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Investigation of The Effects of Technological Development Indicators on Employment in Türkiye: A Bayesian Approach

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Türkiye'de Teknolojik Gelişme Göstergelerinin İstihdama Etkisinin Araştırılması: Bayesian Yaklaşımı

Abstract

In this paper, the relationship between the employment and the technological development is determined. Technological development affects employment both positively and negatively. It is the common goal of the countries to direct this effect positively. The study examined the relationship between the employment rate and two variables, R&D expenditures and the number of patents (resident and non-resident), representing technological development indicators, with the data for the 2004-2019 period in Türkiye. Linear regression and Bayesian regression analysis have been used as the methodology. As a result of the study, it has been determined that there is a positive and significant relationship between technological development indicators and employment. Studies in this field can provide precious contributions to helping countries plan employment.

Keywords : Technological Development, Employment, Bayesian Regression Analysis.

JEL Classification Codes : O3, O20, C11.

Öz

Bu çalışmada temelde, istihdam ile teknolojik gelişim arasındaki ilişki tespit edilmeye çalışılmaktadır. Teknolojik gelişim istihdamı olumlu ve olumsuz olmak üzere iki yönlü etkilemektedir. Bu etkinin olumlu yönde yönlendirilebilmesi ülkelerin ortak gayesidir. Çalışmada 2004-2020 dönemine ait verilerle Türkiye'deki genel istihdam oranı (EMP) ile teknolojik gelişim göstergeleri olan Ar-Ge harcamaları (RD) ve patent sayısı (PA) arasındaki ilişki incelenmiştir. Çalışmada yöntem olarak, regresyon analizi ve Bayesyen regresyon analizi kullanılmıştır. Yapılan çalışma sonucunda teknolojik gelişim göstergeleri ile genel istihdam arasında pozitif yönlü ve anlamlı bir ilişki olduğu tespit edilmiştir. Bu alana yönelik çalışmaların istihdam konusunda ülke planlamasına yardımcı olması açısından önemli katkılar sağlayabileceği düşünülmektedir.

Anahtar Sözcükler : Teknolojik Gelişim, İstihdam, Bayesyen Regresyon Analizi.

1. Introduction

Employment is a process that is evaluated by considering the working relationship of individuals in a job. Individuals working in a workplace where their rights are regulated by contract or agreement continue to work in the positions determined by the workplace. In this way, everything from the employee's income to the social security they have and their status at the workplace is evaluated within the employment framework. Here, the employer could sometimes be private companies or public institutions. Employment, whether in the public or private sector, has advantages such as obtaining financial income, having social security, benefiting from the contribution provided to society, developing professional skills, and career advancement; in addition to these advantages, unemployment, economic crisis, etc. When it comes to specific situations, difficulties in providing employment are encountered. These difficulties in employment are the negative situations faced in case of sectoral change and insufficient job opportunities. In general, employment is a substantial factor in the development and welfare of the society and the country's economic growth (Doğaner, 2022: 353).

In developing countries such as Türkiye, employment or economic growth could fluctuate concerning other economic indicators, including but not limited to inflation, prices and exchange rates. To illustrate, some indicators can be shocked by technologies, labour allocations or sector changes. As a part of economic indicators in Türkiye, employment is a critical variable closely followed by all segments. Türkiye, which has significant workforce potential, employment rate, economic development, economic stability, and economic growth, is significantly affected by developing technology. Sectoral change, business policy, unemployment rate, education and skills, demographic factors, investment, technological development, economic growth, and other factors significantly impact employment (Vivarelli, 2013: 80-81). Since these values are necessary measurements that are widely used to measure the employment development of countries and the health status of employment, the World Bank, Turkish Statistical Institute (TUIK), and Turkish Employment Agency (İŞKUR) are the official sources where these data are collected and analysed. Some of these variables that official sources use to monitor and analyse employment growth are briefly explained below.

As mentioned above, sectoral change is an increase or decrease in employment among the sectors for various reasons. Due to technological, economic, and demographic factors in countries, some occupational groups and sectors lose their importance. It causes employment problems or the emergence of new occupational groups (Bayar & Öztürk, 2021: 120). Increasing consumer demand due to technological development and new job opportunities increases the employment rate (Cengiz & Şahin, 2020: 163). In this process, the need for skill development among employees and the problems of adapting to new situations may arise. This problem can be easily overcome by training and retraining opportunities for employees to update their skills and sometimes learn new ones.

On the other hand, another aspect of employment is business policy, which refers to the decisions taken by states to ensure the continuity and efficiency of the economic system. These decisions include employment incentives, employment regulations, education and skills development policies, unemployment benefits and employment services, workplace cooperation, and dialogue. Therefore, similar arrangements affect business policy's effects on employment productivity (Rubart, 2007: 47-71).

When it comes to the employment rate, whether it is accounted for by economic growth or not, one should always consider the unemployment rate, which is a measure obtained by dividing the working-age labour force population by the total labour force. A low unemployment rate is expected and desired by the entire business world. On the other hand, a high rate indicates that the potential job-seeking workforce needs help to find the job they are looking for and are faced with unemployment (Cressey & Jones, 1995: 1-3, 23-25).

While economic growth is on the negative side of the unemployment rate, according to Okun's Law, the country's gross domestic product needs to increase. Developing technological innovations, structural changes, and automation provide economic growth and thus increase employment (Cengiz & Şahin, 2020: 170). Economic growth will increase the spending tendency and demand of people with growing incomes. To respond to these demands, companies will tend to increase their employment to increase their production. In addition, this increase in employment contributes to economic growth.

Since economic growth could be affected by private investments via interest rates, which indirectly would cause inflation to change aggregate supply and demand, private investments are one of the factors that directly affect employment and cover issues such as the growth of enterprises, competitiveness, new job opportunities, development of workforce skills, and the continuation of the supply chain. In addition, since investments directly affect economic growth, employment is positively affected (Çelik, 2020:413-415).

It can be taken into account that one of the variables of economic growth is technological changes. Technological developments often have a two-way effect on employment. On the one hand, due to rapid advances in automation, software, and artificial intelligence, along with technological developments, some business branches have lost their effectiveness and caused the employment rate to decrease. On the other hand, new business areas and sectors are formed in light of these developments and increase employment (Cafrı & Selci, 2020: 3268).

Another crucial pillar of employment is education. While countries are creating their education systems, they aim to train talented workforce according to the quality of the education applied. Workforce the qualified workforce trained for this purpose will inevitably contribute positively to the increase in employment (Cafrı & Selci, 2020: 3275-3277). Because in a sound education system, the increase in the quality of the workforce will

increase employment thanks to skill development opportunities and applied vocational programs.

Skills can also result from demographic factors, including the population structure of countries, young, middle, and elderly population rates, migration, and working population rates. Here, the increase in the educated and young population provides an increase in employment, while the rate of the elderly population decreases employment (Bayar & Öztürk, 2021: 120).

The remainder of the study is structured as follows. The first part of the study shows a relationship between technological development and employment. The next part includes a literature review, including national and international studies. Then, information about the study method, the MCMC method, and the WinBUGS program are given. The next part mentions the findings and the inferences based on the findings and the comparison of the classical and Bayesian linear regression methods. The last part includes the conclusion, discussion, and suggestions.

2. Technological Development and Employment Relationship

The relationship between technological development and employment is significant and wide-ranging. Along with technological development, the work done through automation systems, the emergence of new job opportunities, increased efficiency in business processes, the need for talent development, the formation of flexible working models, and similar changes (Aydın, 2018: 462-464). Technological development has enabled machines to do many jobs automatically. Technological advances such as robotic systems, artificial intelligence, and automation have paved the way for the machine to replace humans. This situation has brought about the creation of new job opportunities connected to the machine. With the development of technology, the need for a qualified workforce that can analyse big data, actively use artificial intelligence and have different cybersecurity abilities has increased. The needs in this field have positively contributed to employment with its qualified workforce. Along with the development of technological software and hardware, the operations performed in the computer environment accelerate and contribute to the increase in productivity. With the technological development in some jobs, the need to develop talents has arisen. To acquire and develop these new skills, it is vital to take advantage of access to adult learning opportunities. In parallel with these developments, working habits are changing, and remote working and freelancing are becoming more popular. With the development of technological infrastructure and internet access, any desired work has become possible (Şahin et al., 2015: 99-105). In addition, it is inevitable for employees to interact with technology in the institution where they work in the face of developing technology. Her work is integrated with technological devices, regardless of what she does. With the development of technology, this number will inevitably increase.

From this point of view, there is a direct relationship between technological development and employment, and this relationship has two aspects. On the one hand, the sectors in which some jobs take place lose their importance and negatively affect employment; on the other hand, the emergence of new job fields affects employment positively (Tiftik, 2021: 101). In this case, countries have to adapt to rapid change and adapt to change by constantly improving their skills to avoid problems in employment. If the adaptation process is well controlled, it is inevitable that there will be an improvement in the employment rate. Otherwise, the employment rate will show a negative trend if the process cannot be adopted.

R&D expenditures made in countries are strategic investments that significantly impact many areas, such as technological development and progress, innovation, increase in competitiveness, and improvement of employment conditions. With the support of innovative ideas and products, the competitiveness of countries and companies in new markets will increase and support growth. At the same time, these new products and discoveries will increase productivity and effective production (Inekwe, 2015: 729-732; Duman & Aydın, 2018: 50). Considering these developments, new qualified job opportunities will be created, and new skills will be learned due to interdisciplinary interaction. As a result, innovative companies established or renewed themselves because of R&D expenditures, which will contribute positively to developing the country's economy and employment.

Countries' patent data are used as a measure of technological development. In addition, with these patent data, we can interpret which areas the countries are heading and the competitiveness of the countries with each other. For sustainable economic growth to be possible, it is realised by following the innovations and developments in the world's countries and imposing and adapting these innovations within its own country. Patent applications made in this regard are necessary. In many studies, it has been concluded that patent applications are an essential variable in increasing the potential of innovation in the development of countries and in reaching the level of developed world countries or in maintaining and developing the level of development (Tekin & Demirel, 2022: 361-362).

The number of patent applications is crucial to maintaining a certain level of competitiveness among world states. Patent types can be diversified under the patent system and the utility model.

In the examination patent system published with the research report, inventions are made open to critical thinking after publication. Because of this process, whether they are patentable is determined by the score given by subjecting them to the test report.

The utility model comprises the part where the inventions are evaluated and registered, and the registered products are protected for ten years.

3. Literature Review

The studies examined the relationship between employment and R&D expenditures, technology exports, internet users, high-tech patent applications, and innovation variables. Only (Bulut & Yenipazarlı, 2020: 15; Cafrı & Selci, 2020: 3265) studies included the variables in our study. To the best of our knowledge, no studies in the literature have examined the effects of technological development indicators on employment with our methods. Most literature studies have used panel data, Johansen cointegration, least squares, ARDL, and Quantile Regression methods. The most crucial difference between the study and the existing literature is the variables and methods used. From these perspectives, the study aims to provide valuable insights for policymakers. Some studies in the related literature are as follows.

Cantner and Kösters (2009) studied the effectiveness of R&D subsidies in the first three years for the employment growth and patent output of start-ups in Thuringia, part of East Germany. They found that increasing the subsidies would increase employment growth by around 65% and patent output almost threefold. They suggest policymakers should care about targeting R&D schemes and opting for successful ones.

In Lachenmaier & Rottmann's (2011) study, GMM was analysed using panel data to estimate the impact of innovation on employment. The analysis revealed a significant and positive relationship between innovation studies and employment.

In their paper, Buerger et al. (2012) analysed the lead-lag linkage between R&D, the growth rate of patents, and employment using panel data methods in 1999 and 2005 for German regions. As a result, they concluded that an increase in the growth rate of patents causes an increase in employment growth, especially in industries such as medicine, optical technology, electronics, and electronics. For the electrics and electronics industries, the growth rate of patents also causes an increase in the growth of R&D. None of the effects mentioned couldn't be found significant for the chemical and transportation equipment industries.

Tamayo and Huergo (2016) conducted an empirical analysis using panel data techniques on data from Spanish companies to investigate the relationship between employment and R&D expenditures. The study determined a positive and significant relationship between the variables.

Şahinoğlu & Varıcı (2019) analysed the relationship between Türkiye's technological development and employment between 1989 and 2017 using the ARDL method in their study. The study developed three models: total employment, educated employment, female employment rates, and technological development. According to the analysis results, total jobs and female employment have a negative relationship with technological development, and there is a meaningless relationship between educated employment and technological development.

In Bulut & Yenipazarlı's (2020) study, the relationship between technology indicators and employment was analysed using the least squares method based on data from 81 countries. It has been determined that the effects of R&D expenditures and high technology exports on employment vary.

In the study of Cafri & Selci (2020), the effects of technological indicators on R&D expenditures, internet users, and the number of high-tech patent applications on women's employment were examined. In addition to technological variables, variables such as GDP, poverty, vocational training and internship, immigration, government effectiveness, and the level of women with primary and higher education levels were included as control variables, and the two-stage system was analysed with the GMM method. It was concluded that these variables have a positive effect on female employment.

In the study of Cengiz & Şahin (2020), Quantile Regression analysis was used to examine the impact of economic progress and R&D expenditures on employment in Türkiye between 1990 and 2018. As a result of this analysis, while there was a significant and positive relationship between employment and R&D expenditures, no significant relationship could be found between unemployment and economic growth.

Çelik (2020) analysed the effects of technology on employment in Türkiye between 2010 and 2017 with the GMM method. The relationship between the variables of R&D expenditures, higher education graduates, and employment was investigated separately, and a significant and positive relationship was found between the variables in both cases.

In Uyar (2020), the Johansen Co-integration test was used to examine the relationship between Türkiye's economic growth between 1984 and 2018, the total number of patents of the GDP dependent variable, and the foreign investment independent variables. The causality between the variables was measured with the help of the Granger causality test. As a result, it was determined that the relationship between these variables was significant and positive.

Bayar & Öztürk (2021) applied the vector autocorrelation model and Johansen cointegration analysis to test how technological development affects employment. In the study, it has been determined that exports of medium and advanced technology have a negative relationship with employment; in contrast, the number of patent applications and R&D expenditures have a positive relationship with employment.

Doğaner (2022), in her study, analysed the relationship between employment in Türkiye, the number of patent applications, and R&D expenditures among the technological development indicators between the years 2000 and 2020 using the ARDL method. As a result of the analysis, the cointegration effect between technological development indicators and employment was determined, and R&D expenditures had a negative relationship with employment. The number of patents had a positive relationship with employment.

In the study of Kiani, Sabir, Qayyum & Anjum (2023), some countries from South Asia and Southeast Asia were selected to investigate the impact of technological innovations on the environment between 1991 and 2018. The obtained data were analysed using a cointegration test, unit root test, and autoregressive distributed lag model to examine the impact of these countries' ecological footprints on GDP, number of patent applications, urbanisation, trade openness, and renewable energy consumption.

Some studies question not only the size of the employment but also the sign of the employment. In a recent paper by Babina and Howell (2024), the changes in corporate R&D investment would affect the mobility of labour in which direction. It is seen that the technologies, skills, and ideas that companies should give more importance to are carried to start-ups by employees. Those start-ups tend to be higher tech and high wages based on the changes in R&D.

As stated before, when looking at nexus studies in the literature, there is no specific study handling the effects of technological development indicators on employment using Bayesian regression. Although most of the studies have used R&D as a technological indicator, not only R&D but also the number of patents should be proxied as the technological development indicator. Moreover, the literature needs the Bayesian approach, primarily with datasets limited to periods. This study provides to establish a model with both linear and iterated datasets. However, further studies could permanently be opted in the case of different distribution structures or when considering non-linearity.

4. Data, Model Specification and Methodology

Bayesian regression analysis is a method used in fields such as medicine, economics, finance, social sciences, and engineering, and its use is increasing with the development of technological infrastructure. In addition to making data-based predictions, it has an advanced mathematical framework structure that questions the model's reliability and tests the parameter effect. This method works depending on obtaining the posterior distribution by combining the prior knowledge with the available data (Bernardo & Smith, 2000: 14-18).

We use the density function to obtain the posterior distribution, with θ the random variable parameter, the data y, and $f(y|\theta)$ the similarity function.

$$h(\theta, y) = f(y|\theta).g(\theta) = g(\theta|y).f(y) \quad (1)$$

When the necessary adjustments are made in equation (1),

$$g(\theta|y) = \frac{f(y|\theta).g(\theta)}{f(y)} \quad (2)$$

Bayes' theorem is obtained. If the probability function $\ell(\theta|y)$ is used instead of the similarity function and necessary adjustments are made,

$$\ell(\theta|y) = \ell(\theta|y) = f(\theta|y) = \prod_{i=1}^{n} f(y_i|\theta) \quad (3)$$

is,

$$g(\theta|y) = \frac{f(y|\theta).g(\theta)}{f(y)} = \frac{f(y|\theta).g(\theta)}{\int f(y|\theta).g(\theta)d\theta} \quad (4)$$

It is obtained in the form. The expression $\int f(y|\theta).g(\theta)d\theta$ in the denominator of equation (4) is the normalization constant in the Bayesian approach, and its value is 1. If the normalization constant is not written and edited.

$$g(\theta|y) \propto f(y|\theta).g(\theta)$$

$$g(\theta|y) \propto \ell(\theta|y).g(\theta) \quad (5)$$

It is obtained in the form. In the Bayesian approach, the '∝' symbol is proportional. The verbal equivalent of equation (5) is,

$$posterior\ distribution \propto likelihood\ function\ x\ prior\ distribution$$

expressed as (Judge et al., 1985: 97-119).

Our study used the Markov chain Monte Carlo (MCMC) method and WinBUGS program for data analysis, which are widely used to solve statistical inference problems based on Bayesian theory. Accordingly, MCMC, a statistical method that works harmoniously with Bayesian theory, generates samples by navigating a parameter space based on Bayesian theory and estimates the probability distribution of parameters using these samples.

The data drawn from the last probability are derived by the Monte Carlo simulation method, allowing the final probability distribution to be obtained exactly or approximately (Ekici, 2005: 73). Here, the MCMC method, which will enable us to find samples independent from each other from the posterior distribution, as the sample size goes to infinity, our expected value gets closer to the actual value or we get the real value according to the law of large numbers (Hahn, 2014: 36-37).

The study focuses on the WinBUGS program, which can be practically calculated using Bayesian regression analysis. Although WinBUGS is an independent program, it provides the opportunity to work with other programs and can work in an integrated manner with the R program. In addition, it has practical use due to its wide range of probability distributions and its advantages in eliminating uncertainties in model predictions (McCarthy, 2007: 4-6).

In our study, the Bayesian regression method was applied with the help of the WinBUGS program to measure the effect of technological development indicators on employment in Türkiye. In this application, the model consists of the equation below.

$$EMP_t = \beta_1 + \beta_2 RD_t + \beta_3 PA_t + \varepsilon_i \quad (6)$$

They were formed in a linear form. The prior distribution, which does not give information, was used, and the posterior distributions were obtained with the help of the WinBUGS program by taking the logarithm of the data used.

5. Empirical Results

Informative prior distribution was used to obtain the posterior distribution of the data for Türkiye. Here, b [j]s are the uncertain a priori distribution with a mean of zero and a precision of 0.001, and the precision is a gamma distribution with a parameter value of 0.001,

b[j] ~ dnorm (0, 0.001)

tau ~ dgamma (0.001, 0.001)

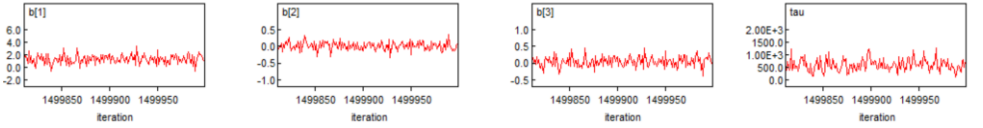
taken in the form. The tables and graphics obtained when these values and data are run with the help of the WinBUGS program are given below, and necessary explanations are made.

Table: 1
Descriptive Statistics

Node	Mean	Sd	MC Error	2.5%	Median	97.5%	Start	Sample
b[1]	1.304	0.6415	5.173E-4	0.03028	1.304	2.577	1000	1499001
b[2]	0.01743	0.1084	8.716E-5	-0.198	0.01742	0.2326	1000	1499001
b[3]	0.04616	0.1364	1.101E-4	-0.2247	0.0463	0.3173	1000	1499001
τ	610.8	239.2	0.2252	236.0	579.8	1161.0	1000	1499001

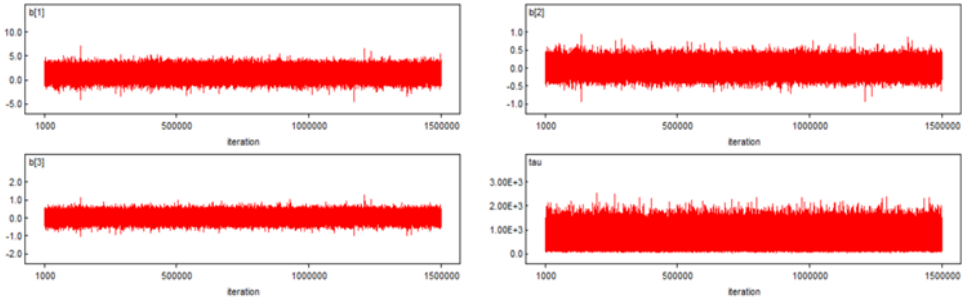
As can be seen in Table 1, it is indicated that the MC error is less than .05. Based on the sign, it shows that the relationship between the variables is significant, expectedly. Moreover, the effects of independent variables are both positive and high since the model's coefficients are 0.01743 and 0.04616 for b[2] and b[3], respectively.

Figure: 1
Trace Drawing



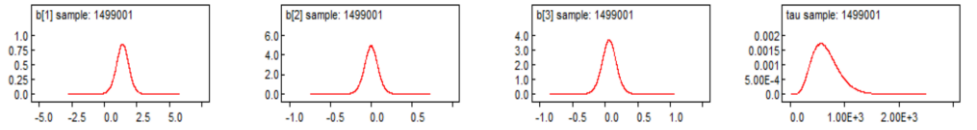
The movement of the last 200 iterations of the Markov chain is indicated in Figure 1. Based on the trace drawing, it can be interpreted that the search speed for b[1], b[2], b[3] and τ is relatively fast.

Figure: 2
Multi-Chain Tracking Motion Graph; 1000-1500000



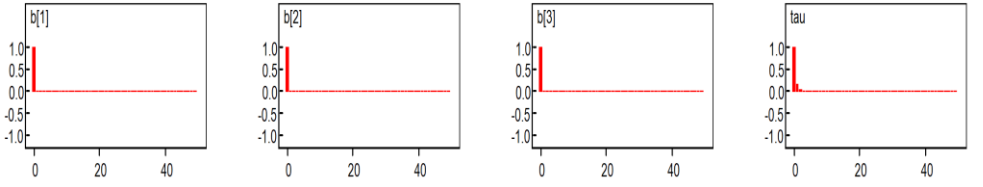
The multi-chain movement for all parameters in the range of 1000 to 1500000 in Figure 2 is highly intense and compatible with the Bayesian regression, in which it is observed that the chain movement produces values close to the posterior distribution and behaves consistently throughout the search. One can also see that the parameter values quickly search around the mean value by examining the same figure.

Figure: 3
Kernel Density Plot



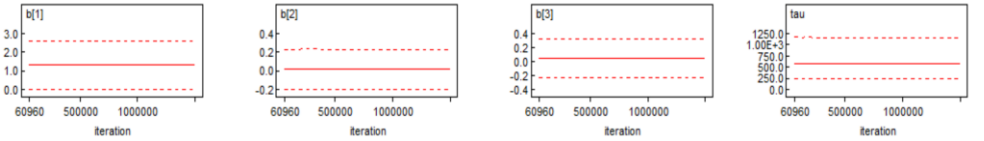
As Figure 3 shows, the Kernel density plots of the parameters indicate a normal distribution in the first three plots, and the precision shows a skewed distribution in the final plot.

Figure: 4
Autocorrelation Plot



Due to its working principle, the WinBUGS program examines autocorrelation in the first 49 iterations. Figure 4 shows that the autocorrelation is zero. This indicates that chains work independently and gives information about chain efficiency (Hahn, 2014: 159-161). In addition, this situation will guide us in obtaining the maximum information about the posterior distribution we want to obtain.

Figure: 5
Working Quantities



When Figure 5 is examined, the parameter values and precision remain constant within the 95% confidence interval. While this situation converges to the desired value, it behaves steadfastly (Hahn, 2014: 158-159). If the graph were not stationary, it could be interpreted as a shift in the mean values not converging to the desired value.

Comparison of Classical and Bayesian Linear Regression Methods

Linear regression analysis was performed using the SPSS22 program to test the effect of the RD and PA independent variables on the EMP dependent variable and compare it with the Bayesian method. The results of the linear regression analysis and the Bayesian regression analysis are shown in Table 2.

Table: 2
Parameter Estimation by Classical and Bayesian Linear Regression Method

Parameters	Parameter value and range	Linear regression analysis	Linear Bayesian regression analysis
b[1]	value	1.399	1.399
	range	(1.144, 1.653)	(0.4149, 2.382)
b[2]	value	0.002	0.002326
	range	(-0.042, 0.047)	(-0.1687, 0.1732)
b[3]	value	0.062	0.06239
	range	(0.003, 0.121)	(-0.166, 0.2906)

As Table 2 states, the analysis results obtained by the Bayesian method are similar to those obtained by the traditional linear regression method. This can indicate that the indefinite a priori Bayes method produces results similar to those of the linear regression model.

6. Discussion

Being the MC error term significant, one can conclude that there is a linkage between the independent and dependent variables. Besides, the effect of R&D and the number of patents on the employment rate is high and positive. The movement of the Markov chain

iteration of the variables shows that the acceleration is smooth and speed is highly fast, which gives better knowledge about the data structure. The Bayesian regression model indicates that the model's parameters are expected when the precision has a right-tailed distribution. It also provides that there is no autocorrelation between the variables. When comparing the Bayesian regression model and linear model, R&D and the number of patents positively affect the employment rate. Therefore, the results are statistically significant. Considering the indefinite a priori Bayes procedure, one can use both the linear and Bayesian regression models. However, the Bayesian regression model is highly preferable regarding the need for more data. The iteration of restricted or limited data using Bayesian regression provides a breakthrough in this paper's empirical sample. Researchers should consider using Bayesian regressions within linear and non-linear time series analysis in economics, mathematics or management informatics studies.

7. Conclusion

The impact of technological development indicators in Türkiye on employment is significant. Our study shows that the coefficients of the model obtained by Bayesian regression analysis have positive signs. When the other variables in the model are kept constant, there is an increase of .06239 units in the number of patents and .002326 units in R&D expenditures against a one-unit increase in employment. In this case, it can be interpreted that the rise in technological development indicators contributes positively to creating new job opportunities and increasing employment opportunities in the labour market. The impact of technological development indicators in Türkiye on employment is significant. It has been obtained that these development indicators affect employment significantly and positively (Tamayo & Huergo, 2016: 1429-1430; Piva & Vivarelli, 2017: 1429-1430; Cafri & Selci, 2020: 3276-3277; Cengiz & Şahin, 2020: 167-170; Çelik, 2020: 421-426). (Şahinoğlu & Varıcı, 2019: 636-637; Doğaner, 2022: 359-363), Contrary to the discourse that the effects of technological development on employment are meaningless and negative, it is observed that the results obtained in this study affect employment positively and positively.

Countries can take the following measures and generalise them to solve the employment problem with the developing technology. Investment and industrial policy are critical points in a country's development. Investing in the country, developing industrial activities, and offering an investor-friendly opportunity is necessary. While creating industrial policies, it is important to prioritise those with sectoral specificity and high exports. Establishing the labour market policy should include balancing factors such as employment level and economic growth rate and each country's economic, social, and political conditions. The state should encourage regional development and employment and provide the necessary support to increase regional development and employment. Declaring certain regions as industrial zones and providing support and incentives to establish and operate facilities in the infrastructure service process and development process will increase employment. In this direction, state policies should be developed long-term, and existing policies should be constantly updated to adapt to technological innovation. The state and

necessary training should support entrepreneurship and business establishment support by developing encouraging policies. To create new opportunities for the workforce, incentive arrangements such as financial support packages, training programs, consultancy services, and tax regulation in favour of entrepreneurs should be made. In the education and skill development phase, education systems should be strengthened against the developing technological structure, and incentives and participation in needed skill development programs should be provided. Work-occupation compatibility and employability transitions to flexible employment models, including remote, part-time, and self-employment, can be achieved. In this way, employment will be increased in labour markets within the scope of technological development.

To maintain the suggestions above, policymakers can use Bayesian regression analysis as well as this paper, in which the effects of R&D and the number of patents on the employment rate are analysed, has tried to do. Moreover, it should be remembered that advancements in technology and software engineering would lead to economic growth and other economic indicators being more precise and successful. An achievement in technological improvements could always have a chance to achieve economic targets. Policymakers should consider this aspect of economic and technological changes.

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