I (0), I (1) or a combination of both.

To test the existence of a long-run relationship between variables in the model, the study employs ARDL Bound tests by means of the F- statistic (Wald test). Irrespective of whether the variables in the model are I (0) or I (1). The critical values of the F-statistics for different numbers of variables (K), and whether the ARDL model contains an intercept and/or trend are available. They give two sets of critical values. I(0) the lower critical bound which assumes all the variables are I(0), that means there is no cointegration among the underlying variables, and another assumption is that all the variables in the ARDL model are I(1) upper critical bound which assumes all the variables are I(1) (Pesaran et al., 2001). ARDL Bound tests for cointegration in Table 2, illustrated that the calculated F-statistics is higher than the upper bound for all Critical

Value Bounds and significant at 1%, 5% and 10% level in the model with the two explanatory variables. Thus, it can be concluded that there is a long run relationship between the wholesale and retail trade sector production in Saudi Arabia and the factors of production (labour, capital and technology).

Table 3 shows the estimate of the dynamic relationships of short and long run coefficient by applying the ARDL. The results show that the Error Correction Term (ECT) in the model is significant and negative. The negative value shows that there exists an adjustment speed from short run disequilibrium towards the long run equilibrium. That means that the wholesale and retail trade production in Saudi Arabia covers equilibrium due to the changes in the factors of production: labour, capital and technology.

Table 2: ARDL Bounds Test

Test Statistic	Value	K
F-statistic	103.5241	2
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	3.17	4.14
5%	3.79	4.85
2.5%	4.41	5.52
1%	5.15	6.36

The Error Correction coefficient in the equation estimates (-1.27), which is negative and statistically significant. Its value is also high, and this indicates high speed of adjustment from short run disequilibrium to long run equilibrium. Therefore, the long run adjustment speed takes less than one year; this confirms the existence of a stable long run relationship between the variables. Table 3 illustrates the long run coefficients of variables. It is observed that coefficients of factor of production (labour, capital and technology) are positive and statistically significant for all factors of production at 1%, 5% and 10% level. The results show the elasticity of the wholesale and retail trade production in Saudi Arabia with respect to capital and labour are about 0.26 and 0.78 respectively. The elasticity of production with respect to the labour component is greater than the elasticity of the capital component. The results also indicate that the sum of estimated parameters in the model are 1.04, which means that the wholesale and retail trade sector in KSA operates in light of increasing returns to scale (IRS), meaning that an increase in factors of production by 100% will lead to an increase in the production by 104%. The elasticity of the wholesale and retail trade production with respect to technological progress is 4.62%, which is positive and statistically significant. Therefore, technological progress has a positive and strong contribution to the growth rate of the wholesale and retail trade production in Saudi Arabia.

Table 3: ARDL Cointegrating And Long Run Form Selected Model: ARDL(1, 3, 1)

Cointegrating Form			
Variable	Coefficient	Std. Error	t-Statistic
DLOG(K)	0.253644	0.016082	15.771957
DLOG(K(-1))	-0.037160	0.013588	-2.734742
DLOG(K(-2))	-0.134082	0.010604	-12.644371
DLOG(L)	-0.494684	0.087284	-5.667542
CointEq(-1)	-1.268479	0.203240	-6.241277
Cointeq = LOG(Q) - (0.2636*LOG(K) + 0.7801*LOG(L) + 4.6218)			
Long Run Coefficients			
Variable	Coefficient	Std. Error	t-Statistic
LOG(K)	0.263578	0.018921	13.930159
LOG(L)	0.780101	0.060085	12.983300
C	4.621829	0.561563	8.230299

5. Conclusions

5.1. Discussions and implications

The results showed that there is a long-run relationship between the production of the wholesale and retail trade sector in Saudi Arabia and the factors of production: labour, capital and technological progress. The Cobb-Douglas production function parameters can be interpreted directly as output elasticities. The parameters of labour, capital and technological progress have positive signs and are statistically significant at the 1 % level. This implies that these inputs are playing a major role in the wholesale and retail trade production in Saudi Arabia. The elasticity of technological progress is the highest compared to labour and capital, implying that the contribution of technology progress in total factor productivity is dominant. A one percent increase in the use of labour leads to a 78 % increase in the wholesale and retail trade production in Saudi Arabia. A one percent increase in the use of capital leads to a 26% increase in the wholesale and retail trade sector in Saudi Arabia. The sum of estimated parameters of labour and capital in the model are 1.04, which means that the wholesale and retail trade sector in KSA operates in light of increasing returns to scale (IRS), meaning that an increase in the factors of production (labour and capital) by 100% will lead to an increase in the production by 104%.

The important input is technological factors used in the wholesale and retail trade sector production. The elasticity of the production of the wholesale and retail trade sector with respect to technological progress is 4.62%, which means an increase in technology use by one percent the Production in the wholesale and retail trade sector quadruples. The results in line with Aljebrin (2013), used Cobb-Douglas function to estimate economic growth in Saudi Arabia. The result shows that the elasticity of output with respect to capital and labour were about 0.67 and 0.57 respectively. Technological progress has a positive contribution to the growth rate of output 8.67% a year.

Therefore, the distribution activities in Saudi Arabia can be improved by improving technology used in production because the greater use of technology increases the wholesale and retail trade sector production. This indicates the existence of potentials through technological development to improve the productive efficiency of the resources allocated to the distribution activities of the wholesale and retail trade sector in Saudi Arabia.

5.2. Limitations and future directions for research

The study aims to estimate the role of technological progress on the distribution sector (wholesale and retail trade) production in Saudi Arabia economy. The study relied on unpublished data from The General Authority for Statistics. The study faced a number of limitations, including the lack of data for a longer period of time as well as the absence of previous studies on the distribution sector at the level of Saudi Arabia, as well as the lack of detailed data for the retail sector and the wholesale sector separately.

The General Authority for Statistics in Saudi Arabia has started publishing the internal trade sector survey data on its website, and this will draw the attention of researchers in the future to this important sector. Future studies can be conducted that focus on estimating the production function of the retail sector and the wholesale sector separately, using different statistical methods and comparing results. Also, studies can be conducted to measure the contribution of the distribution sector in the economic growth and employment.

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