Turkish Online Journal of Qualitative Inquiry (TOJQI)
Volume 6, July 2021 : 6773 - 6779

Research Article

Pharmaceutical Industry And Economic Growth: Non-Traditional Empirical Analysis

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ANNOTATION

This article examines the connection connecting the pharmaceutical industry and economic growth. In this case, the connection between the pharmaceutical industry and economic growth was determined using a «contingency table,» and its impact on economic growth is based on the "Kerrich method." Empirical analyzes have confirmed that there is an essential link between the pharmaceutical industry and economic growth.

Keywords: pharmaceutical industry, economic growth, correlation analysis, regression coefficient, "contingency table," Kerrich's method.

INTRODUCTION

The pharmaceutical industry is an entire sector of the economy based on knowledge and innovation, consisting of enterprises producing and distributing, veterinary and medical products. The main activity of the industry is development, innovation, and research for the production of new pharmaceutical products. New pharmaceuticals have significant positive effects on well-being and profitability, extending life expectancy, preventing surgery, and shortening hospital stays. The benefits of this sector in the national economy are attributed to the reduced burden and costs of the pension system and the health care system, improved quality of life-related to health, the preservation of existing jobs, and the creation of new jobs.

Research shows that the pharmaceutical industry is an essential source of growth and competitiveness in many developed countries. Several studies support an essential correlation between pharmaceutical industry exports and GDP by examining the connection between the pharmaceutical industry and GDP in terms of trade. These studies show that the pharmaceutical exports of countries specializing in this sector positively affect GDP and GDP per capita. Furthermore, the high level of export competitiveness in the industry is significantly dependent on the discovery and production of new drugs and medical products [1].

Further research to explain the impact of the pharmaceutical industry on economic growth will focus mainly on

the innovation factor. In particular, investment in research and development is the most crucial aspect of the innovation factor, which, in turn, is the key to supporting growth and ensuring the stability of the national economy [2].

Most studies argue that innovation, investment in research and development, and investment in technology are the keys to competitiveness and development that sustainable economic growth can be achieved through them. Furthermore, these studies link a stable level of labor education, an increase in investment in research, the creation of new products and the development of the public and private sectors, and an improvement in the living conditions of the population [3].

In the following line of research, confirming the existence of an essential link between the pharmaceutical industry and economic growth, they emphasize that the contribution of human capital to economic growth is very high, and the health factor is the most crucial aspect of human capital and considered as the most crucial element of economic growth. At the same time, healthy workers are considered physically and mentally strong, their work is more productive, and their wages are higher. The conclusion is that a healthy workforce is considered a significant factor in overall resourcefulness and productivity [4].

Subsequent growth theories confirm that there is a two-sided correlation between health and economic growth. Empirical analysis shows that life expectancy or health condition, measured by similar gross indicators, is the most crucial factor in subsequent growth. In practice, primary health care can better predict future economic growth when compared to primary education [5].

In developed and developing countries in the health sector, most of the costs associated with this sector are spent on medicines. Therefore, it is believed that improving drug use will make a worthy contribution to the well-being of families and individuals and economic growth and development in all societies. Furthermore, research in this area confirms that the development of the pharmaceutical industry has a positive effect on the health care system [6].

Summarizing the scientific findings of the above research and studies, it can be said that the development of the pharmaceutical industry in the country and its positive impact on economic growth can be achieved by ensuring the sustainability of export, innovation, and health care systems.

Contrary to the above considerations, the author explains the development of this sector by its positive impact on economic growth by stimulating agriculture, high knowledge-intensive industries, some sectors of machinery, and some service sectors.

Today, in an environment where the impact of the pandemic factor on the economy and real life is growing worldwide, the development of this sector is of great economic importance. Therefore, the study examines the impact of this sector on economic growth. Also, while most studies examine the impact of this sector on economic growth using modern economic growth models, in our case, the issue is explored using non-traditional correlation and regression analysis methods.

The results and scientific conclusions obtained during the study will provide an opportunity to make essential decisions on ensuring economic growth and macroeconomic stability through the development of this sector.

MATERIALS AND METHODS

In order to study the relationship between the production of the pharmaceutical industry in the country and economic growth (GDP), we use non-traditional methods of correlation and regression analysis of econometric evaluation.

In this case, we study the correlation between the pharmaceutical industry's production and economic growth using the "correlation table" of correlation analysis and the impact of pharmaceutical production on economic growth using the Kerrich method.

The difference between the "correlation table" of the correlation analysis and the traditional double correlation coefficient is that this method is based on data generated using respondents' surveys rather than statistically observed values used to calculate the double correlation coefficient. This, in turn, allows the formation of critical scientific conclusions in the absence of statistical data for econometric analysis.

The Kerrich method only allows the value of the regression coefficient to be determined. However, since the study's primary goal is to determine the impact of the pharmaceutical industry on economic growth in the country, this method is considered appropriate.

Second, we know that if one of the conditions of the linear regression model is violated, then the result of the Gauss-Markov theorem is incorrect, and this situation limits the possibilities of linear regression to some extent. However, the Kerrich method used in our country is free from such a problem.

RESULTS

Based on the above considerations, we will form an overview of the "correlation table." If we represent a two-dimensional correlation table in the form of a matrix, its general appearance was as follows [7]: let's say we have two X and U symbols, and the first character took the values "r," 1,2,…, r and the second character "c," 1,2,…, c. [7]

$$\left\| n_{ij} \right\| = \begin{Vmatrix} n_{11} & n_{12} & \dots & n_{1c} \\ n_{21} & n_{22} & \dots & n_{2c} \\ \dots & \dots & \dots & \dots \\ n_{r1} & n_{r2} & \dots & n_{rc} \end{Vmatrix} \quad (1)$$

In this case, the n_{ij}-number formed by the intersection of the i-row and the j-column represented the number of observations from the total number n.

Based on the symbols *X* and *U* and the formula (1), this matrix can be more accurately expressed in the form of the following table (Table 1).

Table 1

An overview of the correlation table

X	*Y*						∑
	1	2	...	*j*	…	*c*	
1	n_{11}	n_{12}	…	n_{1j}	…	n_{1c}	n_1
2	n_{21}	n_{22}	…	n_{2j}	…	n_{2c}	n_2
…	…	…	…	…	…	…	…
i	n_{i1}	n_{i2}	…	n_{ij}	…	n_{ic}	…
…	…	…	…	…	…	…	…
r	n_{r1}	n_{r2}	…	n_{rj}	…	n_{rc}	n_r
∑	n_1^*	n_2^*	…	n_j^*	…	n_c^*	*n*

Resource: [8].

In this case, *n* is the sample size, which consisted of all columns or all rows. Also, *the X-column* represented the pharmaceutical industry's production, and *the U-row* represented GDP growth.

We used the following statistics as a measure of a link between the pharmaceutical industry and GDP [9]:

$$\chi^2 = n\left(\sum_{i=1}^{r} \sum_{j=1}^{c} \frac{n_{ij}^2}{n_i n_j^*} - 1 \right) \quad (2)$$

In this case, the correlation χ^2 between the degree of freedom $f = (r-1)(c-1)$ distribution and $\chi^2 \succ \chi_\alpha^2[(r-1)(c-1)]$ the probability of *a* correlation between the production of the pharmaceutical industry and GDP is reasonable.

So when $\chi^2 \succ \chi_\alpha^2[(r-1)(c-1)]$ H_0 : (there was no correlation between the pharmaceutical industry and economic growth) we rejected the hypothesis and accepted hypothesis H_1. However, it should be noted that the χ^2 square statistic also had inconveniences in assessing the link between characters. Because its value was not standardized, in particular $n \to \infty$ $\chi^2 \to \infty$. Therefore, some specific correlation coefficients proposed for estimating correlation according to the table $r \times c$, one of which was the Chuprov coefficient:

$$K_R = \left\{ \frac{\chi^2}{n[(r-1)(c-1)]^{\frac{1}{2}}} \right\}^{\frac{1}{2}} \quad (3)$$

The K_R coefficient was ± 1 only when there was a complete correlation of the $r = c$ characters. Then the correlation coefficient was represented by χ^2, the verification of their significance was carried out using the significant values of the distribution χ^2, and when there was a correlation of the $K_R \succ K_R(\alpha)$ characters was considered necessary.

The following simple assessment was considered in the study of correlation by the Kerrich method, which included the following [9-10]:

$$d_i = \lg y_i - \lg x_i \tag{4}$$

According to formula (4), the average obtained from the individual values of the parameter *di* was equal to:

$$\bar{d} = \frac{1}{n}\sum_{i=1}^{n} d_i \tag{5}$$

and

$$S_{\bar{d}} = \left\{ \frac{1}{n(n-1)} \sum_{i=1}^{n} \left(d_i - \bar{d}\right)^2 \right\}^{\frac{1}{2}} \tag{6}$$

In this case, any ratio of *yi/xi* was equal to the value of *a*, and any value of *di* was equal to the value of l*ga*.

When $S_{\bar{d}} / \bar{d} \prec\prec 1$ it was small, the lg*a* value equalized to $\bar{d}$, and it resulted as $\tilde{a} = 10^{\bar{d}}$.

Thus, the above two methods allowed us to study the connection between the pharmaceutical industry and GDP quantitatively, and the results obtained were reflected in the following section.

The results of the interaction between the pharmaceutical industry production and GDP, based on the respondents' questionnaires, are reflected in the following table (Table 2).

Table 2

Survey results

Level of production of the pharmaceutical industry	**Economic growth (GDP) level**					∑
	Very high	**High**	**Median**	**Low**	**Minor**	
High	65	53	19	39	15	**191**
Median	72	86	75	87	55	**375**
Low	29	39	29	19	68	**184**
∑	**166**	**178**	**123**	**145**	**138**	**750**

.

In this case, with the number of rows and columns of the table - the degree of freedom was equal to 8.

Also, according to formula (2), the calculated value of the square statistic χ^2 was equal to 37.087, and its $\alpha = 0.95$ probable table value ($\chi^2_{0.95}(8)$) was equal to 15.50. According to formula (3), Chuprov's correlation coefficient *(K_R)* was 0.132.

The dynamics of the *di* parameter calculated based on formula (4) according to the Kerrich method was expressed in Figure 1 below, the average of which was - 0.17.

According to the Kerrich method, it was expedient to check the fulfillment of the following condition $S_{\bar{d}} / \bar{d} \prec\prec 1$, according to which the fulfillment of this condition was equal $\tilde{a} = 10^{\bar{d}}$. Based on the calculation, we had the result of $S_{\bar{d}} / \bar{d} = 0.03$

Hence, it followed that the regression coefficient ($\tilde{a} = 10^{\bar{d}}$) calculated by the Kerrich method was 0.68.

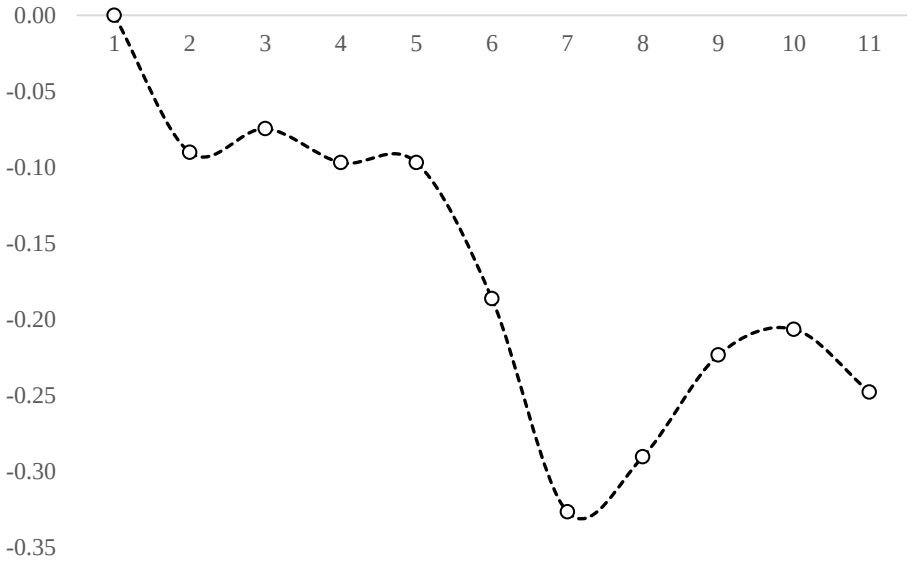

Figure 1. The di parameter calculated by the Kerrich method dynamics of values

In addition, the correlation between pharmaceutical industry production and GDP could also be seen in the following correlation area (Figure 2).

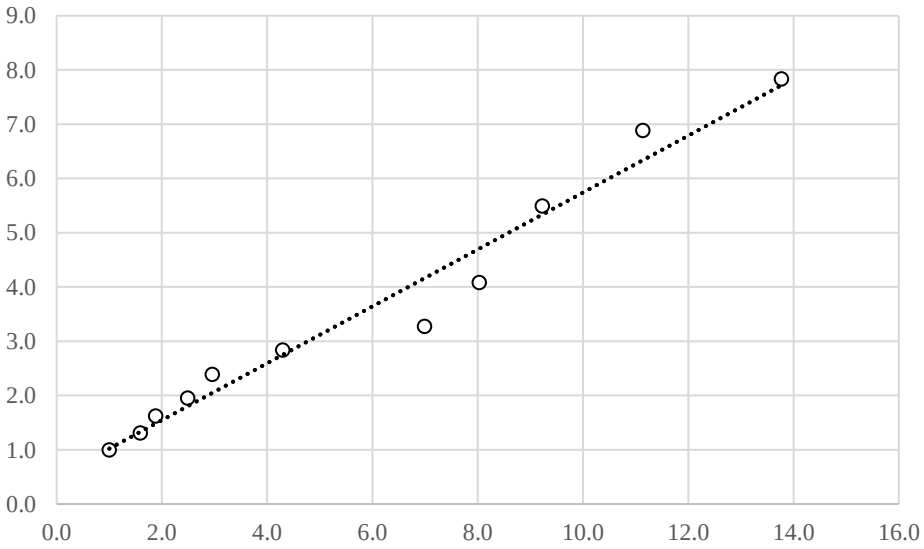

Figure 2. Graph of the relationship between pharmaceutical industry production and GDP

DISCUSSION

According to the results of the analysis, it was found that $\chi^2 = 37.087 \succ \chi^2_{0.95}(8) = 15.507$. Based on this result, our hypothesis H_0: (no correlation between the pharmaceutical industry and economic growth) was rejected, and hypothesis H_1 was accepted instead. Based on hypothesis H_1, it was found that there was a significant correlation between the production of the pharmaceutical industry and economic growth.

According to the results obtained, the parameter's value $S_{\bar{d}} / \bar{d}$ was 0.03, and the $S_{\bar{d}} / \bar{d} \prec\prec 1$ fulfillment condition was recognized as reasonable. Furthermore, the fulfillment of this condition showed that the regression coefficient ($\tilde{a} = 10^{\bar{d}}$) calculated by the Kerrich method was reasonable and amounted to 0.68.

The most crucial indicator of regression analysis was the regression coefficient, which indicated how many units could change on average when a factor changes by one unit. Regression analysis results in regression equations that quantify economic indicators.

According to the regression coefficient calculated by the Kerrich method, an additional 1 percent increase in the pharmaceutical industry's production rate could lead to an additional 0.68 percent increase in economic growth, i.e., GDP growth.

The scientific results of empirical analysis have once again confirmed an essential relationship between the pharmaceutical industry and the country's economic growth.

The results we have obtained and their economic content were in line with our views on the development of the global pharmaceutical industry and its positive impact on economic growth.

The empirical analysis carried out only directly reflected the impact of the pharmaceutical industry's production on the country's economic growth. However, a wide range of economic studies showed that the development of this sector also indirectly affected the country's economic growth. In particular, this sector would stimulate the development of agriculture, industries with high demand, some mechanical engineering sectors, and some service sectors. A special place in the study of important relationships between these types of relationships was occupied by the "table of interdependencies," which required the effective use of expert opinions in assessing development in the absence of statistical data of the object or socio-economic phenomena. This, in turn, served in the formation of essential statistics.

Economic policies aimed at stimulating exports in many countries pay special attention to the development of this sector, including the production of innovative pharmaceutical products, which contributed to the country's exports, which, in turn, contributed to sustainable economic growth.

CONCLUSION

According to the analysis results, the calculated values of the χ^2 square statistic turned out to be larger than its table values. As a result, our hypothesis H_0: (there was no correlation between the pharmaceutical industry and economic growth) was rejected, and hypothesis H_1 was accepted instead. According to hypothesis H_1, there was a significant correlation between pharmaceutical industry output and economic growth. According to the results obtained, the parameter's value $S_{\bar{d}} / \bar{d}$ was 0.03, and the $S_{\bar{d}} / \bar{d} \prec\prec 1$ fulfillment of the condition was recognized as reasonable. The fulfillment of this condition showed that the regression coefficient calculated by the Kerrich method was reasonable and was 0.68.

According to the Kerrich regression coefficient, an additional 1 percent increase in pharmaceutical production could lead to an additional 0.68 percent increase in economic growth, GDP growth. The study noted that the impact of pharmaceutical products on the country's economic growth was indirect and indirect since its development stimulated the development of agriculture, higher education, some machines, and many service sectors.

Taking into account the above opinions, in order to develop the pharmaceutical industry in the country and increase its share in GDP, widely introduced the latest scientific developments in this area, radically improved the quality of education, additionally strengthened the raw material base and deep processing of local raw materials, the transition to the method turned out to be expedient.

CONFLICT OF INTERESTS AND CONTRIBUTION OF AUTHORS

The authors declare the absence of apparent and potential conflicts of interest related to the publication of this article and report on each author's contribution.

SOURCE OF FINANCING

No funding was required for this research.

LIST OF REFERENCES

1. Muratoglu G. Does Pharmaceutical Industry Boost Economic Growth? A Competitiveness-Related Approach. Journal of Yasar University, 2017, 12/48, 296-314.
2. Pham D. Nam. The Innovative Pharmaceutical Manufacturing Industry: Driving Economic Growth. March 2015., NDP analytics.
3. Andreea Maria Pece et al. Innovation and Economic Growth: An empirical analysis for CEE countries.

Procedia Economics and Finance 26 (2015) 461 - 467.

4. Bloom D. E., Canning D., & Sevilla J. 2004. The effect of health on economic growth: a production function approach. World Development, 32(1), 1-13.
5. Barro R. Health and Economic Growth. Annals of Economics and Finance 14 - 2, 329 - 366 (2013).
6. Eduardo Urias "The Contribution of the Pharmaceutical Industry to the Health Status of the Developing World" In Multinational Enterprises and Sustainable Development. Published online: 19 Sep 2017, 41 - 67.
7. Kateri M. Contingency Table Analysis: Methods and Implementation Using R, Statistics for Industry and Technology, DOI 10.1007/978-0-8176-4811-4-2, Springer Science+Business Media New York 2014.
8. Fagerland M.W., Lydersen S., Laake P. Statistical Analysis of Contingency Tables. 2017 by Taylor & Francis Group, LLC. P. 275.
9. Кобзарь А.И. Прикладная математическая статистика. Для инженеров и научных работников. - М.: ФИЗМАТЛИТ, 2006. - 816 с.
10. Kerrich J.E. Fitting the line *y=ax* when observation errors are present in both variables//The American Statistician. 1966. V. 20. P. 24.