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ANALYSIS / RESEARCH

EXTENDED ABSTRACT

Youth Unemployment and Energy Consumption in OECD Countries

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Abstract

Youth unemployment is considered a socio-economic problem with serious consequences. It can increase criminal activity among youth. Apart from this, current youth unemployment may cause a serious loss of the income in the future. Therefore, a potential link between energy consumption and youth unemployment is explored in this research. Annual panel data have been collected for 34 OECD countries between 1991 and 2015. This paper employed a panel VAR approach. The empirical findings indicate that youth unemployment responds negatively to energy consumption. These results were confirmed using the Granger causality test, which revealed a unidirectional causal link running from energy consumption to youth unemployment. This is why necessary efforts need to be made to increase youth employment. A negative impact reported in this research gives important insights for key policy makers. The concluding remarks of this paper discuss policy recommendations in detail and offer insight for future research.

Keywords: Causal link, Energy consumption, OECD countries, Panel VAR, Youth unemployment

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OECD Ülkelerinde Genç İşsizliği ve Enerji Tüketimi

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Öz

Genç işsizliği, ciddi sonuçları olan bir sosyo-ekonomik sorun olarak kabul edilmektedir. Bu durum gençler arasında suç faaliyetlerini artırabilmektedir. Bunun dışında, mevcut genç işsizliği gelecekte ciddi bir gelir kaybına neden olabilmektedir. Bu nedenle, bu araştırmada enerji tüketimi ile genç işsizliği arasındaki potansiyel bağlantı incelenmiştir. 34 OECD ülkesi için 1991 ve 2015 arası yıllık panel verileri toplanmıştır. Bu çalışmada panel VAR yaklaşımı kullanılmıştır. Ampirik bulgular, genç işsizliğinin enerji tüketimine olumsuz yanıt verdiğini göstermektedir. Bu sonuçlar, enerji tüketiminden genç işsizliğe uzanan tek yönlü bir nedensel bağlantı ortaya koyan Granger nedensellik testi kullanılarak doğrulanmıştır. Bu nedenle gençlerin istihdamını artırmak için gerekli çabaların gösterilmesi gerekmektedir. Bu araştırmada raporlanan olumsuz bir etki, temel politika yapıcılar için önemli bilgiler vermektedir. Bu makalenin sonuç yorumları, politika önerilerini ayrıntılı olarak tartışmakta ve gelecekteki araştırmalar için fikir sunmaktadır.

Anahtar Kelimeler: Nedensel bağlantı, Enerji tüketimi, OECD ülkeleri, Panel VAR, Genç işsizlik

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Introduction

The 2007-2008 financial crisis dramatically influenced the global labor market and caused the position of young individuals to undergo a tremendous change. In 2010, the slight recovery allowed many young people trying to find employment opportunities. Still, many attempts were not successful, which then led to periods of extended joblessness (Gontkovičová et al., 2015:1680). Hence, youth unemployment is recognized as a critical socio-economic problem (Bilgili et al., 2017:193) because those who remain unemployed for an extended period of time face problems finding housing and establishing their own families, and often find themselves involved in the shadow economy. Thus, Scarpetta et al. (2012:6-7) stresses the need to invest in the youth and provide them an opportunity to be involved in the labor market.

Youth unemployment is considered a socio-economic problem with serious consequences. Ayhan and Bursa, (2019:467) suggest a positive relationship between crime and unemployment rate. This holds true for youth in particular (Farrington et al., 1986:335). Apart from this, Nordstrom Skans (2004:4) suggests that current youth unemployment may cause a serious loss of income in the future. Additionally, Hammarstrom et al. (1988:1026) outline possible (mental) illnesses that similar to depression that are caused by extended unemployment. As such, this problem attracts much attention in both developed and developing countries. Despite the fact that this problem causes serious consequences, Jensen et al. (2003:301) suggest that only a limited number of countries have managed find an effective solution to it.

Hallsten et al. (2017:237) list specific reasons underlying youth unemployment. Employers very often hesitate to employ young individuals because they have not proven themselves to be productive and no information exists regarding their performance. It is worth noting that many employers favor work experience and consider it extremely important while evaluating job applications. Moreover there is very often a lack of motivation caused by very low starting salaries, especially in developing countries. This is considered an important generator of the stress and sadness that may even lead to a further decrease in motivation, which, in turn, decreases employment opportunities.

Taking into account the above points, economists express great concern about the low youth employment rates. Calderon (2004:65), for example, suggests that youth employment contributes to social balance and peace. Thus, policy makers should make the necessary changes to increase young people's motivation to work and consequently youth employment rate. With this in mind, this paper explores whether or not energy consumption stimulates youth employment in OECD countries.

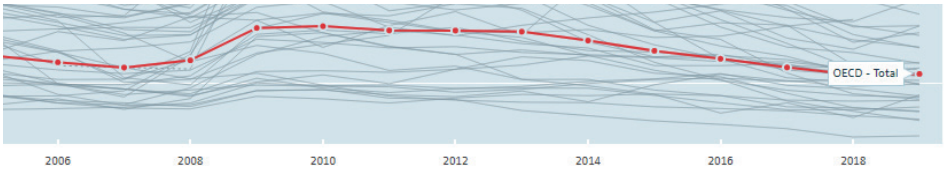
With regard to the relationship between energy consumption and total unemployment rate, Hamilton (1988:595) links unemployment to oil prices. To be more specific, the author suggests that unemployment is strongly connected with the business cycle. Since

oil prices are considered to be the most important determinant of the fluctuations in the business cycle, unemployment strongly reacts to changes in oil prices.

It is also important to emphasize that energy is considered one of the most important factors of production (Incekara & Ogulata, 2017:589). However, the main models of the growth do not present energy as a source of production (Aghion & Howitt, 2009:377). This is because these models did not explain the role of technology and have assumed technological change to be exogenous. In early 60s, however, Arrow (1962:155) introduced an endogenous growth model. More recent endogenous models include AK models and Schumpeterian growth models[1]. In these models, technology responds to changes in other variables in the model. Hence, energy is considered to be a crucial factor of production and no factor equals energy in importance. This is because all value produced is based on energy that is itself directed by other factors of production, namely capital and labor. Thus, energy consumption contributes significantly to economic growth and tends to play a great role in youth employment.

The literature on youth employment generally focuses on reasons for youth unemployment. Most of the related literature agrees that the major reasons for high youth unemployment are the shortage of aggregate demand, crises, and economic stagnations (Bilgili et al., 2017: 193). The authors also emphasize that the youth unemployment rate rises much faster than the total unemployment rate during crises because expenditures and labor demand decline. Awogbenle and Iwuamadi (2010: 832) suggest that the youth employment rate depends heavily on the status of the economy as a whole. Moreover, these authors indicate that economic activity is the main factor in determining youth employment rates when measured by GDP growth. Historical data imply a significant increase in youth unemployment rates in OECD member states (Figure 1). Youth unemployment increases faster that total unemployment.

Figure 1. Youth Unemployment Rate



Source: https://data.oecd.org/unemp/youth-unemployment-rate.htm

These differences become even more apparent during economic stagnations and crises. For the purposes of this study, youth unemployment is recognized as one of the most critical problems facing European countries in particular since 2008 (Bilgili et al., 2017: 194). To solve this problem, long-term economic growth needs to be stable.

1 For detailed explanations, please see Ugur (2016).

Youth unemployment is a serious problem in the countries in question. Youth are more seriously affected by unemployment than adults. Addressing this issue, OECD has created an action plan aiming to give youth a better start in the labor market. Some of the actions include tackling weak aggregate demand and boosting job creation, providing adequate income support to unemployed youth, and encouraging employers to continue or expand quality apprenticeship and internship programs (OECD, 2013:3). There are various determinants of economic growth recognized in the literature, such as market size, the productivity of labor and capital, and foreign trade. Beyond these, Bilgili et al. (2017:194) recognize energy to be a very important determinant of economic growth.

The link between energy consumption and economic growth has been well studied in the empirical research to date (Satrovic, 2019:2). Al-Kandari and Abul (2019:103) suggest that crude-oil production has dominated the unprecedented growth rate in Kuwait in the long-run. Moreover, Sari and Soytas (2004: 335) state that energy is an important determinant of GDP and that its impact is equal to employment in Turkey. Just as the demand for labor decreases in the case of low GDP growth, economic stagnation or crisis, and low investment rate, the youth unemployment rate increases exponentially because the most recently employed workers are the first to be laid off. Since energy consumption plays a key role in economic growth, it is also recognized to be a key determinant of total unemployment in addition to youth unemployment. Consequently, energy policies are considered to play a crucial role in decreasing youth unemployment rates (Bilgili et al., 2017: 193). As such, policymakers should take the necessary measures to support energy consumption and investments in the energy sector to increase youth employment rates.

This study's contribution to the literature is twofold. First, it explores whether or not energy consumption decreases youth unemployment in OECD countries and provides significant insight for policymakers. To the best of our knowledge, this is the first attempt to analyze the link of interest in terms of OECD member states that takes into account the latest available data. Additionally, the paper suggests that the discussion on the link between these two economic terms of interest is lacking among the academic community. Consequently, this paper attempts to provide empirical evidence on the matter. Furthermore, this paper gives an outline of the literature to date on the link between energy consumption and youth unemployment. In addition, the methodology is presented in detail together with the variables. The empirical section offers an interpretation of the results. Lastly, we conclude with a discussion of policy implications and recommendations for future research.

Literature Review

The link between energy consumption and economic growth has been extensively explored in research to date. Although the business cycle significantly influences unemployment, empirical evidence establishing this link is lacking. Moreover, the limited number of studies has explored the link between energy consumption and youth

unemployment was the motivation to conduct this research. The literature to date on this matter is summarized below.

Cetin and Egrican (2011:7184) have analyzed the impact of solar energy usage on employment trends. This type of energy is considered to be one of the main sources of renewable energy worldwide. Moreover, the authors highlight the role of solar energy in sustainable economic development. Analyzing Turkey, the authors suggest that solar energy is likely to become the main source of energy in Turkey and tends to have a significantly positive impact on employment trends in Turkey. Consequently, solar energy development requires significant government support. These authors also point out that the production of renewable energy creates new employment opportunities that are strongly connected with an increase in industrial activities.

George and Oseni (2012:10) implicate low employment and mediocre energy provision as major problems of the Nigerian economy. Accordingly, the authors explored whether or not electricity influenced unemployment between 1970 and 2005, finding mediocre electricity provision to be a critical determinant of unemployment in Nigeria. The paper therefore addresses the need to provide financial support to electricity production since it is directly connected to the industrial sector and its ability to create a significant number of job opportunities.

Bilgili et al. (2017:193) explored the link between energy consumption and youth unemployment in several European countries between 1990 and 2011. They employed FMOLS, DOLS, and panel causality tests. Their findings suggest that energy consumption has a negative impact on youth unemployment. Causality tests suggest a unidirectional causal link running from energy to unemployment. The authors suggest several policy implications as a result. These results are opposed to those of Bilgili et al. (2017:194), who suggest a bidirectional causal link between energy consumption and employment. With regard to the link between economic terms of interest, it is important to present the results of Sadikova et al. (2017:706) in the case of Russia, who collected data on quarterly basis between 1992 and 2015. Exploring the link between the variables of interest in the long term, their results suggest a positive impact of energy consumption on unemployment.

Besel (2017:21) has examined the link between energy consumption and unemployment in the case of Turkey between 1980 and 2015. The author employed a time-series methodology based on cointegration and causality tests to explore the link between variables of interest in the long term. The findings suggest a unidirectional link running from energy to unemployment rate.

The papers to date indicate mixed evidence on the link between energy consumption and unemployment. However, it is difficult to compare the empirical evidence because the data covers different countries and periods of time. Of the above studies, only Bilgili et al. (2017:195) pay special attention to the link between energy consumption and youth unemployment, suggesting a negative link. However, the previous studies did not utilize a panel VAR model to analyze the link between variables of interest. Thus, this paper presents results obtained using panel VAR in addition to causality analysis. Collecting data for 15 countries between 1995 and 2009, Costantini et al. (2018:250) explored the

actions to increase energy efficiency in EU. Their results suggest that energy efficiency by sector negatively influences employment growth. This is particularly the case in energy-intensive industrial sectors. These findings indicate that the link between the terms of interest is very complex and should be very carefully monitored. A negative impact is also cited by Bartik (2015:182), who suggests that employment rates may decrease in certain sectors as a result of environment-friendly regulations. Moreover, the author stresses the need to create more environment-friendly jobs.

Methodology and Variables

This study employs a panel VAR model to explore the link, if any, between energy consumption and youth unemployment. VAR models are very popular in modern economic research and were first developed for time-series data. The advantages of panel data over time-series are various. Hence, panel VAR has many advantages in comparison to time series VAR. One of the most important advantages is the ability of panel data to deal with heterogeneity among individuals. Consequently, panel VAR enables researchers to control for both static and dynamic interdependencies (Canova & Ciccarelli, 2013:1). The detailed explanation of the methodology used in this research relies on Love and Zicchino (2006:193-195).

One of the advantageous properties of VAR models is that they assume all variables to be endogenous. Since panel VAR models rely heavily on methodological properties developed for time series data, there is a need to first present the generalized form of this model. Thus, VAR can be summarized as (Eq. 1):

$$Y_t = A_0(t) + A(lag)Y_{t-1} + u_t. \quad (1)$$

The notation explained by Canova and Ciccarelli (2013:6) shows that endogenous variables are denoted by Y_t whereas A *(lag)* represents the lag operator. Moreover, the error term is assumed to be IID. Taking into account the above discussion on the difference between panel and time series VAR, the general form of panel VAR is given as (Eq. 2):

$$y_{it} = A_{0i}(t) + A_i(lag)Y_{t-1} + u_{it}. \quad (2)$$

It is important to emphasize that panel VAR introduces both time (*t = 1,…,T)*, and individual dimensions (*i=1,…,N)* and includes the vector of disturbance denoted by u_{it}. With regard to the research interest of this paper, Eq. 3 presents the models to be explored in the empirical part of the study:

$$\boldsymbol{UNE_t} = \sigma + \sum_{\boldsymbol{i=1}}^{\boldsymbol{k}} \boldsymbol{\beta_i}\, \boldsymbol{UNE_{t-1}} + \sum_{j=1}^{k} \theta_j\, ENE_{t-j} + u_{1t}$$

$$\boldsymbol{ENE_t} = \alpha + \sum_{i=1}^{k} \beta_i\, UNE_{t-1} + \sum_{\boldsymbol{j=1}}^{\boldsymbol{k}} \boldsymbol{\theta_j}\, \boldsymbol{ENE_{t-j}} + u_{2t}. \quad (3)$$

Dependent variables are assumed to be the function of all variables (lag) in the model. Innovations are expressed by u. In terms of the data, these are collected at the annual level for 34 OECD member states. The link between energy consumption and youth unemployment has been explored quite broadly in research to date. However, as far as we can tell from the literature, this is the first attempt to analyze the link of interest in the case of OECD countries, and this is our motivation to conduct this study and to specific OECD member states in the sample. Relevant data originated from 1991 to 2015. The criterion for selecting the particular time-frame was data availability. With regard to the variables, there are two variables of interest. Youth unemployment is approximated using total youth unemployment as a ratio of total labor force, and encompasses ages 15 to 24 (UNE). Energy consumption is approximated using kilograms of petroleum per capita (ENE). To provide more informative results and to suggest more effective policy recommendations, we have focused on forecast-error variance decomposition as well as on impulse-response function together with the graphical interpretation, as suggested by Abrigo and Love (2016:21).

Findings and Discussion

The most important empirical findings together with their discussion are presented in the following section. The descriptive statistics show a minimum youth unemployment rate of 2.63%, a maximum of 58.21%, and a mean of 16.55% (Table 1). The empirical data indicate a significant difference in youth unemployment among OECD member states. In terms of energy consumption, the maximum value is 18178.10 kg/capita, the minimal is 947.76, and the mean is 4239.29. As in the case of youth unemployment, there are the significant differences among OECD member countries in terms of energy consumption. To deal with interpretative issues and to make data more comparable, the natural logarithm are calculated and used in the following tables.

To estimate the panel VAR, determining whether or not the variables satisfy the stationary properties is essential. Consequently, we tested for these properties both for the variables in levels and their first differences (Muslija, 2018:55). In order to provide more informative data, we employed three different tests and summarized the outcomes in Table 2.

Table 1. The Basic Measures of Summary Statistics

Stats	ENE	UNE
Mean	**4239.29**	**16.55**
Sd	**2323.97**	**8.99**
Max	**18178.10**	**58.21**

Min	**947.76**	**2.63**
skewness	**2.31**	**1.30**
kurtosis	**12.22**	**5.26**
countries	**34 (Appendix 1)**	

Source: Authors

Table 2. Stationary Tests

Trend: included Method	lnENE		D.lnENE		lnUNE		D.lnUNE	
	Stat.	p-value	Stat.	p-value	Stat.	p-value	Stat.	p-value
LLC	**-1.98**	**0.024**	**-22.64**	**0.000**	**-4.54**	**0.000**	**-13.80**	**0.000**
IMS	**2.47**	**0.993**	**-22.74**	**0.000**	**-1.87**	**0.031**	**-12.61**	**0.000**
ADF-Fisher	**31.59**	**1.000**	**-22.64**	**0.000**	**94.87**	**0.017**	**-13.80**	**0.000**

Source: Authors

In terms of the first variable of interest (i.e., energy consumption), the tests in level agree that this variable does not meet the stationary properties (α = 0.01). Hence, there is strong evidence for the presence of a unit root. In terms of the first difference, all of the three tests agree on the stationary properties of the variable in question (α = 0.01), indicating that the null hypothesis on the unit root is rejected. With regard to the second variable, the Levin–Lin–Chu (LLC) test provides the stationary properties for the variable in level and in first difference (α = 0.01). However, both Im–Pesaran–Shin and ADF–Fisher suggest that the variable in level is not stationary (α = 0.01), indicating that the null hypothesis is rejected. In terms of the first difference, these tests confirm the results of the LLC test, indicating the stationary properties of the first difference (α = 0.01). Taking into account the fact that variables are significant at their first differences, these variables are used in the following research.

The final step before estimating the VAR model is to decide on the order. Table 3 shows the results of J statistics together with their p value. The decision is based on three criteria

(i.e., MBIC, MAIC, MQIC). The values assigned to these criteria for the first order were compared with the same values obtained for the second- and third-order panel VAR. Table 3 presents the minimum values assigned by MBIC and MQIC in the first-order panel VAR. MAIC suggests the minimum value assigned with the third-order panel VAR. Apart from this finding, this paper follows most of the criteria suggesting the first-order panel and has employed Generalized Method of Moments (GMM) to provide more rigorous results (Satrovic & Muslija, 2018:69).

Table 3. PVAR Order Selection

Order	CD	J	J p-value	MBIC	MAIC	MQIC
1	0.210046	27.88562	0.005749	-49.764	3.885616	-16.9296
2	0.209057	19.37609	0.012973	-32.3903	3.376092	-10.5007
3	0.156346	10.04225	0.039722	-15.841	2.042249	-4.89615

Source: Authors

Table 4 outlines the results of the GMM estimation. Youth unemployment has a significant, positive response to its lagged value ($\alpha = 0.01$). However, the response of youth unemployment to energy consumption was found to be negative, which offers very important insight for policymakers. This finding suggests that it is necessary to increase energy consumption by stimulating a priori the industrial sector, as it is an important energy consumer. The other coefficients were not found to be significant.

Table 4. GMM Estimation of PVAR Model

Independent variables	Dependent variables	
	D.lnUNE	D.lnENE
$D.lnUNE_{t-1}$	0.232 (0.041)***	-0.015 (0.013)
$D.lnENE_{t-1}$	-0.544 (0.159)***	-0.037 (0.061)

Note: *, **, * significant at 1%, 5%, and 10%, respectively.**

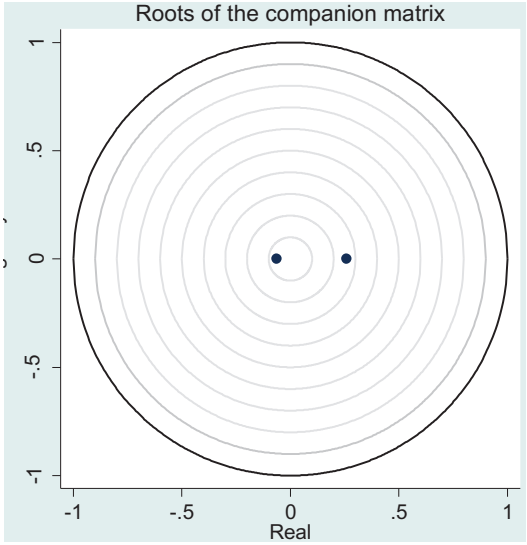
Source: Authors

To test for model stability, we determined the eigenvalues and have displayed them below. Eigenvalues lower than one indicate model stability (Table 5). Displaying all eigenvalues to be within the unit circle, Graph 1 illustrates that model stability has been established

Table 5. Eigenvalues

Eigen value		Modulus
Real	Imaginary	
0.259232	0	0.259232
-0.06412	0	0.064124

Graph 1. Graphical Presentation



Source: Authors

We then explored the potential Granger causality in the subsequent analysis, which suggests a unidirectional relationship running from energy consumption to unemployment in the 34 OECD member countries (Table 6). Yet, there is no evidence for the causal impact of youth unemployment on energy. However, these results are in accordance with the panel VAR, indicating the necessity to increase energy consumption in order to reduce youth unemployment.

Table 6. VAR Based Granger Causality (Bivariate Models)

Equation	Excluded	chi2	p-value
D.lnUNE	D.lnENE	11.706	0.001
D.lnENE	D.lnUNE	1.339	0.247

Source: Authors

As indicated above, this paper will display the forecast-error variance decomposition (FEVD) and impulse responses function (IRF) to provide more informative results. Table 7 illustrates that the variation of youth unemployment is explained by unemployment and energy consumption in the following ratio, respectively, 98.2%:1.8%, indicating that while energy consumption is an important determinant of youth unemployment, there are many other determinants that play an essential role in explaining youth unemployment. Since the number of determinants is most likely infinite, econometricians have a central role in selecting the most important ones. With regard to energy consumption, youth unemployment is found to explain 3.2% of the variability whereas the rest is explained by energy consumption itself.

Table 7. Forecast-Error Variance Decomposition

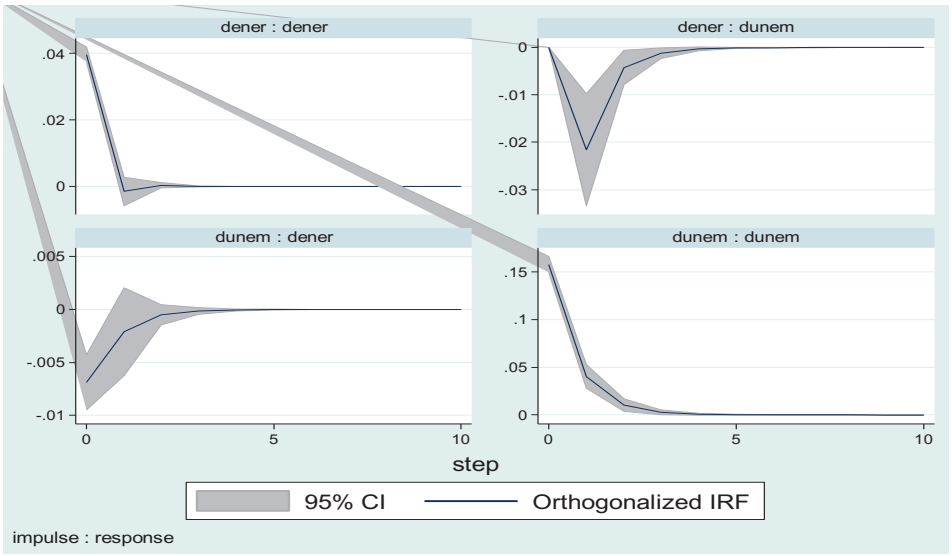
Response variable	Impulse variable		Response variable	Impulse variable	
D.lnUNE	D.lnUNE	D.lnENE	D.lnENE	D.lnUNE	D.lnENE
0	0.000	0.000	0	0.000	0.000
1	1.000	0.000	1	0.029	0.971
2	0.983	0.017	2	0.032	0.968
3	0.982	0.018	3	0.032	0.968
4	0.982	0.018	4	0.032	0.968

5	0.982	0.018	5	0.032	0.968
6	0.982	0.018	6	0.032	0.968
7	0.982	0.018	7	0.032	0.968
8	0.982	0.018	8	0.032	0.968
9	0.982	0.018	9	0.032	0.968
10	0.982	0.018	10	0.032	0.968

Source: Authors

Finally, we have plotted IRF to conclude the empirical research conducted in this paper. Graph 2 displays the IRFs for the variables of interest.

Graph 2. IRF Plots



Source: Authors

The most important finding of Graph 2 is that unemployment rate has a negative impact on energy consumption during period 0-5, meaning that energy has great potential to decrease youth unemployment, or, in other words, to increase youth employment in the

short term. This impact is not found to be significant after period 5, providing no evidence on the link between variables of interest.

Conclusion

The present study has aimed to answer the question as to whether energy consumption has an impact on youth unemployment (individuals aged 15-24) in OECD member states using data collected between 1991 and 2015. The results of the panel VAR model suggest that youth unemployment responds negatively to energy consumption and positively to its lagged value. The other coefficients were not found to be significant, indicating no evidence for energy consumption leading to increases in youth unemployment.

With regard to the Granger causality test, these results outline a unidirectional relationship running from energy consumption to unemployment rates in 34 OECD member countries. Yet, there is no evidence on the causal impact of youth unemployment on energy. However, these results are in accordance with the panel VAR, indicating the necessity to increase energy consumption in order to reduce youth unemployment. In the final two steps of this empirical study, we estimated FEVD and IRFs. The FEVD suggests that variation up to 5% in both variables can be explained by youth unemployment or energy consumption. IRFs support the results of panel VAR model in the short term.

The results of this paper present valuable insight for policymakers in OECD member states. Policymakers need to promote sectors that consume energy, and especially industrial sectors, since energy consumption was found to have a negative impact on youth unemployment. Moreover, key decision makers are encouraged to help young people open new businesses, as doing so will not only increase energy consumption but also decrease youth unemployment. This paper argues that it is imperative to discuss the importance of energy policies in reducing youth unemployment at the international level through panels and international conferences and to include all key policymakers. The following recommendations for future research can be made: it is necessary to analyze the link between energy consumption and youth unemployment by sector, the impact of financial crises should be taken into account, and the role of renewable energy should be further explored.

Appendix 1: List of the Countries

Australia	Iceland
Austria	Israel
Belgium	Italy
Canada	Japan
Switzerland	Korea, Rep.
Chile	Luxembourg
Czech Republic	Mexico
Germany	Netherlands
Denmark	Norway
Spain	New Zealand
Estonia	Poland
Finland	Portugal
France	Slovak Republic
United Kingdom	Slovenia
Greece	Sweden
Hungary	Turkey
Ireland	United States

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