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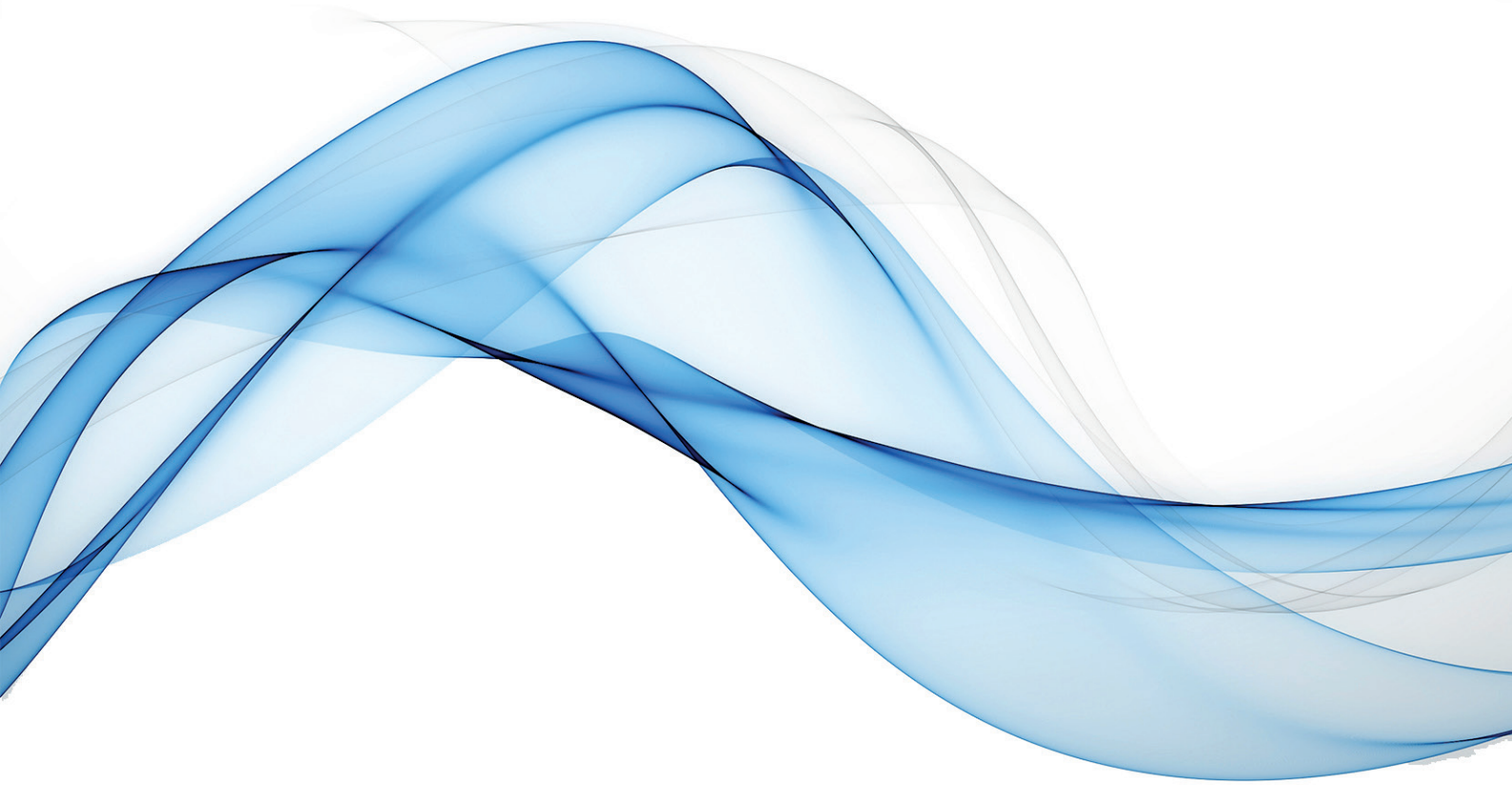

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RESEARCH ARTICLE

Dynamics affecting renewable energy: A panel quantile regression approach*

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Abstract

The effective use of energy resources, energy production and consumption are accepted as one of the most basic indicators of development in recent years. It has become important to use these energy resources in an environmentally friendly manner and have a positive and efficient effect on the economy.

The relationship between renewable energy consumption (LREC) and economic factors such as growth rate of GDP per capita (LGDP)), fixed capital investment (LFCI), total labor (LTL), total amount of waste per capita (LWCA) is examined in this study. Data on those variables are collected for the period of 2012-2020 for OECD countries. A panel quantile regression approach method is employed to examine the association between renewable energy consumption (REC) and economic factors.

The effects of independent variables on renewable consumption have been interpreted depending on the estimation results obtained in the analysis. Firstly, the panel unit root tests are determined for stationarity. As a result, a panel quantile approach is adopted. The results of the analysis show that all economic variables used in the model have a statistically significant effect on renewable energy consumption in the last two quantiles.

Keywords: Renewable Energy, Economic Growth, Economic Factors, Panel Quantile Regression

JEL Codes: C5, C51, C52

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1. INTRODUCTION

The resources used to meet the energy requirements could be divided into two groups: a) non-renewable energy sources and b) renewable energy sources. Renewable energy resources such as wind, water and sun are constantly found in nature as these energies are obtained from natural sources (Spurgeon and Flood 2010: 43). The renewable energy consumption production reduces the volatility and supports economic and social development (Irena 2013: 12). Economic development and environmental problems have an important place in sustaining economic growth.

Energy production and consumption are also necessary for production ~~in~~ for many economies. The studies investigating energy consumption and GDP relationship rely on a wide range of economic factors. The results of those studies show that certain economic factors and their effects vary from country to country. Moreover, the majority of these studies employed time series and causality tests to investigate this relationship. Different from previous studies, this study investigates this relationship between energy consumption and basic economic factors such as GDP per capita annual growth rate (%) along with fixed capital investments and total labor via a panel quantile regression model for OECD countries from 2020 to 2021.

An introduction on energy consumption and the relationship with economic fundamentals is initially provided. In the second section, the previous literature is presented. Third section provides information about data and econometric methods. The empirical results are further reported in the same section. Finally, the fourth section concludes and provides inferences based on the results.

2. LITERATURE

A new system taking into account the use of natural resources and minimizing them should be established. It is important to discuss that the unlimited economic growth is not possible due to the environmental factors. It is evolving to take H. Daly's (1973, 2007) model as a reference to ecological and physical realities. It could be stated that the concept of circular economy is shaped around two basic ideas. The first one is traditional or linear economics. Pearce and Turner (1990) point out that their models lack the idea of recycling used in an economic model. According to the authors, this shortcoming is due to the economy and the environment. It violates the functional relationship that exists between them. The second model suggests that the environment provides a resource base, where its functions include an input for the economy, both in terms of renewable and non-renewable resources. The goal set by circular economic models considers waste to be reused as a resource. (Institute Montaigne 2016: 9).

The causality between energy consumption and economic growth is examined in a study by Oh and Lee (2004) where two multivariate time series models were included. They reported that there was no causal relation between energy and GDP. However, they found that there was a unidirectional causality from GDP to energy in the long run.

Investors who are fascinated by the renewable energy technologies are recommended to maintain the increase in the manufacturing capacity of OPV technologies along with identifying numerous countries to point out and prioritize monetarily appealing settings for PV self-consumption (Chatzisideris et al. 2017)

The association between energy consumption and capital formation along with the real GDP among G7 countries was examined by Narayan and Smyth (2008) via panel unit root and panel cointegration analyses. Odhiambo (2009) determined the causality between economic growth and energy consumption in Tanzania.

Căutişanu et al. (2018) examined the impact of per capita municipal waste and waste recycling rate on economic growth in OECD countries using clustering, correlation and path analyses. The study suggested that economic growth; average years of education and waste management were significantly correlated. The research further reported significant relationships between R&D expenditures, waste management and waste recycling rate.

Inglesi-Lotz (2015) used panel data. The dependent variable was GDP, and RES consumption, RES percentage of energy mix, R&D (research and development) costs, labor force and capital formation were considered as the independent variables in the dataset.

Another study by Caraiani, Lungu and Dascalu (2015) found an overall long-run relation between GDP and renewable energy consumption among developing European countries. However, they reported a short-run two-way relationship is stated for Turkey, Romania, Hungary and Poland.

Overall, one can suggest that income and consumption are closely related so do income and consumption of energy. Therefore, it is possible to see that the pioneering work of Kraft and Kraft (1978) could have been influenced by this relationship.

An econometric study by Adebeyo, Rjoub and Akinsola (2022) provides new evidence for Sweeden on the asymmetric effects of renewable energy consumption and trade openness on carbon emissions via a quantitative regression.

3. DATA AND METHODS

The number of OECD countries used in this study is 38 based on the availability of the data. The data were obtained from the BP Statistical Review (2021) and the World Bank Database. The data set consists of indicators for economic structures at the country level. Australia, Austria, Belgium, Brazil, Canada, Chile, China, Czech Republic, Colombia, Costa Rica, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, India, Ireland, Israel, Italy, Japan, South Korea, Luxembourg, Latvia, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Russia, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States are included in the analysis for the years from 2020 to 2021.

Table 1. Variables and Abbreviations

Dependent Variable	LREC (Logarithmic Renewable Energy Consumption)
Independent Variables	
LGDP	Logarithmic Growth Rate of GDP per capita
LFCI	Logarithmic Fixed Capital Invesment
LTL	Logarithmic Total Labor
LAWC	Logarithmic Amount of Waste of Capita

Firstly, the fixed effects panel regression model was estimated, then the panel quantile regression analysis was undertaken. As a result, one can make a comparison between these two models.

The reduced form of the panel data model is given below:

$$LREC_{it} = \alpha_0 + \alpha_1 LGDP_{it} + \alpha_2 LFCI_{it} + \alpha_3 LTL_{it} + \alpha_4 LAWC_{it} + u_{it} \quad (1)$$

where i refers to an OECD country and t represents time.

$LREC_{it}$ represents the dependent variable (energy consumption). u_{it} is the error term and is defined as $u_{it} = \mu i + \nu_{it}$. μ is the individual country effect that is constant over time but varies across cross-sections. ν is the time effect that varies by each cross-section unit. These panel data models with such type of error term is called one-sided error component regression model (Baltagi 2005; Koc & Sahin 2015).

However, the most typical problem in a classical regression model is the existence of extreme values that could arise from the effects of events such as crises or any policy shocks. In such cases, the error term ~~are~~is not normally distributed. As a result, the reliability of the estimation based on the average would be weakened. Therefore, a quantile regression model based on the minimization of deviations was developed by Koenker and Basset (1978).

Instead of estimating the conditional mean based on the sample mean or a single value, the method provides an analysis of several different regression curves in different quantiles rather and does not take the conditional mean distribution into account.Therefore, it is possible to identify and obtain a detailed picture of all quantiles (Koenker and Hallock 2001)

$$Qant_{\theta} = (\frac{LREC_{it}}{X_{K,it}}) \quad (2)$$

Equation 2 shows the conditional distribution quantile of the dependent variable associated with the independent variables. *t* is the time period and *i* indicates country. expresses the conditional distribution ofwith respect to the dependent variable.

The quantiles to be used in this study are the values above and below the mean for each quantile and is determined as τ = {0.25, 0.50, 0.75, and 0.90}.

The descriptive statistics of dependent and independent variables are shown in Table 2.

Tablo 2. Descriptive Statistics

	LGDP	**LREC**	**LFCI**	**LTW**	**LAWC**
Mean	3.2145	8.4213	5.4522	0.4567	0.5543
Standard Deviation	0.8723	0.5639	0.9823	0.4500	0.3409
Skewness	-0.8723	-0.3490	-0.4500	0.7834	0.6723
Kurtosis	3.2312	2.8933	2.9056	1.4509	1.6789
Jarque-Bera	13.8934	22.1349	17.2894	11.7392	8.4583
No. of Observations (N)	304	304	304	304	304

Table 2 shows that almost all variables including especially renewable energy do not have a normal distribution. Therefore, the analysis is less sensitive to extreme values than classical panel regression. The estimation of the panel quantile regression model seems to be appropriate.

In this study, in order to make a comparison with the panel quantile regression analysis, first of all, the classical panel regression estimation was made. The Hausman test was applied to decide which of the random effects panel regression estimates to use.

As a result of the test, 3 degrees of freedom test statistics calculated $\chi 2$ = 38.634503, and the probability value $Prob > \chi 2$ = 0.0000 is found.

In this case, the Random Effects Panel Regression model was estimated by rejecting the Ho hypothesis expressed as been taken.

Table 3. Random Effects Model

Dependent Variable: LREC (Logarithmic Renewable Energy Consumption)				
Variables	**Coefficients**	**Standard Errors**	**t statistics**	**p values**
LGDP	0.328915	0.032918	9.99669	0.0000
LFC	0.145894	0.021634	6.741656	0.0000
LTL	0.573421	0.04577	12.5470	0.0000
LAWC	-0.203673	0.05782	-3.56248	0.0000
	R^2 = 0.8337	$\bar{R}^2$= 0.8821	F statistics =	Prob(F stat.)
			430.2642	=0.0000

Table 3 shows that all variables statistically have a very high level of significance to explain renewable energy. Logarithmic total labor and logarithmic fixed capital investment have positive effects on logarithmic renewable energy consumption. There is a negative relationship between logarithmic amount of waste per capita and logarithmic renewable energy consumption. Accordingly, the one unit changement ratio of total labor reduces renewable energy consumption by about 0.5 percentage points.

The mean of the sample or the conditional mean of a single value is used in the panel regression estimations. At this point only when considering different quantiles below or above the mean, rather than an average, it is important to determine whether or how the results would change.

As this study investigates the association between economic fundamentals and energy consumption via a panel quantile regression approach, the panel quantile regression results are summarized in Table 4.

The quantile regression models allow researchers to account for unobserved heterogeneity and heterogeneous covariates effects and the availability of panel data provides an advantage to be able to include fixed effects in order to provide more controls for some unobserved covariates (Canay 2011).

Table 4. The Panel Quantile Regression Model Results

	Dependent Variable: LREC				
Independent Variables	**Coefficients**	**Standard Errors**	**t-statistics**	**p values**	**Quantiles (τ)**
LFCI	2.3687	1. 7351	1.3651	0.0641	0.25
	3.7822	2. 3070	1.6384	0.1344	0.50
	1.5634	0.2128	7.4285	0.0000**	0.75
	1.5432	0.0865	19.258	0.0000**	0.90
LGDP	2.7432	0.3821	7.1708	0.0000*	0.25
	1.4790	0.4520	3.2721	0.0000*	0.50
	1.5790	1.2189	1.2164	0.06464	0.75
	1.8930	1.3490	1.2975	0.06453	0.90
LTL	1.0437	1.2684	0.8253	0.6732	0.25
	0.4739	0.3423	1.3823	0.5921	0.50
	-0.5644	0.0326	-17.300	0.0000**	0.75
	-0.4572	0.0021	228.50	0.0000**	0.90
LAWC	2.6046	0.5941	4.4406	0.0000**	0.25
	0.5689	0.1153	5.0907	0.0000**	0.50
	2.8782	0.3281	8.7532	0.0000**	0.75
	1.5411	0.2489	6.2096	0.0000**	0.90

Note: *1%, **5% statistical significance levels respectively.

Table 4 shows the coefficients of LFCI are statistically significant at upper quantiles where τ = 0.75 and 0.90 respectively. Moreover, logarithmic fixed capital investment on renewable energy consumption is going down at the upper quantiles of fixed capital investment. In 0.75 and 0.90 quantiles, the coefficients of gross domestic product are statistically significant.

However, in the 0.25 and 0.50 quantiles of renewable energy consumption (where τ is defined as 0.25; 0.50 respectively), the coefficient of total labor is not statistically significant. Considering the 0.75 and 0.90 quantiles (τ = 0.75; 0.90), the coefficients of total labor are found to be statistically significant. The LAWC is more effective than other variables on countries' renewable energy consumption.

The total labor has a negative effect on renewable energy consumption. The negative effect of total labor is reduced for high renewable energy consumption level rate for OECD countries. The effect of total labor is not statistically significant at all quantiles. The coefficients of LFCI are statistically significant at the 0.75 and 0.90 quantiles where τ = 0.75 and 0.90 respectively. The LGDP has a positive effect of renewable energy consumption.

4. CONCLUSION

Today, renewable energy consumption and environmental problems have increased gradually, especially since the last quarter of the twentieth century. This has led to the focus on the causes and solutions of the problems.

In a panel quantile regression, all independent variables affect renewable energy consumption in the last two quantiles. Moreover, one of the results of the models is that as growth rises in countries in general, all the positive effects of independent variables on sustainable energy consumption is gradually increasing. In the panel quantile regression, which is not based on the conditional mean of the entire sample and considers all distributions of the response variable, we found that the independent variables (logarithmic growth rate of gdp per capita, logarithmic fixed capital ınvesment, logarithmic amount of waste of capita) had a positive effect on sustainable energy consumption. Even the fact that economic growth is not statistically significant for the last two quartiles, this might also be an indication of the fact that this situation progresses differently in some countries or that the growth effect does not have the same effect for all countries.

The share of labor income, its distribution in GDP of countries and the environmental, economic variables effect the renewable energy distribution for all individual countries. The empirical examination of the effects on the variables is important for the development of this field. The countries have to assist in the development and the consumption of non-fossil energy so that the government can encourage the supportive policies of renewable energy. The energy efficiency and consumption with many circular economics which protect energy saving in sectors should be handled carefully to prevent the heating demand.

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RESEARCH ARTICLE

Estimating returns to education: The control function approach

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Abstract

This study aims to evaluate the effect of schooling years on wage level in Turkey by using the Mincer wage equation. This function is used as the baseline for the investigation of earnings determinants. For this purpose, the relationship between wage and education level of people is estimated by using a semiparametric regression model considering the control function approach. Various variables such as education level, experience, gender and marital status are estimated separately in the wage model by utilizing the Household Budget Statistics micro data set of 2017 in Turkey obtained by the Turkish Statistical Institute. The parametric model does not clarify the model clearly when functional form of relation is not known. To overcome this drawback, semiparametric regression model, which contains parametric and nonparametric variables, can be successfully applied. This model is extended by adding the 1997 education reform as a control variable. The achieved semiparametric test results from this study showed that there is a positive relationship between schooling years and wage level. On the other hand, control function approach results indicate the existence of fluctuant progress for the effect of schooling years on the wage level along the period.

Keywords: Labor Markets, Mincer Wage Equation, Education, Semiparametric Regression Model, Control Function Approach, Endogeneity

JEL Codes: I0, C0, J01

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1. INTRODUCTION

Education is essential for human beings and a key factor in the process of development. At the same time, it is an important determinant of wage level. Some empirical studies reveal that educational wage differentials increased in the past decades. Mincer (1974), one of the pioneers who analysed relations between human capital accumulation and earnings in labor markets, reveals that education levels and experience are determinants for wage levels. According to the Mincerian wage equation, more educated and more experienced workers earn more than others who are less eligible. In other words, wage level is a function of education and experience.

Mincer indicates that wage in logarithmic form is linear in schooling and quadratic in experience in function, some reported studies showed the same empirical results as well (Martins and Pereira 2004; Tansel and Bodur 2012). On the other hand, some of the research results conclude the different functional type of Mincerian wage equation (Murphy and Welch 1990; Seltzer and Frank 2007). There is no exact agreement about the functional form of the wage model in recent studies. The investigation of this assumption entails an estimate of whether the Mincerian wage function is in a certain form empirically or not. Although parametric regression models are assumed to be the best models which explain relations between variables, these models may not perform this assumption (Lee 1990). Assumption requirements and exact orders in the validity of parametric regression models lead to the design and development of new approaches and methods, which provide flexibility in the validity of assumptions. Nonparametric and semiparametric regression methods which ensure this flexibility in models are used for this purpose (Gibbons 1976). Mincerian wage equation contains nonparametric and parametric variables in the model. Thus, the semiparametric regression model is appropriate for this approach.

In this study, the relationship between schooling years and wage level based on the Mincerian wage equation is investigated by using semiparametric methods that consider the endogeneity problem. The data set is obtained from the 2017 Household Budget Statistics micro data set for Turkey provided from the Turkish Statistical Institute (TUIK). This semiparametric regression model involves the nonparametric components of years of education and years of experience along with parametric components of other variables in the Mincer function to clarify the log of wages. Schooling may be endogenous because of the omission of some factors, which affect the wage level in the Mincer equation. The existence of a correlation between these unobserved factors and schooling causes inconsistent and biased estimate results. The instrumental variable method is used to overcome this endogeneity issue. This issue is solved by the control function approach.

1997 education reform was politically motivated and unexpected. The reform extended compulsory education from five years to eight years. This reform is used as a natural policy experiment in the analyses and is viewed as an ideal instrument in literature (Patrinos et al. 2021). The education reform is used as an instrumental variable in the control function approach in this study.

The rest of the paper is structured as follows: Section 2 involves a definition of the Mincerian wage equation and literature. Section 3 presents the methodology, Section 4 includes data and Section 5 provides the achieved results. Finally, the conclusion is provided in the last section.

2. MINCERIAN WAGE EQUATION AND LITERATURE

The Mincerian wage equation involves determinants of individual wages and has been interested in many economists for decades. The logarithmic form of wage level is organized as a function of years of schooling and years of potential experience in the Mincerian earning model (Mincer 1974). Standard Mincerian semi-logarithmic wage function is formulated as:

$$lnW_i = \alpha + \beta ED_i + \zeta_1 EX_i + \zeta_2 EX_i^2 + \varepsilon_i \quad (1)$$

where lnW_i is log of gross hourly wages, is years of schooling, ED is experience which EX is obtained as age minus schooling years minus school starting age and is error term. Mincerian wage equation postulates a linear relationship with years of schooling and a quadratic relationship with years of experience. The functional form of these variables is derived from human capital theory, which refers that people accumulate human capital in the

labor market and school. According to this theory, earnings are assumed to depend on years of schooling and potential experience referred to as on the job training in the human capital literature.

Generally, years of schooling's coefficient is assumed as the rate of returns to schooling in regression of log earnings level on years of schooling. Other variables such as gender, marital status, occupation, region, firm size can be used in this regression model. Earnings, years of schooling and years of experience are three key regressors in the Mincerian wage model while other regressors are added to the model (Güriş and Çağlayan 2012: 1409).

A number of empirical studies on the estimates of the rate of returns to education using Mincerian wage (earnings) equation were reported in the literature. Various econometric models and approaches were used to estimate the results of the wage distribution and returns to education. Heckman et al. (2008) examined the internal rate of return to schooling using the U.S. decennial censuses between 1940 and 2000 based on Mincerian earning model. The results indicate that high school graduation provides larger returns than graduation from college. Black et al. (2011) predicted the return to schooling across local labor markets in the United States in 1980, 1990 and 2000. According to the results, returns to education is relatively low in expensive high-opportunity cities. Bhuller et al. (2017) investigated the causal relationship between schooling and earnings over the life cycle using Norwegian data from 1967 to 2014. In their study, the obtained results exhibited that additional schooling gives higher lifetime earnings. Gautam (2020) studied the relationship between wage and education in 2017 in Nepal. It was found that the rate of return to schooling in Nepal is lower than the South Asian average and varies across demographics.

Studies concerning the Turkish case also investigated the impact of years of schooling on earnings using Mincerian wage equation. Tansel (1994) estimated earnings function using Turkish data and found that university graduation has more influence on women's wage earner than men wage earners. Bircan and Tansel (2006) investigated the returns to education using the data from 1994 and 2002 in Turkey. The findings revealed that returns to education declined on average in the related period. Vural and Gürcan (2008) examined the private returns to education using 1994 and 2004 data for Turkey. The achieved findings demonstrated that returns to education change across the different sectors and there exists an important heterogeneity in returns to different schooling levels. Güriş and Çağlayan (2012) analysed differences in returns to education in the years 2003 and 2006 in Turkey. The findings concluded that schooling has an impact on wages for both male and female workers.

Nonparametric and semiparametric regression models were also estimated using the Mincerian wage model in empirical studies. Ulrick (2007) applied a nonparametric model to measure returns to education for year 1999 using U.S. data. The obtained results indicated that nonparametric model estimates the returns as double compared to the standard Mincer formulation. Henderson et al. (2011) estimated homogeneous rates of return to schooling by using nonparametric regression in the period between 1940 and 2000 decennial data in the U.S. In their study, the results indicated that contrary to previously reported studies. The average gap in the rate of return between black and white employees is larger. However, this gap between immigrants and natives is smaller.

On the other hand, Turkish case studies using semiparametric approach are quite restricted in literature. For example, Akay and Uyar (2017) successfully applied the semiparametric regression model to investigate the relationship between wage and other control variables by utilizing 2013 data in Turkey. The achieved results confirmed that the effect of schooling on female workers is more than on male workers; also this effect on workers in the private sector is more than in the public sector. Baskaya and Hulagu (2011) used semiparametric technique to estimate the wage gap between formal and informal employees using data between 2005 and 2009 in Turkey. The achieved findings concluded that an increase in years of education affects being a formal worker positively.

There is a variety of studies that examined the Mincer wage equation using semiparametric regression with an instrumental variable approach. Kharbanda (2014) investigated the marginal rate of return of education on wages using data from 1980 and 2000 in India. According to the findings, the existence of instrumental variables in the model affects the marginal rate of returns to education after a high school degree especially. Gabbriellini (2015) also estimated the rate of returns to education using semiparametric regression with an instrumental variable approach. In this study, the obtained findings supported that returns to education is important for earnings.

3. METHODOLOGY

Semiparametric specification is used to investigate the relationship between wage level and years of education. There is a parametric form between dependent and independent variables in the parametric model. Because parametric functions might be misspecified and restrictive, a semiparametric approach is applied in this study:

$$y_i = f_1(x_1)+\ldots+f_j(x_j) + \beta_1 x_1+\ldots.+\beta_k x_k + \varepsilon \quad (2)$$

where where $\beta_1 x_1+\ldots.+\beta_k x_k$ represents the parametric component and $f_1(x_1)+\ldots+f_j(x_j)$ the nonparametric component. Parametric variables are estimated by using ordinary least squares (OLS) and nonparametric variables are estimated using splines. The backfitting algorithm is used in the presence of the relation between parametric and nonparametric variables and provides opportunity of consideration this relation. Partial residuals of each independent variable are obtained in the process of backfitting algorithm. Partial residuals of nonparametric variables are smoothed and the partial residuals, which belong to parametric variables, are used to construct a regression of these variables. The regression model estimation is applied by using the OLS method. Nonparametric regression estimation is obtained by applying backfitting algorithm.

The nonexistence of correlation between explanatory variables and the error term is an essential hypothesis in regression model. If there is a correlation, estimators are no valid in function. In such case, the OLS method is no valid and an instrumental variable approach is necessary to apply. The instrumental variables should be selected in a way that they are correlated with the explanatory variables strongly but not correlated with error components in the function. The problem of endogeneity may occur in the nonparametric function and the control function approach, enhanced by Newey et al. (1999) can be used to overcome this issue. This approach considers a triangular nonparametric system where:

$$\begin{aligned} Y &= f(X, Z_1) + \varepsilon \\ X &= \mu(Z) + U, E[\varepsilon|U, Z] = E[\varepsilon|U], E[U|Z] = 0 \end{aligned} \quad (3)$$

X is d_x x 1 vector of endogenous variables, Z is a d_x x 1 vector of instrumental variables and Z_1 is included as d_{11}x1 subvector. $\mu(Z)$ is d_x x 1 vector of functions which belong to instruments Z and U is d_x x 1 vector of error terms.

Newey et al. (1999) focus on the identification of *f(.,.)*. They aimed to reduce the curse of dimensionality problem and implemented a procedure of three-step estimation for an additively separable nonparametric structural function for this purpose. To obtain consistent estimates of residuals, the first stage includes separate regressions for each endogenous regressor on the exogenous regressors. In the second stage regression, obtained residuals are employed. Single regression of the response variable is applied to each endogenous regressor and each residual is calculated from the first-stage regressions. Finally, in the third stage includes, the backfitting algorithm is used to estimate additive components or *f(.)* functions (Ozabaci et al. 2014).

In this study, the years of schooling is a possible endogenous variable because of adverse causality with wage level. The endogeneity problem is considered for the Mincerian earning function in a nonparametric form. The exogenous variable for years of schooling is selected as 1997 educational reform, which is taken from the literature.

4. DATA

In this study, the relationship between schooling years and wage level based on the Mincerian wage equation is investigated by using semiparametric methods that consider the endogeneity problem. For this purpose, data were obtained by Household Budget Statistics micro data set in 2017 for Turkey provided from the TUIK. The employees ages from 15 to 65 were considered.

The natural logarithm of annual wages (WG) is considered as the function of education (EDU), years of experience (EXP), marital status (MS), gender (GN) and educational reform of 1997 (ER). Education is defined as completed years of schooling in the study. There are various changes in the years of schooling number based on educational reforms in the Turkish educational system. Compulsory level primary school degree was 5 years until 1997. Middle school degree was 3 years and high school degree was also 3 years till the educational reform started in 1997. After this reform, the completion necessity of basic education was 8 years; evaluated as 5 years of primary education and 3 years of middle school. High school degree was 3 years and extended to 4 years in 2005. Another educational reform was implemented in 2012. Primary school degree was decreased from 5 years to 4 years after this reform. Middle school requirement was also extended to 4 years and high school degree remained as 4 years. This current system is named as 4+4+4 system since 2012. As a result, the compulsory level of schooling was evaluated as 12 years including the high school level as well. The people who did not complete any school degree are assigned as 2 years of schooling in the study. There are 2 years of college education, 4 years and 6 years of bachelor's degree as well. A post-graduate degree is also separated in the questionnaire. Additional 2 years is approved if the person is graduated from master degree of schooling, 4 years is assumed if the individual completed the doctorate degree.

Experience is estimated as equal to "age- completed years of schooling-6", where 6 is approved as the school start age in literature. Marital status, gender and people that were affected by the 1997 educational reform are defined as dummy variables in the study. Dummy variables are equal to one for male employees, married employees and the employees for which the 1997 educational reform had an impact on. People who were born in 1986 or later were assumed to be affected by the 1997 reform.

Table 1. Descriptive Statistics of the Variables

Variables	**WG**	**ED**	**EXP**
Mean	4.1	9.3	21
Maximum	5.8	20	57
Minimum	1.6	2	0
Std. Dev.	0.5	4.05	13.1
Num. of Obs.	11447	11447	11447

Table 1 shows the descriptive statistics for the variables in the study. For the employees, an average level of logarithmic wage is 4.1. The maximum wage level is approximately 6, the minimum level is higher than 1.5. Average years of education is 9.3. The maximum years of schooling is 20 years, equal to a doctorate completion year. The minimum years of schooling is 2 years, which represents the noncompletion of any schooling degree. Mean years of experience is calculated as 21 years and the maximum years of experience is 57 years in the findings. Minimum years of experience is defined as 0 which means that there are employees who didn't complete one year of experience in labor markets.

5. RESULTS

The effect of years of education on the wage level is investigated by a semiparametric regression model with a control function approach. In this section, the standard Mincerian wage model, Mincerian wage function with semiparametric regression model and Mincerian wage equation obtained by semiparametric regression model with control function approach were investigated separately. Firstly, partial *F* test and likelihood ratio (LR) test were implemented. The partial *F* test investigates if the effect of each variable on the independent variable is significant or not. LR test is calculated to represent which model's explanatory power is better (Keele 2008).

Table 2 shows the results of the partial F test and LR test. Findings in section (a) conclude that *EXP* and *EDU* nonparametric variables should take part in the model. Test results in section (b) state that *EXP* and *EDU* variables should be considered as nonparametrically in the model. According to the LR test results, acceptance of the model as nonparametrically is statistically significant.

Table 2. Results of the Partial F and LR Tests

Partial F Test Results				
	(a)		**(b)**	
	EXP	EDU	EXP	EDU
F Test Statistics	318.8	590.67	352.5	51.7
Prob.	0.000	0.000	0.000	0.000
LR Test Results				
Chi-Square Test		1586.2		
Prob.		0.000		

The three regression models which estimate the effect of schooling years on the wage level are represented in Table 3. Firstly, the standard Mincerian wage equation is estimated by using OLS. Secondly, the semiparametric regression model which doesn't make any restrictive assumptions about the relations of variables is applied. Thirdly, a semiparametric regression model with the control function approach, which is used to prevent endogeneity problem in the nonparametric case, is estimated. While quantitative variables are added into the model nonparametrically, qualitative variables are added parametrically. The coefficients of these dummy variables are interpreted by using the approach developed by Halvorsen and Palmquist (1980).

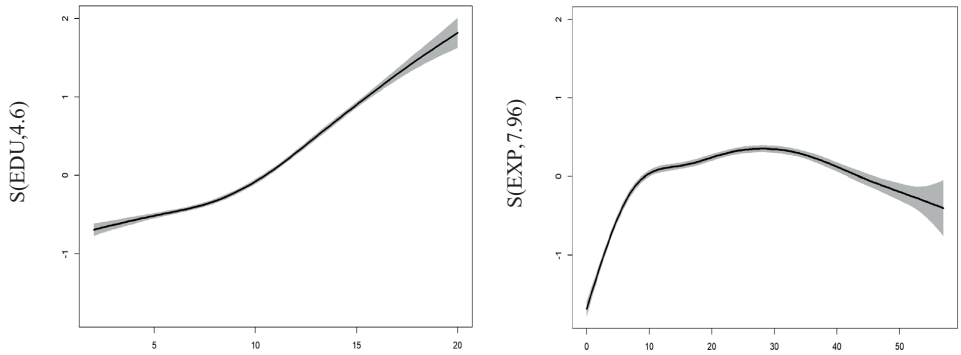
Table 3. Results of the Model Estimations

Variables	**OLS**	**Semiparametric Regression**	**Control Function Approach**
Intercept	6.6 (0.04) (t-test: 155.3) (Prb:0.000)	8.9 (0.02) (t-test:398.1) (Prb:0.000)	8.9 (0.02) (t-test:397.6) (Prb:0.000)
EDU	0.14 (0.003) (t-test: 54.3) (prb:0.000)	(See Fig 1 (a)) (F-test: 595.7) (prob:0.000)	(See Fig 2(a)) (F-test: 270.9) (prob:0.000)
EXP	0.1 (0.003) (t-test: 36.7) (prb:0.000)	(See Fig 1(b)) (F-test: 207.1) (prob:0.000)	(See Fig 2(b)) (F-test: 183.3) (prob:0.000)
$(EXP)^2$	-0.001 (0.0001) (t-test: -32.5) (prob:0.000)		
MS	0.21 (0.025) (t-test: 8.44) (prob:0.000)	0.17 (0.02) (t-test: 6.8) (Prob:0.000)	0.16 (0.1) (t-test: 6.61) (Prob:0.000)
GN	0.5 (0.02) (t-test: 26.36) (prob:0.000)	0.5 (0.02) (t-test: 28.73) (prob:0.000)	0.5 (0.02) (t-test: 29.1) (prob:0.000)
ER			-1.7 (0.2) (t-test:-11.4) (prob: 0.000)

According to the standard Mincerian wage equation; an increase in the years of education level and years of experience is associated with an approximate 14% and 10% increase in wages, respectively. The effect of marital status on wages is 23%, in other words, married employees earn 23% more than unmarried employees. Test results also indicate that male workers earn 64% more than female workers. Findings of semiparametric estimation and semiparametric estimation with the control function are almost the same in marital status. Married employees earn 18% and 17% more than unmarried employees respectively. Results of the two regression models indicate that male employees earn 64% more than female employees. According to the control function test statistics result of the dummy variable which represents individuals affected by the 1997 educational reform, control function is significant. In other words, the control function can be used as an exogenous variable for years of education endogenous variable.

Nonparametric regressions are examined through graphical representation. Curves indicate the estimation of *f(.)* functions for the variables. There are confidence intervals including upper and lower 95% grey layers on the side of the main curve. Figure 1 and Figure 2 compare estimation results of *EDU* and *EXP* nonparametric variables. Figure 1 shows results of the relation that do not consider endogeneity, estimation results of Figure 2 consider endogeneity though.

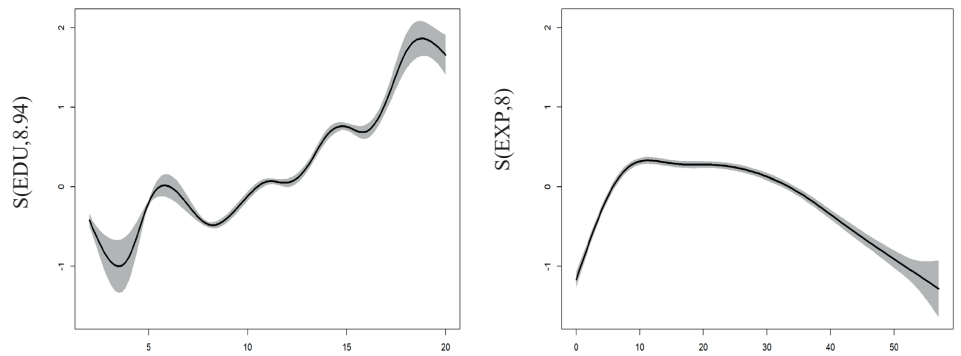
Figure 1. Estimation Results of Semiparametric Regression w/o Considering Endogeneity



(a) EDU (b) EXP

Graph (a) represents the effect of years of schooling on wages in Figure 1. According to the curve, a raise in years of education affects the wages positively. This rate of this impact less in the first eight years than other years in the period. After eight years, the rate of effect of years of schooling increases and remain in the process. Graph (b) shows the impact of years of experience on wage level. According to the result, the rate of this impact is quite high in the first ten years, an increase in years of experience raises the wages at a high rate in this period. In the period from ten to thirty years, the rate of positive impact declines and affects lower in the process. After the 30th year, the impact of experience on wage level is negative. In other words, the experience causes a decrease ~~on~~ in the wage level after 30 years.

Figure 2. Estimation Results of Semiparametric Regression Considering Endogeneity



(a) EDU (b) EXP

Graph (a) shows the effect of years of education on wages considering endogeneity in Figure 2. In general, an increase in the years of education affects wage level positively. This effect is negative in the first three years, between the sixth and eighth years and after the eighteenth years mainly. Education levels of individuals who did not complete any educational degree, graduated from primary school and completed doctorate degree affect wage levels negatively. According to the results, university graduation particularly has an important impact on wages, the rate of increase in wages is fairly high in this period. Results of Graph (b) indicate a positive impact of experience on wages at a high rate in first ten years. After this period, the effect of experience on wage level is negative in general.

6. CONCLUSION

This study investigates the impact of years of education on wage level using the Mincerian wage equation for 2017 data in Turkey. The Mincerian model is estimated by using some control variables (i.e. schooling and experience) which are determinants for this model. The model is estimated by applying a semiparametric regression model which provides flexibility of functional form. The endogeneity problem is considered and the control function approach, enhanced by Newey et al. (1999), is used to overcome this problem. 1997 education reform is applied as a control function to deal with the endogeneity of schooling and this exogenous variable is significant according to the results. The estimation results of "the semiparametric Regression without considering endogeneity" and "semiparametric regression considering endogeneity" are compared. Both of these two regressions' findings indicate that the effect of years of schooling on wage is positive in general. Semiparametric regression results without considering the endogeneity confirm that each schooling year has a positive effect on the wages in the related period. The rate of this effect tends to rise in the eighth year and continues at this rate in the period.

On the other hand, the achieved findings of the semiparametric regression considering the endogeneity problem reveal that impact of the schooling years on the wage level changes by years of education. Especially individuals who are literate without a degree, completed middle school level and doctorate degree respectively have a negative impact on earning level. Completing primary education level affects the wages positively and the rate of rising is quite high in this schooling level particularly. The same impact occurs in the university and master's degree completion level-where the curve has a quite high leap in the related period. As a result, the impact of the 1997 educational reform on wages is quite high for individuals who graduated from primary school and master's degrees respectively.

The effect of the 1997 education reform on years of experience differs after ten years compared to the findings of semiparametric regression without considering endogeneity. The negative impact of years of experience on wages after the related term is more than the effect of semiparametric regression. The results also indicated that the effects of gender on the wages are the same using these three methods. The impact of marital status on wages varies according to the obtained results using these methods. Semiparametric test results considering endogeneity and without considering endogeneity are almost the same. However, the result of the OLS method indicates that the positive impact of being married on wages is higher than the results of other regression models. Education reform instrumental variable has no significant impact on the effect of gender and marital status on wage level compared to the semiparametric regression results without considering endogeneity.

The findings of the study considering the instrumental variable show that there is also a positive relationship between educational attainment and wage level. The aim of the 1997 education reform is to extend the years of compulsory education. The success of the reform especially reflects to the wage level among people who graduated from primary school and university. These policy implications related to increase educational attainment can be exceeded to provide workers to have more schooling levels, thus having more wage levels in the future.

Policy implications for the educational process related to the results can be implemented successfully. According to the test results, university graduation has an important impact on wages. This study suggests that educational reforms and implementations based on university education can be exceeded quality. At the same time increasing employment opportunities for university graduated people is essential to rise the willingness of people about prosecution the education level after a high school degree. Preschool education investments also should be enhanced to ensure people to realize the importance of education from childhood. In general, supportive policies at all levels of education are necessary for economic growth and development.

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RESEARCH ARTICLE

A cross-sectional analysis of factors affecting human development index

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Abstract

Although human development has made significant progress in recent years, especially in developing countries, there are differences in human development between countries. To determine the development level of a country, it is necessary to evaluate the social, cultural, demographic and political factors along with the economic factors. The Human Development Index, which covers three basic components in terms of socio-economic order, such as income, education and health, gains a different dimension in the name of welfare in all of these areas. Therefore, this study aims to determine factors affecting human development which is essential in terms of development goals. A cross-sectional analysis on a global scale is presented to investigate the impact of democracy, economic development, IMF loan use, infant mortality, and urbanization on human development. Quantile regression was estimated for 128 countries using 2019 data. The estimation results show that per capita income, democracy, urbanization, and IMF loan use have positive effects on human development. In contrast, infant mortality reduces human development. Afterward, we discussed the findings obtained from the analysis.

Keywords: Human Development, Democracy, Economic Growth, Quantile Regression

JEL Codes: O15,O50,C31

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1. INTRODUCTION

The concept of human development is essential in terms of economic, social, political and cultural dimensions in the development of countries. Therefore, the Human Development Index (HDI) has been recorded every year since 1990. Moreover, it is published regularly by the United Nations Development Program (UNDP).

The human development index is defined as a vital welfare indicator that reveals societies' social and economic welfare dimensions. Given that defining, the requirements for a productive life have been the central theme of politicians and philosophers from past to present. Therefore, it is crucial to determine which aspects of human development in life can be addressed. There are important reasons why we should reduce poverty and promote human development (Streeten 1994: 232). First of all, promoting human development is a goal. The second reason, it is a tool to increase productivity. A healthy, educated, and equipped workforce is the most important productive asset. The third reason, it is geared toward the reduction of family size. When these factors are considered, human development, which has experienced negativities due to political instability and increased unemployment, has started to gain importance again.

One of the key variables that affect human development is infant mortality. Infant mortality is an important indicator of social inequality and necessary for human development (Alijanzadeh et al. 2016:1). One might think that the increase in the number of family members means more burden to the household. However, this is contradicted as policies reduce infant mortality, improve health standards and lower population growth. The fourth reason is the physical environment. The impact of population on human development is also essential when considered an integral part of the physical environment. However, especially concerning the secure land rights, an increase in the population growth and the high population density can be effective for soil protection and forests, affecting human development (Streeten 1994: 232). In addition, sustainable urbanization policies are essential in the development of countries. Urbanization has a significant impact on economic activity by providing employment opportunities and increasing access to critical services. Thus, determining the effect of the rate of urbanization on human development is crucial to assessing the success of urbanization in a country. In addition, studies examining the effect of urbanization on human development are also limited.

The fifth reason is that improving health care and poverty reduction contributes to a peaceful civil society and democracy. Although democracy is an important mechanism that ensures and protects people's rights and freedoms, its impact on welfare cannot be ignored. Determining the effect of democracy on human development will also guide policies to be developed. Thus, democracy and democratic institutions are essential for human development. This factor is generally based on the idea that public participation in the electoral process strengthens the less advantaged ordinary group in society and mobilizes the political dynamic that suits the needs and interests of this group (Gerring et al. 2012: 1). Particularly in a complex society, this factor is treated as a political system providing regular constitutional opportunities to change the government. Therefore, since it is considered a social mechanism for solving social problems (Leblang 1997: 454), it is integral to human development. Moreover, human development is defined as the ultimate goal of the development process (Ranis 2004: 1). This situation has broadened the definitions and objectives of economic development. As freedom and capabilities develop with a democratic system, human development would significantly impact growth to the extent that it improves financial performance.

Similarly, as socioeconomic conditions improve, governments and households expand the range of choices and capabilities, and economic growth would positively impact human development. At the same time, with economic growth, countries would be able to make improvements in many areas, such as education and health. The possibility of creating suitable conditions for the realization of many social goals would also increase. Therefore, there is mutual interaction. Furthermore, considering that economic growth occurs in a stable macroeconomic environment, the existence of IMF programs is essential. The IMF is critical in effectively using scarce resources, managing exchange rate policies, creating a healthy economic climate, and ensuring price stability and economic growth (Camdessus 2000:5). The IMF cooperates with the World Bank and regional development banks while working with member governments to formulate appropriate social policies and evaluate these policies in a macroeconomic context. Each country's development priorities are different and different items are highlighted in the development plan. The IMF loans or programs aim to create a policy framework that enables sustainable, high-quality growth. As a result, the policy emphasis of IMF support is to reduce unproductive spending.

Human development standards measure the success achieved by implementing the created social policies. Thus, the IMF can be considered an influential factor in human development. Each country's development priorities are different and different items are highlighted in the development plan.

The aim of the study is to examine which factors effect human development socio-economically, politically, and environmentally. The study differs from other studies in the literature with selected variables and analysis methods. It contributes to the literature by including the effect of political factors on human development and analyzing its impact on socioeconomic and environmental factors using the quantile regression method for 2019. For this purpose, a cross-sectional analysis was carried out for 128 countries.

The study is organized as follows; after the introduction, Section 2 presents the relevant literature. The data and the methodology are introduced in Section 3. Section 4 presents the results of the study, and the results are discussed in Section 5.

2. LITERATURE REVIEW

When the literature is examined, one can observe that there are many studies discussing the effects of economic, political, and social factors on human development. Each of those studies reported different findings using varying methods. Microeconometric analysis is limited in studies. It has been observed that the studies are generally concentrated in the panel data area.

Alkire (2002) evaluated the multidimensionality of human development to provide a basis for human development and associated dimensions with Amartya Sen's approach to talent. At this point, the issue of which abilities are essential has been emphasized, and various opinions have been put forward. In addition to the capability approach, the suggested dimensions are based on the metaphysical system. Martha Nussbaums' "basic human abilities," Manfred Max-Neefs' "axiological categories," Deepa Narayan et al.'s "dimensions of well-being," Shalom Schwartzs' "universal human values," Robert Cummins" quality of life domains," Maureen Ramsay's 'universal psychological needs,' Doyal and Gough's 'basic human needs, and within the framework of these views, human development dimensions were evaluated.

Welzer et al. (2003) defined human development as a targeted syndrome and it was emphasized that human choice was the underlying idea of socioeconomic development, emancipatory mass values, and official democracy components. European/World Values Surveys (EVS/WVS), which included 73 countries, were used. The findings showed that the human development syndrome improved the institutional basis of effective Democracy and human choice.

Constantini and Monni (2008) investigated the link between human development, sustainability, and economic growth around the resource curse and environmental protection using the 3-Stage Least Squares (3SLS) method. Their findings suggested that developing countries should develop policies that encourage environmental protection. In addition, it was reported that the necessity of increasing human well-being and human development should be the first objective of development policies to provide a sustainable path.

Reiter and Steensma (2010) examined the link between human development, economic development and foreign direct investment. In the analysis, the panel data method was used for 49 developing countries for the period of 1980 to 2005. The human development index was used as the dependent variable. Life expectancy, restricted sectors for foreign investors, foreign investor discrimination, and corruption are some of the independent variables. Their results stated that foreign direct investments could positively affect countries' economic growth, but this was uncertain. Moreover, their finding suggested that foreign direct investments had a healing effect on human development when limited to the fields requiring foreign investment expertise.

Gerring et al. (2012) investigated the impact of democracy on the quality of life by considering its impact on social welfare. They suggested that infant mortality rates were one of the basic human measures. They explained the history of democracy, development, and human development. The analysis was undertaken for a panel data set consisting of 196 countries between 1960 to 2000. They examined variables such as female illiteracy, instability, GDP per capita, urbanization, and mortality in human development. They argued that the country's stock of democracy was associated with low infant mortality rates and there was no relationship between the country's regime type and human development. It was emphasized that countries should not expect sudden results from the human development levels resulting from democratic transitions and they should be cautious about improving their human development levels.

Spaiser et al. (2014) applied the Bayesian dynamic system approach to defining the human development index in the economy, democracy, and cultural values. The analysis discussed ten different indicators of human development as the leading indicator. According to the findings, countries were reported to become advantageous in terms of economic growth at a high level of democracy and freedom. In addition, it was emphasized that the rise in the level of liberation limited growth.

Annaka and Higashijima (2017) investigated whether democracy led to advances in human development via a panel data analysis for years from1800 to 2015. Error Correction Models (ECM) with Instrumental Variables (IV) estimation were applied. By demonstrating the dynamic relationship between human development and the democratic process, their results stated that the democratic process could only have a long-term impact on human development.

Mustafa et al. (2017) examined the relationship between human development, trade openness and economic growth in Asian Economies. The data set covers the period 1970-2011. The estimation method includes motivated simultaneous equations. Motivated simultaneous equations framework They stated that trade openness had positive effects on economic growth and human development. However, this effect alone was insufficient for human development in Asian countries. How the increase in infant mortality could be reduced during periods of unequal economic growth was discussed. It was emphasized that the findings obtained could confirm the view that trade liberalization was a viable development strategy for Asian countries once local institutional quality was taken into account.

Özdemir and Salihoğlu (2019) examined the factors affecting human development. Forty countries included in the Human Development Index were analyzed. As the economic factors, the discontent index and the economic freedom index were used. The analysis included political and economic stability and life satisfaction indices as political factors. The robust regression method was used with classical regression analysis in the study. Obtained findings were discussed for all variables. It was emphasized that countries should adopt approaches that would encourage the investments of domestic and foreign capital and should stay away from behaviors that would disturb the market in order to improve or develop their economies.

Korle et al. (2020) examined the impact of economic freedom measures on human development and foreign direct investment for 32 African countries. In the study, the panel data analysis method was used with the data of the period 1996-2017. They found that economic freedom and foreign direct investment had a positive effect on human development. In addition, they stated that this effect was statistically insignificant.

Efeoğlu (2021) examined the economic and political dimensions of human development for 128 countries based on their level of human development. Financial freedom, political stability, misery index, and democracy were considered independent variables in the study. The results suggested that there should be a political recovery in the countries and economic recovery and the regulations would further increase financial freedom whereas political stability would increase human development in countries.

Banday and Koçoğlu (2022) tried to analyze the relationship between the human development index (HDI), energy consumption, economic growth, and carbon dioxide in the context of environmental impact using the panel quantile regression method. A panel dataset was used for emerging economies between 1990 and 2014. They formed their policy recommendations for economic development by taking into account the environmental effects. In the study, it was found that the increase in CO2 emission was caused by energy consumption and the decrease in human development was caused by trade. The effect of the GDP variable on human development was determined to be nonlinear. In line with the findings, the importance of following renewable energy-based and emission-reducing technologies was emphasized.

3. METHODOLOGY

Quantile regression analysis is a statistical technique that gives robust estimators in a regression analysis, especially in the case of extreme values. In analysis, the distribution may differ according to the lower and upper parts of the regression. As in linear regression, modeling only the mean might miss important aspects of the relationship between the outcome and its estimators if the outcome distribution is skewed. Thus, quantile regression allows modeling any quantity of the outcome distribution, including the median, that is, the mean value (Beyerlein 2014: 330).

The quantile regression was defined as the generalized type of median regression for the determined quantiles. The τ-th quantile of the random variable Y for any $\tau \in (0,1)$ is defined as follows:

$$Q(\tau) = inf\{y: F(y) \geq \tau\} \quad (1)$$

The quantile function, similar to the distribution function F, allows the entire structure of Y to be described. The quantiles provide solutions to the following optimization problem by defining the piecewise linear control function as in Equation (2):

$$\rho_\tau(u) = u(\tau - I(u < 0)) \quad (2)$$

where I(.) is the indicator function. The solution to the minimization problem is as follows:

$$\hat{\alpha}(\tau) = argminE[\rho_\tau(Y - \delta)] \quad (3)$$

$Q(\tau)$, is based on a random sample $\{y_1, \dots, y_n\}$ of Y. τ-th quantile, in accordance with equation (3), is defined as any solution to:

$$\hat{\alpha}(\tau) = argmin \sum_{i=1}^{n} \rho_\tau \ (y_i - \delta) \quad (4)$$

Accordingly, the model defined by Koenker and Bassett (1978) is as follows:

$$y_i = x_i'\beta_\tau + u_{\tau_i} \quad (5)$$

Here y_i is the ith observation of the continuous dependent variable. Similarly, $x_{i1}, \dots, x_{ip}$ represents independent variables. $\tau \in (0,1)$ represents the quantile level of y given x (Q_τ (y|x)). The quantile level τ is the probability expression defined as Pr (y≤ Q_τ (y|x) |x). The whole conditional distribution is defined with a selected quantile level. The quantile constraint for the error term u_{τ_i} distribution is $Q_\tau(u_{\tau_i}|x_i) = 0$.

Using the conditional mean function estimate $\hat{\beta} = argmin \sum_{i=1}^{n}(y_i - x_i'\beta)^2$, the quantile function $Q(\tau|X = x) = x_i'\beta_\tau$ is estimated as:

$$\hat{\beta}_\tau = argmin \sum_{i=1}^{n} \rho_\tau(y_i - x_i' \beta \quad (6)$$

The quantile regression estimator takes each quantile of the conditional distribution into account. Thus, given X= x, it gives more information about how the conditional distribution of Y depends on x. That is, quantile regression is also concerned with the effects on the shape of the distribution rather than assuming that the variables change the position or scale of the conditional distribution (Buhai 2005: 4).

The main reason for using quantiles instead of simple regression is that the relationship between random variables can be expressed more accurately. Koenker and Bassett (1978) discuss that quantile regression provides more robust and efficient estimations compared to the traditional OLS estimators when the assumption of the normal distribution is not valid. The quantile regression is useful in capturing non-normally distributed and nonlinear relationships with explanatory variables. The quantile regression can estimate the median or any quantile when linear regression assumptions are not valid. In addition, it is used when there are extreme values in the data.

4. DATA AND EMPIRICAL MODEL

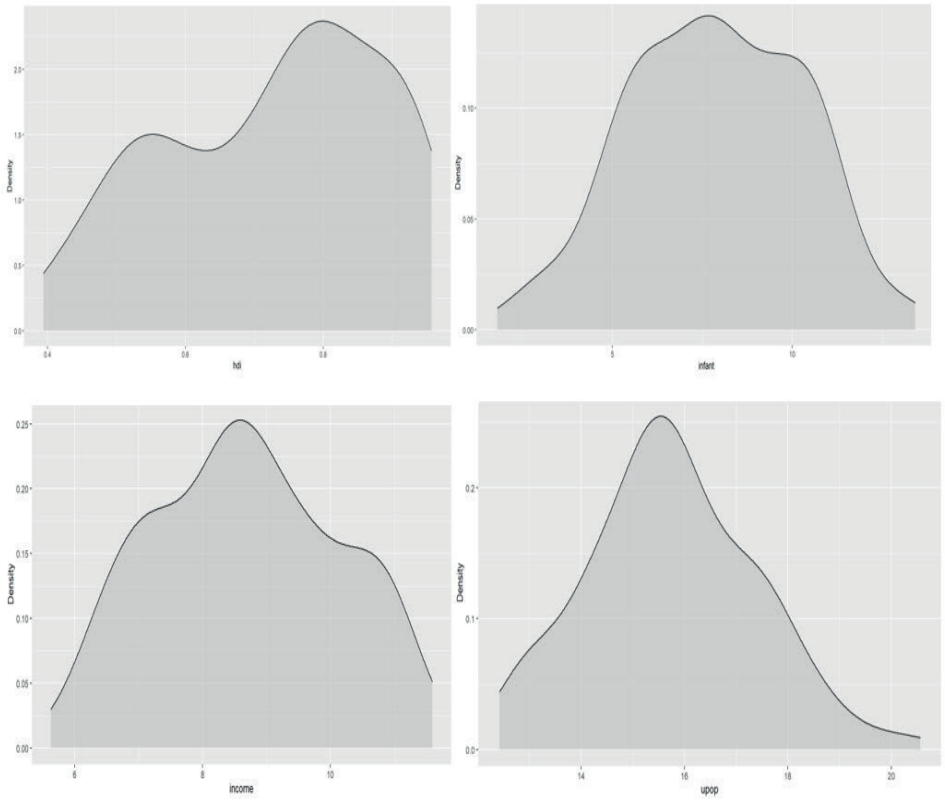
There are many empirical studies examining the factors affecting the human development index of countries. Few studies, however, examine the relationship between human development, democracy and IMF lending. In this respect, it is thought that this study would help fill the empirical research gap in examining the relationship between human development and democracy. The empirical analysis aims to determine the effects of democracy and IMF loan utilization variables on human development. 2019 cross-sectional data were used for 128 countries. Here, a human development model is estimated, including infant mortality and economic factors, especially the democracy index. The model in Equation 7 is based on studies by Saha and Zhang (2012), Tsai (2006) and Welzer etc. (2003).

$$HDI_i = \beta_0 + \beta_1 INCOME_i + \beta_2 INFANT_i + \beta_3 UPOP_i + \beta_4 IMF_i + \beta_5 DEMO_i + \varepsilon_i \quad (7)$$

The study uses the human development index (HDI) as the dependent variable to measure human development. The human development index (HDI) calculated by the United Nations Development Program (UNDP) was used as the dependent variable in the analysis. The independent variables are as follows: income is gross domestic product per capita (real GDP per capita); infant is the number of infants who died before reaching the age of one; demo denotes the democratic nature of countries (1 if full or defective democracy, 0 otherwise); the IMF determines whether the country uses an IMF loan (it takes a value of 1 if it used an IMF loan, 0 otherwise); upop, urban population, represents the number of people living in urban areas.

In this study, the Kernel density function and summary statistics were used to obtain information about the data distribution. Kernel density function and summary statistics are given in Table 1 and in Figure 1, respectively.

Figure 1. Kernel Density Functions



The scale difference in the model was eliminated by taking the natural logarithm of the variables.

Table 1. Summary Statistics

	Mean	Standard Dev.	Min	Max	Skewness	Kurtosis	Jarque-Bera
HDI	0.726	0.156	0.394	0.957	-0.355	1.998	8.609 (0.013)**
INCOME	8.670	1.433	5.628	11.594	0.058	2.085	4.858 (0.085)*
INFANT	7.906	2.400	1.791	13.430	-0.083	2.460	1.818 (0.403)
UPOP	15.770	1.620	12.420	20.559	0.234	2.887	1.327 (0.5149)
IMF	0.669	0.472	0	1	-0.730	1.533	
DEMO	0.453	0.499	0	1	0.161	1.025	

Note: *, **, *** denote 10%, 5%, 1% significance levels respectively.

Table 2 reports that there is no strong correlation between explanatory variables in the model.

Table 2. Pairwise Correlation Matrix for Explanatory Variables in the Model

	INCOME	INFANT	UPOP	IMF	DEMO	u_t
INCOME	1.0000					
INFANT	-0.6984	1.0000				
UPOP	-0.0049	0.6449	1.0000			
IMF	-0.7493	0.5709	0.1054	1.0000		
DEMO	0.6063	-0.4472	-0.0351	-0.4491	1.0000	
u_t	-0.0000	-0.0000	-0.0000	-0.0000	-0.0000	1.0000

Looking at the Jarque-Bera statistics of the variables in Table 1 and the Kernel density functions in Figure 1, one can see that HDI and income variables are not normally distributed. In addition, Table 2 shows that there is no strong correlation between explanatory variables in the model. As a result, the quantile regression is employed as it is more resistant to extreme values and allows a more flexible distribution.

5. EMPIRICAL RESULTS

The estimation results are presented in Table 3. In the continuation of the study, the results for the coefficients of this human development model are discussed.

Table 3. The Quantile Regression Model Results

Variables	(Q=0.25)	(Q=0.50)	(Q=0.75)
INCOME	0.0625***	0.0682***	0.0576***
	[0.0092]	[0.0072]	[0.0059]
INFANT	-0.0423**	-0.0376***	-0.0435***
	[0.0059]	[0.0046]	[0.0038]
UPOP	0.0448***	0.0391***	0.0437***
	[0.0065]	[0.0051]	[0.0042]
IMF	0.0456***	0.0382**	0.0239***
	[0.0153]	[0.011]	[0.0098]
DEMO	0.0066**	0.0026**	0.0003
	[0.0028]	[0.0122]	[0.0018]
Constant	-0.2566***	-1.1491***	-0.1223**
	[0.0682]	[0.0533]	[0.0439]

Note: a) *, **, *** denote 10%, 5% and 1% significance level respectively. Square brackets indicate standard errors. b) Q refers to quantile.

According to the estimation results, the income variable is found to be statistically significant and positive in all models. When per capita income increases, human development increases, and it is seen that countries positively affect the human development index. Moreover, it is seen that the infant variable added to the model only as an indicator of infant mortality has a negative sign. In other words, the increase in infant mortality caused a decrease in the human development index. The urbanization variable has a positive sign by the expectation and is statistically significant in all quantiles.

The IMF variable, which shows the IMF loan use of countries, is statistically significant and positive in all quantiles. It has also been found that the IMF variable has a significant effect on the human development index at a low quantile. In contrast, it has a more negligible effect on human development at other high quantile levels. It found the demo variable included in the model as an indicator of democracy to be significant only at 0.25 and 0.50 low quantiles. The democracy coefficient is positive, indicating that democratic countries with checks and balances help develop their citizens. Thus, from a human development perspective, democracies outperform autocracies in 128 countries. When the results are examined, it has been determined that the variable that most affects human development is income per capita.

5. CONCLUSION

Socioeconomic development, development and democratization ensure consistent social progress. The similarities between the countries provide common evidence of how the countries economic development, democratic structure, and human development values have developed. Moreover, it is accepted that social and ecological sustainability complement each other for sustainable human development. In this context, the factors affecting the human development of countries are examined within the framework of income, environmental and democratic structure.

This study explores the impact of democracy, infant mortality, urban population, IMF loans and economic development on human development in 128 countries for 2019. The results show that per capita income and democracy have significant effects on the human development level of countries. The democracy of countries supports human development. In other words, democratic countries with checks and balances outperform autocratic countries in terms of human development.

It has been determined that the IMF loan use variable has a positive effect on human development. IMF loans or programs it supports aim to create a policy framework that enables sustainable, high-quality growth. Therefore, the policy emphasis of IMF support is to reduce unproductive spending. Another goal of IMF support has been to reallocate spending to activities that are most beneficial to the poor, such as basic health care, housing, education, and other critical investments. Therefore, the positive impact on human development is as expected.

It is known that infant mortality is considered the essential criterion, especially in development goals, due to its effect. It is also used to monitor social inequality and health inequality. According to the results obtained, the impact of infant deaths on human development is negative, and the maximum effect is at the 75th quantile level. To reduce infant mortality, policymakers should focus on socio-economic indicators such as social literacy/education level and family income.

Finally, determining the impact of the rate of urbanization on human development is crucial to assessing the success of urbanization in a country. The urban population was evaluated as an indicator of urbanization. According to the findings obtained from the analysis, the effect of urbanization on human development is positive. The positive impact on human development points to balanced urbanization policies. We also need sustainable urbanization, especially in developing countries, to benefit from urbanization.

Overall, the results show that democracy, urbanization, IMF loan utilization and per capita income positively affect human development. Furthermore, it has been determined that the variable that most affects human development is income per capita. In terms of a policy proposal, governments should focus on developing economic development and democracy processes to enhance human development.

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Conflict of Interest

The authors declare that they have no conflicts of interest.

Submission Declaration Statement

We confirm that this work is original and has not been published elsewhere, nor is it currently under consideration for publication elsewhere.

Endnotes

[1]See: Njoh (2003); Moore et. al.(2003); Tripathi (2019); Freeman et. al (2019).
[2]There are many studies on the impact of democracy on human development. See: Ross (2006); Welzer and Inglehart (2001); Annaka ve Higashima (2017).
[3]Human development index values have been compiled from (https://hdr.undp.org/en/data).
[4]The democracy variable (demo) variable was taken from the official site of The Economist Intelligence Unit, EIU, (www.eiu.com), while it took other variables from the world bank (WDI). It created the dummy variable according to the democracy index value. A value of 1 is given if the index value is 6.02 and above, and 0 if it is less than 6.02.
[5]In the data set; 37th, 51th, 58th, 79th, 82th, 109th, 122nd, and 126th observations are extreme values.
[6]Ramsey-Reset Test result is as follows: F (3, 130) = 4.74 Prob>F= 0.0036, H_0: $\beta_1 = \beta_3 = \beta_4 = \beta_5 = 0$
Multicollinearity value: VIF: 5.28.
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity: chi2(1) = 6.7 Prob> chi2 = 0.0095.

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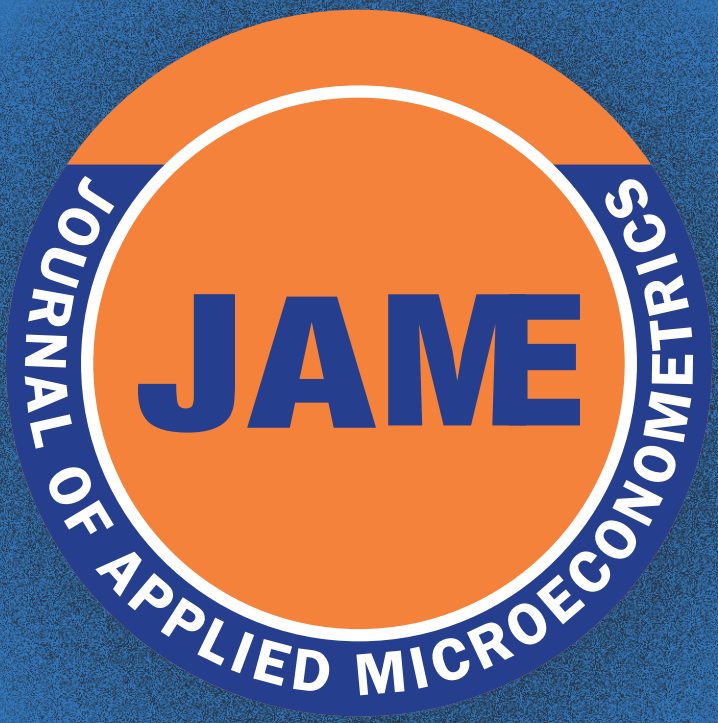

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