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RESEARCH ARTICLE
Macroeconomics

# The Impact of Institutional Factors on R&D Expenditures: An Analysis for D-7 Countries

*Kurumsal Faktörlerin Ar-Ge Harcamaları Üzerindeki Etkisi*

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**ABSTRACT**

Research and development activities (R&D) positively affect a country's production infrastructure and the productivity of existing factors and thus lead to economic growth. On the other hand, the emergence of research and development activities in a country is closely related to the institutional structure that determines how to live and produce. In other words, the institutional structure influences individual behaviour patterns and affects the processes of being entrepreneurial, libertarian, innovative and supporting research and development activities of firms. Institutional factors should be considered as habits, norms, rules and bureaucratic processes that determine the whole economic, social and political life of a country. The existence of a strong and effective institutional structure plays a vital role in reducing or preventing growth and development problems by affecting economic processes. R&D expenditures, on the other hand, affect the innovation infrastructure of a country and thus the production potential and efficiency of production. In this context, the study seeks to answer the question of how R&D expenditures will be affected when there is an improvement in institutional factors or how a change in R&D expenditures will affect institutional factors. In this study, a panel data model is used for the period 1996-2022 for selected D-7 countries (USA, Germany, France, UK, Italy, Canada and Japan). As a result of the study, it is concluded that as institutional quality indicators improve in D-7 countries, R&D expenditures also increase.

**Keywords:** R&D, Institutional Economics, Panel data analysis.

**ÖZET**

Araştırma ve geliştirme faaliyetleri (Ar-Ge), bir ülkenin üretim altyapısını ve mevcut faktörlerin verimliliğini olumlu yönde etkiler ve böylece ekonomik büyümeye yol açar. Öte yandan, bir ülkede araştırma ve geliştirme faaliyetlerinin ortaya çıkması, nasıl yaşanacağı ve üretileceğini belirleyen kurumsal yapıyla yakından ilişkilidir. Başka bir deyişle, kurumsal yapı bireysel davranış kalıplarını etkiler ve girişimci, özgürlükçü, yenilikçi olma ve firmaların araştırma ve geliştirme faaliyetlerini destekleme süreçlerini etkiler. Kurumsal faktörler, bir ülkenin tüm ekonomik, sosyal ve siyasi hayatını belirleyen alışkanlıklar, normlar, kurallar ve bürokratik süreçler olarak düşünülmelidir. Güçlü ve etkili bir kurumsal yapının varlığı, ekonomik süreçleri etkileyerek büyüme ve kalkınma sorunlarını azaltmada veya önlemede hayati bir rol oynar. Ar-Ge harcamaları ise bir ülkenin yenilik altyapısını ve dolayısıyla üretim potansiyelini ve üretim verimliliğini etkiler. Bu bağlamda, çalışma, kurumsal faktörlerdeki bir iyileşme durumunda Ar-Ge harcamalarının nasıl etkileneceğini veya Ar-Ge harcamalarındaki bir değişikliğin kurumsal faktörleri nasıl etkileyeceğini cevaplamayı amaçlamaktadır. Bu çalışmada, seçilmiş G-7 ülkeleri (ABD, Almanya, Fransa, İngiltere, İtalya, Kanada ve Japonya) için 1996-2022 dönemi için bir panel veri modeli kullanılmıştır. Çalışmanın sonucunda, G-7 ülkelerinde kurumsal kalite göstergeleri iyileştikçe Ar-Ge harcamalarının da arttığı sonucuna varılmıştır.Keywords: R&D, Institutional Economics, Panel data analysis.

**Anahtar Kelimeler:** AR-GE, Kurumsal İktisat, Panel Veri Analizi

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## INTRODUCTION

Institutional economics is an important field of study that investigates how the behaviour, habits and motives of society determine the rules of the game played in the economy and the effects of the economic system formed by these rules (North, 1991). In institutional economics, institutional factors affecting the economy include various factors that affect the structure, efficiency and general functioning of an economy, and these factors significantly affect economic development, growth and welfare. In the basic literature of institutional economics (Coase, Williamson, North), the main variables regulating economic life are discussed as follows:

Legal and Regulatory Framework: Ease of doing business, barriers to investment and trade, licensing, taxation and other regulations shape the economic environment. A sound legal and regulatory framework enables economic activity to be carried out efficiently and fairly.

Property Rights: Strong and reliable property rights increase the motivation of individuals and firms to invest and undertake ventures, which in turn contributes positively to the overall performance of the economy.

Corporate Governance: Well-managed companies create a more efficient and sustainable business model. Corporate governance principles ensure that companies act in a transparent, accountable and ethical manner.

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Financial System and Access: A sound financial system and access to appropriate financing are critical for supporting economic activity and stimulating growth.

Market Structure and Competition: A competitive market structure encourages firms to innovate and operate efficiently. Market consolidation or monopolisation adversely affects economic dynamism and consumer welfare.

Labour Market: A flexible and efficient labour market responds quickly to the needs of the business world. This supports economic growth by reducing unemployment.

Education and Innovation: An educated labour force and investments in innovation stimulate economic growth and make the economy more competitive.

Social and Cultural Factors: The norms, values and habits of the society shape economic behaviours and direct the activities of enterprises.

Infrastructure: A good infrastructure ensures that economic activities are carried out efficiently. Infrastructure services such as transport, communication and energy affect the overall performance of firms and the economy.

When these key influencers are considered together, institutional factors have a major impact on the performance and sustainability of an economy. By analysing these factors, institutional economics investigates how economies can be managed more efficiently and fairly. In this sense, this study aims to explain how institutional factors have an impact on research and development (R&D) expenditures.

## CONCEPTUAL FRAMEWORK AND LITERATURE

The most widely studied issue related to R&D expenditures and investments is its relationship with economic growth. Accordingly, in recent studies measuring the contribution of R&D expenditures to economic growth (Gümüş et al: 2015, Şahin: 2015, Bozkurt: 2015, Lakicevic: 2015, Freimane et al: 2016, Sezgin et al: 2016, Hafeez et al: 2019, Abdülkadir et al: 2020) emphasise that R&D expenditures and investments are the driving force of economic growth. However, there is no study that directly investigates R&D expenditures with the variables that make this study unique (control of corruption, rule of law, government effectiveness, degree of political violence, quality of regulations, accountability). The study aims to contribute to the literature in this respect. In addition to this point of view, in the studies analysed with different variables in the literature, it has been found that institutional structure changes have a positive effect on R&D expenditures. In these studies, it is emphasised that improvements in institutional structure increase the potential of R&D expenditures that can be explained by concepts such as innovation, change and competition.

Hsu (2015) et al. argue that institutional factors play an important role in capital accumulation and that this accumulation can be directed to R&D expenditures. In a similar perspective, Yu-Feng (2012) underlines that R&D initiatives are more successful in companies and societies that fulfil institutional requirements. Alam et al. (2019) emphasise that corruption, an important institutional indicator in developing countries, is an important determinant of R&D investments. However, they found that the increase in corruption limits research and development activities. Rim (2010), in their study examining the corporate behaviour and research activities of firms in Japan and France, state that the current governance structure of countries and firm behaviour are closely related.

In his study, Smith (2010) draws attention to how research is organised and how new technologies are managed and regulated in innovation activities that will create national competitiveness. He argues that when innovation and research processes are established with an institutional infrastructure, long-lasting and sustainable economic development goals will be achieved.

Min (2018) states that in order for innovation and new ideas to combine with competitiveness and create a competitive advantage in enterprises, a favourable economic environment must exist. Accordingly, favourable institutional infrastructure policies in China explain the increase in foreign trade that started in the 1970s. Phung et al. (2019) found in their study that national external openness (in terms of characteristics innovations and developments) innovation capacity and public expenditures directly increase economic growth and the country's research and development capacity.

Based on the related studies, the idea that institutional quality indicators directly and indirectly affect research and development expenditures constitutes the main subject of this study. Based on the institutional theory, which institutional economics centres on as the determinant of economic life, the relationship between R&D expenditures and institutional quality indicators of selected D-7 countries (USA, Germany, France, UK, Italy, Canada and Japan) is investigated with the application of panel data analysis within the scope of the 1996-2022 research period.

## RESEARCH PERIOD, DATA SET AND ECONOMETRIC MODEL

Under this heading, the research period of the study, the definitions and descriptive statistics of the data used in the analysis phase, and the estimation method will be explained theoretically.

**Research Period**

In this study, the relationship between R&D expenditures and institutional quality in selected D-7 countries is investigated with panel data technique within the scope of the 1996-2022 research period. In the selection of this time period, the availability of the data used in the analysis was taken into consideration.

**Data Set and Model**

In the study, the following models 3.1 and 3.2 are estimated:

$$RD_{i_{i,t}} = \varphi_i + \beta_1.REG_{i,t} + \beta_2.ACCOUNT_{i,t} + \beta_3.LAW_{i,t} + \beta_4.GOV_{i,t} + \beta_5.POL_{i,t} + \beta_6.CORR_{i,t} + u_{it} \quad (3.1)$$

$$RD_{i_{i,t}} = a_i + \chi_1.INST_{i,t} + u_{it} \quad (3.2)$$

The definitions of the variables used in the models and their data sources are given below. While determining the variables to be used in the analyses, the definitions commonly used in the literature were taken into consideration, and in this way, it was aimed to ensure consistency with the studies in the literature.

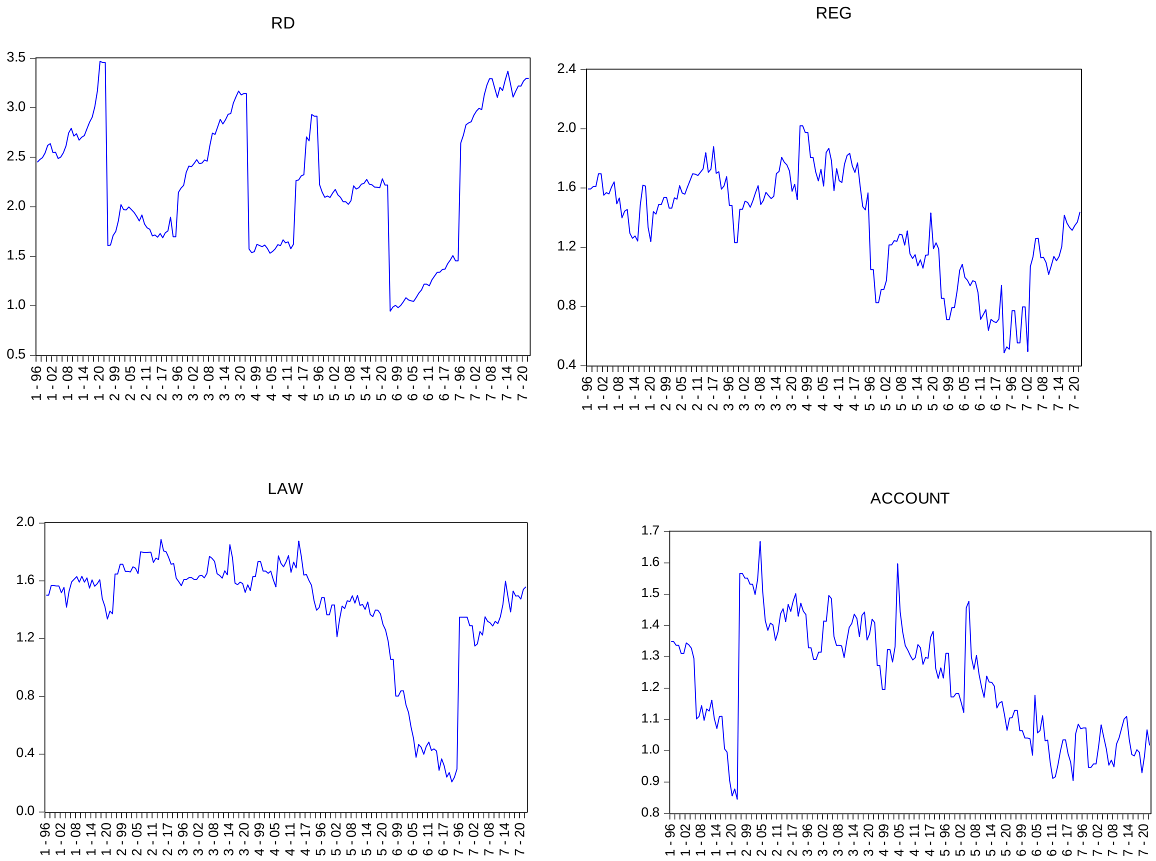
R&D expenditures: The share of R&D expenditures in GDP was used to represent the technological development variable. The data set was obtained from the World Bank's World Development Indicators database and included in the model as RD.

Institutional quality variables were obtained from the Worldwide Governance Indicators (WGI) presented by the World Bank. These indicators are

Rule of Law (LAW): It ensures that problems between individuals and between individuals and the state are resolved in accordance with the law. Government effectiveness (GOV): Measures the quality of provisions regulating public services, perceptions of the reliability of government commitment. Regulatory Quality (REG): The ability to formulate and implement appropriate policy and legal arrangements that enable the state to advance itself. Accountability (ACCOUNT): Refers to the free expression of opinion, political and civil liberties and human rights of individuals. Anti-corruption (CORR): Ensuring that those who hold public power do not use it for personal gain Political stability (POL): The assessment of the likelihood of political instability and political violence.

Finally, the INST variable, which is included in the model as the independent variable of equation (3.2), refers to the sum of the variables in (3.1) as the governance index or institutional quality variable based on the literature.

Graphical representations of all variables used in the models are presented in Figure 1.



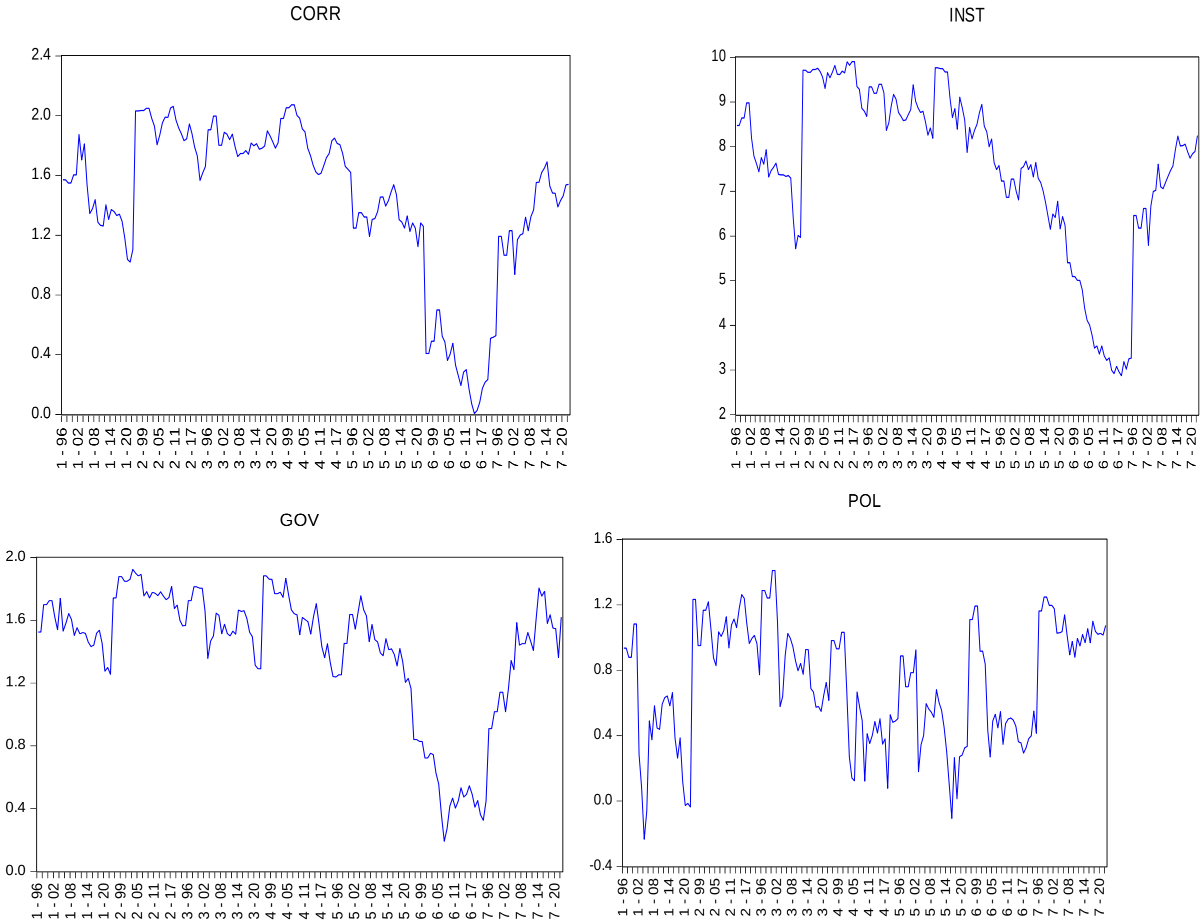



Figure 1: Time Series Graphs of the Variables Used in the Study

Table 1 shows the descriptive statistics of the variables used in the study. From Table 3.1, where the descriptive statistics of the variables to be used in the econometric analysis are given, it is seen that the mean values of all variables are neither very close to their maximum values nor to their minimum values. At the same time, the standard deviations of the variables were also found to be dispersed from the mean. As a result, it can be said that there is no sampling bias in the data set.

Table 1: Descriptive Statistics of Variables

| | RD | REG | ACCOUNT | LAW | GOV | POL | CORR |
|---|---|---|---|---|---|---|---|
| Average | 2.236865 | 1.347302 | 1.224368 | 1.405146 | 1.412638 | 0.724011 | 1.428290 |
| Median | 2.219180 | 1.455097 | 1.244535 | 1.549294 | 1.523581 | 0.772814 | 1.549399 |
| Maximum | 3.467770 | 2.020525 | 1.668455 | 1.886385 | 1.924680 | 1.411336 | 2.072457 |
| Minimum | 0.945900 | 0.487741 | 0.845122 | 0.207709 | 0.191648 | -0.233040 | 0.005990 |
| Std. Error | 0.668786 | 0.360716 | 0.185145 | 0.401703 | 0.413900 | 0.360158 | 0.522776 |

**Econometric Methodology**

In this study, panel data analysis method, which has many advantages over time series and horizontal cross-sectional studies, has been used. The most prominent advantage of this analysis method is that it combines time series and horizontal cross-sectional series, allowing the creation of a data set with both time and cross-sectional dimensions. Panel data analysis has several advantages when compared with horizontal cross-section and time series. Firstly, since both horizontal cross-section and time series data are used in panel data models, the number of observations increases considerably. The high number of observations increases the degree of freedom and reduces the possibility of a high degree of linear relationship between explanatory variables. Therefore, panel data method enables more reliable econometric estimations (Hsiao 2003).

In order for the results of the analyses to be realistic and reliable, it is an important requirement that the series included in the analysis do not have unit roots. Otherwise, the problem of spurious regression may be encountered and the empirical findings obtained may be indicative of an unreal relationship.

In the study, before investigating the stationarity of the series, the presence of horizontal cross-section dependence between the cross-sections was tested.

In this study, the Lagrange Multiplier (LM) test of Breusch-Pagan (1980) will be used since the time dimension of the panel is larger than the horizontal section dimension. The LM test statistic is calculated based on the following regression:

$$y_{it} = \alpha_i + \beta_i{}'.x_{it} + \mu_{it} \quad i=1,2,...,N;\ t=1,2,...,T$$

The null and alternative hypotheses of the horizontal cross-section dependence test, which tests the existence of cross-sectional dependence, are as follows:

$$H_0 : Cov(\mu_{it,}\mu_{jt}) = 0 \text{ for all t's } i \neq j$$

$$H_1 : Cov(\mu_{it,}\mu_{jt}) \neq 0 \quad i \neq j$$

In the hypotheses, $\hat{\rho}_{ij}$ represents the correlation coefficients obtained by estimating the basic regression equation using the Least Squares (LS) method. The LM test statistic, which has a standard normal distribution, is formulated as follows:

$$LM_{BP} = T.\sum_{i=1}^{N-1}\sum_{j=i+1}^{N}\hat{\rho}_{ij}^2 \sim \chi^2_{N.(N-1)/2}$$

If the probability value of the LMBP test statistic is greater than 0.05 significance level, the null hypothesis of no horizontal cross-section dependence cannot be rejected at 95% confidence interval.

In this study, the panel stationarity test proposed by Hadri and Kurozumi (2012), which takes into account the dependence between horizontal sections in the stationarity investigation of the variables, will be applied.

This test is sensitive to horizontal cross-section dependence among panel series. The panel stationarity test by Hadri and Kurozumi (2012) states that the series do not contain unit roots under the null hypothesis, while the alternative hypothesis states that the series contain unit roots. It also allows for serial correlation and horizontal cross-section dependence and this test is a test that can be used both for T<N and T>N.

Hadri and Kurozumi (2012) use the following equation 3.3 in their analyses:

$y_{it} = k'_t \delta_i + f_t . \gamma_i + \varepsilon_{it}$ , $\varepsilon_{it} = \phi_{i1} . \varepsilon_{it-1} + ... + \phi_{ip} . \varepsilon_{it-p} + v_{it}$ i=1,...,N, t=1,...,T (3.3)

In the equation $z'_t$ represents the deterministic term, $k'_t \delta_i$ represents the individual effects, $f_t$ represents the unobservable common factor, $\gamma_i$ represents the loading factor and $\varepsilon_{it}$ represents the individual specific errors.

H-K (2012) calculates the following statistics by regressing $y_{it}$ on $w_t = \left[ k'_t, \bar{y}_t, \bar{y}_{t-1}, ..., \bar{y}_{t-p} \right]$ for each i to correct for horizontal cross-sectional dependence:

$$Z_A = \frac{\sqrt{N}(\overline{ST} - \xi)}{\zeta}$$ here $\overline{ST} = 1/N . \sum_{i=1}^{N} ST_i$

$$ST_i = \frac{1}{\hat{\sigma}_i^2 . T^2} \sum_{t=1}^{T} S^w{}_{it}$$ here $S_{it}{}^w = \sum_{r=1}^{t} \hat{\varepsilon}_{ir}$ ,

$\hat{\sigma}_i^2$ refers to the long-run variance estimator. H-K (2012) uses the following formulas to obtain the long-run variance estimator:

$$\hat{\sigma}_{iSPC}^2 = \frac{\hat{\sigma}_{vi}^2}{(1 - \hat{\varphi}_i)^2}$$ here $\hat{\sigma}_{vi}^2 = 1/T . \sum_{t=1}^{T} \hat{v}_{it}^2$ $\hat{\varphi}_i = \min \left\{ 1 - \frac{1}{\sqrt{T}}, \sum_{j=1}^{p} \hat{\varphi}_{ij} \right\}$ .

and Hadri-Kurozumi (2012) calculate the $Z_A{}^{SPC}$ statistic to be used in the presence of horizontal cross-section dependence based on all equations as follows:

$$Z_A{}^{SPC} = \frac{1}{\hat{\sigma}_{iSPC}^2 . T^2} \sum_{t=1}^{T} (S_{it}{}^w)^2$$

**Estimation of Slope Coefficients with Panel Data**

In panel data analysis, individual observations for different time points in the sample are taken into account and multiple observations are created for each individual data. In its simplest form, a panel data regression model can be shown as in (3.4):

$$Y_{it} = \alpha_i + \beta . X_{it} + \varepsilon_{it} \text{ , i=1,2,...,N ; t=1,2,...,T} \quad (3.4)$$

In the model, i denotes countries and t denotes the time dimension. What distinguishes the model used in panel data analysis from the model used in pooled data analysis is the presence of αi , which is called individual effects. The αi in equation (3.4) are individual-specific factors, which vary from cross-section to cross-section and represent unobservable heterogeneity that is assumed to be constant over time.

Panel data studies yield various models depending on assumptions regarding the intercept, slope coefficient, and error term. Below are definitions of these models:

**Pooled Regression**

If αi contains only a constant term, i.e. if the assumption is made that the individual effects are the same for all countries, the Least Squares (LS) method provides consistent and efficient estimates of the joint αi and the slope coefficient (Greene 2008: 183). In its simplest form, pooled data is modelled as follows:

$$Y_{it} = \alpha + \beta . X_{it} + u_{it} \quad (3.5)$$

Horizontal cross-section heterogeneity is not included in pooled data. In addition, the assumptions of zero mean, constant variance and zero covariance of uit are made.

**Fixed Effects**

The panel data model where the slope coefficients are consistent across time and cross-sectional units, but the intercept coefficient varies among cross-sectional units, is known as the "fixed effects" model. In this model, variations in the behavior of cross-sectional units are attributed to differences in the intercept term.

Fixed effects model has two types as one-way and two-way. In the one-way fixed effects model, the changes in the parameters are caused by the changes in the cross-sectional data. Therefore, in this model, time series have no effect on the change. In the two-way fixed effects model, changes in both cross-sectional data and time series data are taken into account (Baltagi 2001; as cited in Şak 2006).

If the individual effects αi are unobservable, but are associated with Xit, then the Least Squares estimator of β is biased and inconsistent (Hsiao, 2003). The fixed effects model is expressed in matrix formulation as follows (Greene 2008:194):

$$Y_{it} = X_{it}\beta + i.\alpha_i + \varepsilon_{it} \qquad (3.6)$$

Fixed effects model can be estimated with within estimator. Within estimator moves with averages (Greene, 2008).

If each cross-section is averaged over T periods in Equation (3.4), the following equation is obtained:

$$\bar{y}_{i.} = \alpha_i + \beta.\bar{x}_{i.} + \bar{\varepsilon}_{i.} \qquad (3.7)$$

Here, the dot next to yi means intra-individual (intra-group).

$\bar{y}_{i.} = \dfrac{\sum_{t=1}^{T} y_{it}}{T}$ is calculated as.

Subtracting (3.7) from (3.4) yields equation (3.8) representing the within-group regression.

$$(y_{it} - \bar{y}_{i.}) = \beta(x_{it} - \bar{x}_{i.}) + (\varepsilon_{it} - \bar{\varepsilon}_{i.}) \qquad (3.8)$$

Since there are no insignificant parameters in equation (3.8) and the error term satisfies the assumptions of the classical linear regression model, the ECM method can be applied to this model.

**Random Effects**

In the random effects model, changes that occur by units or time are added to the model as an element of the error term in order to prevent loss of degrees of freedom (Baltagi 2001; as cited in Şak 2006). Before constructing the random effects model, the sample of horizontal cross-section units must be randomly selected. Therefore, the random effects model is valid if it is assumed that the horizontal cross-section units are randomly drawn from a large main mass.

One-way random effects model is divided into two as error components model and models with random coefficients. If the differences between cross-sectional units are added to the error term in such a way that they affect only the fixed parameter, this model is called "error components model".

If the differences between cross-sectional units are added to the error term in such a way that they affect all parameters; this model is called "model with random coefficients". In the two-way random effects model, changes across units and time are treated as a component of the error term.

Therefore, in the two-sided random effects model, changes in both cross-sectional and time series data are treated as a component of the error term (Baltagi 2001).

$$Y_{it} = X'_{it}\,\beta + (\alpha + \mu_i) + \varepsilon_{it} \qquad t=1,2,...,T \qquad (3.9)$$

In Equation (3.8), different characteristics of the units that cannot be observed by the independent variables are included in the error term. The random variable $\mu_i$ with zero mean and constant variance indicates unobserved random heterogeneity and is assumed to remain constant over time. $\alpha$ denotes the mean of unobserved heterogeneity , $\varepsilon_{it}$ denotes the panel error term, while $\mu_i$ denotes the individual-specific error term.

The efficient estimation method used to estimate the Random Effects Model is the Generalised Least Squares method.

$$Y_{it} = X'_{it}\beta + \alpha + \eta_{it} \qquad (3.10)$$

Equation (3.10) is called the Error Correction Model (ECM) (Greene 2008: 201).

Estimator of the slope parameter obtained with the GLS estimation method,

$$\hat{\beta}_{GLS} = (X'\Omega^{-1}X)^{-1}X'\Omega^{-1}Y \quad (3.11)$$

After the model is transformed in such a way that autocorrelation is eliminated, equation (3.11) is estimated by the ECM method.

**Empirical Results**

Table 2 shows the results of the horizontal cross-section dependence test for the series used in the study. Since the probability value of the horizontal cross-section dependence test statistic for the variables forming Model (3.1) is less than 0.05 significance level, the null hypothesis stating that there is no horizontal cross-section dependence is rejected.

Table 2: Cross Section Dependence Test Results

| Variable | LMBP Test Statistic (Probability Value) |
|---|---|
| RD | 237.19*** (0.00) |
| REG | 126.19*** (0.00) |
| ACCOUNT | 70.62*** (0.00) |
| LAW | 149.04*** (0.00) |
| GOV | 204.09*** (0.00) |
| POL | 233.63*** (0.00) |
| CORR | 130.16*** (0.00) |

*** indicates that the null hypothesis is rejected at 1% significance level.

In this case, while investigating the unit root properties of the series, the second generation panel unit root test that takes into account both horizontal cross-section dependence will be used.

Table 3 shows the test results of Hadri-Kurozumi (2012), one of the second generation tests used to investigate the stationarity of the series. According to the results presented in Table 3.3, since the probability values of the test statistics of all variables used in the model are greater than 0.01, all series are accepted as stationary variables at their levels.

Table 3: Stationarity Test Results

| Constant term | | |
|---|---|---|
| Variable | ZA-Spac Test Statistic | p-Probability value |
| RD | -1.9150 | 0.9726 |
| REG | -0.4463 | 0.6723 |
| ACCOUNT | -1.2243 | 0.8896 |
| LAW | 0.6273 | 0.2652 |
| GOV | -0.7128 | 0.7620 |
| POL | -0.5783 | 0.7185 |
| CORR | -1.8135 | 0.9651 |

After the cross-sectional dependence and stationarity investigations of the series forming the model, the model was estimated with the Panel EKK estimator. In the estimation stage, standard errors were corrected by means of White's cross-sectional covariance coefficient method, and the problem of different error variances in each cross-section as well as possible cross-sectional correlation was solved. After the correction, all series in the model are stationary and the estimation results are shown in Table 3. The values in brackets in the columns indicate the probability values of the variables.

Table 4: Panel Least Squares Estimation Results: Model 3.1

| Variables / Dependent Variable | Model 3.1 | |
|---|---|---|
| | | |
| REG | -0.245907* | 0.0939 |
| ACCOUNT | -3.098315*** | 0.0000 |
| LAW | 0.654281*** | 0.0056 |
| GOV | 0.144862 | 0.4949 |
| POL | -0.184306** | 0.0338 |
| CORR | 0.841626*** | 0.0000 |
| C | 4.162586*** | 0.0000 |
| R-squared value | 0.642 | |
| F-statistic of the model | 54.307***(0.00) | |

Note: ***,**,* denote that the variable is statistically different from zero at 1%, 5% and 10% significance levels, respectively.

Table 5: Panel Least Squares Estimation Results: Model 3.2

| Variables / Dependent Variable | Model 3.2 | |
|---|---|---|
| | $RD_{i_{i,t}} = a_i + \chi_1.INST_{i,t} + u_{it}$ | |
| INST | 0.171922 | 0.0000 |
| C | 0.656589 | 0.0000 |
| @TREND | 0.024035 | 0.0000 |
| R-squared value | 0.3505 | |
| F-statistic of the model | 50.207***(0.00) | |

According to the findings estimated in Table 4, rule of law, anti-corruption and political stability variables positively affect R&D expenditures (RD).

According to the findings estimated in Table 5, the aggregated institutional quality variable has a statistically significant and positive effect on R&D expenditures. Therefore, it is concluded that as institutional quality increases in D-7 countries, R&D expenditures also increase.

## CONCLUSION

Institutional economics analyses the institutional structure and institutions as the basic subject of life in a society. In this context, it emphasizes that social behaviour, habits and motives shape social life and thus economic life. In this respect, institutional economics aims to formulate economic policy by taking institutional changes into account. This perspective positions the field of study quite differently from the abstract, theoretical and historical perspective. For this reason, institutional indicators in a society shape the whole economic life.

The study aims to measure the relationship between the control of corruption, rule of law, government effectiveness, degree of political violence, quality of regulations, accountability indicators and research and development expenditures. R&D expenditures are important as they are the trigger of economic growth and an important factor shaping the innovation infrastructure. In this respect, it is very important for policy makers to determine the role of the existing institutional structure in R&D expenditures. In this context, statistically significant results were obtained in the analyses. On the other hand, a strong relationship was found between institutional variables and R&D expenditures. This econometric result shows that as the institutional structure improves, improvements in innovation infrastructure will also be observed.

On the other hand, this result also supports the positive relationship between growth and R&D expenditures in the literature. Another important econometric result is that the positive effect of rule of law, anti-corruption and political stability variables on R&D expenditures is stronger. In this context, it is possible to say that innovation activities are stronger in countries whose legal infrastructure is built on solid foundations. In terms of these results, the study has reached important conclusions for D-7 countries and tried to bring a new perspective to future studies.

## REFERENCES


Abdulkadir, A. and Afriana, W. and Azis, H.A. (2020). The Effects of r&d Expenditures On Economic Growth In OECD Countrıes. Airlangga Journal of Innovation Management, Vol.1, No.2, 175-183.

Alam, A. and Uddin, M. and Yazdifar, H. (2019). Institutional determinants of R&D investment: Evidence from emerging markets. Technological Forecasting and Social Change.

Baltagi, B.H. 2001. Econometrics Analysis of Panel Data, Wiley.

Bozkurt, C. (2015). R&D Expenditures and Economic Growth Relationship in Turkey. International Journal of Economics and Financial Issues, (5):188-198.

Breusch, T., and Pagan, A. 1980. The LM Test And Its Applications To Model Specification In Econometrics. Review of Economic Studies. 47. 239-254.

Coase, R. (1998). The New Institutional Economics. The American Economic Review, 88(2), 72-74.

Coase, R. H. (1960). The Problem of Social Cost. The Journal of Law & Economics, 3, 1-44.

Coase, R. H. (1988). The firm, the market, and the law. University of Chicago Press.

Coase, R.H. (1937). The Nature of the Firm. Economica, 4:386-405.

Freimane, R. and Bāliņa, S. (2016). Research and Development Expenditures and Economic Growth in the EU: A Panel Data Analysis. Economics and Business, (29): 11-5.

Greene, W.H. 2008. Econometric Analysis. Englewood Cliffs, NJ: Prentice-Hall.

Gümüş, E. and Çelikay, F. (2015). R&D Expenditure and Economic Growth: New Empirical Evidence. Margin: The Journal of Applied Economic Research, 9, 205 - 217.

Hadri, K., and Kurozumi, E., 2012. A Simple Panel Stationarity Test in the Presence of Serial Correlation and a Common Factor, Economics Letters, 115, 31-34

Hafeez, A. and Syed, K.B. and Qureshi, F. (2019). Exploring The Relationship Between Government R&D Expenditures and Economic Growth in a Global Perspective: A PMG Estimation Approach. International Business Research.

Hsiao, C. 2003. Analysis Of Panel Data. Cambridge: Cambridge University Press.

Hsu, Hsueh-En and Venezia, Chiulien and Schrader, Chelsea, Relationships between Institutional Ownership, Capital Structure and Research and Development Investment (2015). Accounting & Taxation, v. 7 (2) p. 75-82.

Lakićević, M. (2015). Does R&D Expenditure Promote Economic Growth? An Empirical Analysis On The EU Regional Level, LUND Universtiy Press.

Min, C. (2018). An Empirical Study of Institutional Investor and Enterprise Innovation. European Scientific Journal, ESJ, 14, 227-227.

North, D. C. (1971). Institutional Change and Economic Growth. The Journal of Economic History, 31(1), 118-125. doi:10.1017/S0022050700094109

North, D.C. (1991). Institutions. Journal of Economic Perspectives. 5 (1): 97-112.

Pesaran, M. Hashem. 2004, General Diagnostic Tests for Cross Section Dependence in Panels, University of Cambridge Working Paper, 0435, Internet Address: http://papers.ssrn.com/sol3/papers.cfm?abstract_ id=572504, Date of Access: 10.09.2014.

Phung, T.D. and Van, V.T. and Thuong, T.T. and Ha, N.T. (2019). Innovation and Economic Growth: The Contribution of Institutional Quality and Foreign Direct Investment. Asian Economic and Financial Review.

Rim, Z. and Ghazi, Z. (2010). Institutional Investors And R & D Investment: An International Comparison. Corporate Ownership and Control, 7(3), 44-56.

Sahin, B. (2015). The Relationship Between R&D Expenditures and Economic Growth: Panel Data Analysis 1990-2013, EY International Congress on Economics II (EYC2015), November 5-6, 2015, Ankara, Turkey 207, Ekonomik Yaklasim Association.

Sezgin, F.H., and Yazici, B.E. (2016). Analysis Of The Relationship Between R&D Expenditure and Economic Growth: A Case Of BRIMC Countries, Eurasian Econometrics, Statistics & Emprical Economics Journal , vol.1, no.4, pp.1-16, 2016

Smith, J.A. (2010). New Institutional Arrangements for Development, Science and Technology. Development, 53, 48-53.

Şak, N. An Investigation of the Validity of Purchasing Power Parity in OECD Countries with Panel Cointegration Approach. T.C. Marmara University Institute of Social Sciences, Department of Econometrics, Master's Thesis, Istanbul, 2006.

Williamson, O. E. (1975). Markets and Hierarchies: Analysis and Antitrust Implications. New York: Macmillan Publishers

Williamson, O. E. (1985). The Economic Institutions of Capitalism. New York: Macmillan.

Williamson, O. E. (1990). Economic Organisation. New York: New York University Press.

Williamson, O.E. (1996). The Mechanisms of Governance. New York: Oxford University Press.

World Bank, World Development Indicators, Access Date: 01.04.2024 http://data.worldbank.org/

Yu-feng, W. and Zheng-Ting, Z. (2012). An Empirical Study on Relationship between Institutional Investors and Research and Development Input. International Conference on E-Business and E-Government.