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# TERM PROJECT

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## Introduction

Youth represents a vital asset for economies and societies worldwide. According to Eurostat, Europe alone is home to over 94 million young individuals aged between 15 and 29. To fully harness their potential, it is imperative to effectively engage and integrate them into society. However, numerous EU Member States encounter obstacles in assimilating and incorporating young people into educational systems and labor markets, resulting in significant social and economic ramifications. The issue of youth disengagement from the labor market has been prominent since the 1980s and persists to this day. Despite their high motivation and fresh perspectives, young people often face challenges due to their lack of experience and prevalence in low-skilled jobs. The onset of the pandemic and economic downturns has further compounded these challenges, leading to historically high levels of youth unemployment.

Understanding why young people are not in education, jobs, or training (NEET) is vital for governments and policymakers. By looking at wages and investment in research, we can find ways to help young people get jobs and improve the economy. High NEET rates show that many young people are not using their skills, which slows down a country's growth. The relationship between wages and how much people earn on average affects job opportunities and how much money people have. Also, investing in research helps create new ideas and boosts the economy in the long run.

To analyze the relationship between the NEET rate and explanatory variables (such as the minimum wage relative to the average wage and R&D expenditures), we utilized a panel data regression model. Panel data enables us to control for both time-invariant country-specific effects and time-specific effects, thereby facilitating a more robust analysis of data across multiple countries and years. This paper leverages recent OECD and World Bank data to delve into the causes of youth labor market disengagement, examining shifts in the minimum wage relative to the average wage and variations in Research and Development (R&D) expenditures.

Our NEET research underscores the significant impact of increased R&D expenditures in reducing NEET rates, emphasizing the importance of targeted investments to integrate young

individuals into the labor market. However, changes in the minimum wage relative to the average wage were found to have an insignificant effect on NEET rates. Our model elucidates approximately 12% of the variability in NEET rates, underscoring the multifaceted nature of factors influencing youth labor market outcomes

## Literature Review

How youth minimum wage policies affect the labor market is one of the most comprehensively studied topics in labor economics. The pioneering work of Card and Krueger (1994) sparked a lively debate, beginning by questioning the conventional wisdom that higher minimum wages reduce unemployment. Research in this area often focuses on the effects of minimum wages on low-skilled workers and youth, as these groups are among those most affected by such policies. While many studies have evaluated the impact of minimum wages applied separately by age groups, increasing attention is being paid to the impact of age-specific minimum wage policies.

For example, Pereira (2003) analyzed the consequences of the abolition of youth minimum wages for 18- and 19-year-old youth in Portugal in 1987. It found that minimum wage increases in this age group reduced hiring and that employers were hiring between the ages of 20–25. Similarly, Portugal and Cardoso (2006) examined the same policy change for 17–19 year olds in Portugal and used employer-employee matching data. They observed that the proportion of workers in the 17–19 age group decreased in new hires, but the turnover rates for this group decreased in existing businesses.

Yannelis (2014) examined the consequences of implementing an age-specific minimum wage for workers under 25 years of age in Greece. He found that this policy had positive employment effects on young people aged 20–24 than on those aged 25–29**. Hyslop and Stillman (2007) examined a policy reform in New Zealand that changed the age structure and proportion of the youth minimum wage structure. Although they did not find a significant effect at first, they observed negative effects on youth employment two years after the reform**.

Shannon (2011) examined the impact of eliminating youth minimum wages in Canada. Evidence has shown that employment rates and working hours of young people aged 15–16 have decreased after the reform, but this evidence is weak.

Using intersectional data from 30 OECD countries for the period 2000-2014, it was found that in countries where youth minimum wages are implemented, employment and labor force participation rates of individuals under 25 are relatively higher than in countries where youth minimum wages are not implemented. These results are an important step to better understand the impact of youth minimum wages on the young population.

Most of the studies mentioned use the difference-in-differences (DID) methodology to evaluate the impact of minimum wage policy. Another empirical approach widely used in the literature is RDD. For example, taking advantage of the discontinuities of a stepped minimum wage structure applied to workers aged 15–23 in the Netherlands, Kabatek (2021) finds a significant increase in the sharp turnover rate. **Similarly, Olssen (2011) finds that a 10% minimum wage increase for workers up to 21 years of age in Australia each year does not significantly affect young people's working hours**.

We did not address youth minimum wages and focused on the NEET ratio of the general minimum wage to the average minimum wage. In his article, Dayıoğlu (2022) emphasized that the youth minimum wage is significant, but the general minimum wage change has a weak significance level, and that our study and the literature are mostly parallel. We can also infer from this that the youth minimum wage must be increased in order for the minimum wage to produce a meaningful result.

For R&D expenditure and NEET rate relationship, Granger Causality Analysis results; In general, it shows that there is a unidirectional causality relationship from R&D intensity to youth unemployment and that increases in R&D intensity have a decreasing effect on youth unemployment in Turkey and all EU countries. Therefore, increasing R&D expenditures not only allows countries to develop technologically, but also has a serious macroeconomic impact (Atabey, 2019). “Turkey and 11 EU countries (Estonia, Greek Cyprus, Latvia,

Lithuania, Slovenia, Slovakia, Bulgaria, Croatia, Hungary, Poland, Romania) found that increasing the share of high-tech products in manufacturing industry exports reduced youth unemployment. These countries also have very high youth unemployment rates and low R&D intensity. Therefore, considering these similarities, it can be concluded that when these countries with low R&D intensity increase their existing R&D expenditures, the emergence of new job opportunities is more limited than in other EU countries and young people are less employed in these business sectors. Therefore, it can be said that simply increasing R&D expenditures may not be enough to prevent youth unemployment, and the reasons that negatively affect youth employment should be investigated on a country basis and solution suggestions should be developed.The country most affected by this effect is France. In France, a 100 percent increase in high-tech product exports reduces youth unemployment by 18.5 percent. Finland follows France with a rate of 18.4 percent. Therefore, countries where the share of high-tech products in manufacturing industry exports has a negative impact on youth unemployment will increase their investments in high technology, which may positively affect both economic growth figures and youth employment."

As we found a significant R&D and NEET correlation, literatures shows us the same result and beyond that developed countries should do more investment to R&D, developing countries should do more to decrease NEET RATE by fixing technology institutions etc.

## Data and empirical approach

To analyze the relationship between the NEET rate and the explanatory variables (minimum wage relative to average wage and R&D expenditures), we utilized 22 years of data from 25 OECD countries through a panel regression model. Panel data enables us to account for both time-invariant country-specific effects and time-specific effects, thereby offering a more robust analysis across multiple countries and years.

We will use Ordinary Least Squares (OLS) and Fixed Effects models to examine the relationship between NEET rates, minimum wages relative to average wages (MIN2AVE), and R&D expenditure as a percentage of GDP (R&D_EXP). The fixed effects model will

control for country-specific characteristics that remain constant over time, allowing us to isolate the effects of our variables of interest.

Model:

$NEET_{it} = \beta_0 + \beta_1 \times Min2Ave_{it} + \beta_2 \times R\&D\_exp_{it} + \varepsilon_{it}$

i: 25 countries, t: 22 years

TIME_PERIOD: Year of observation (2000 to 2022)

NEET: Share of the population not in education, employment, or training. All genders between ages 15-29, all education levels

Min2Ave : minimum wage/average wage of OECD countries

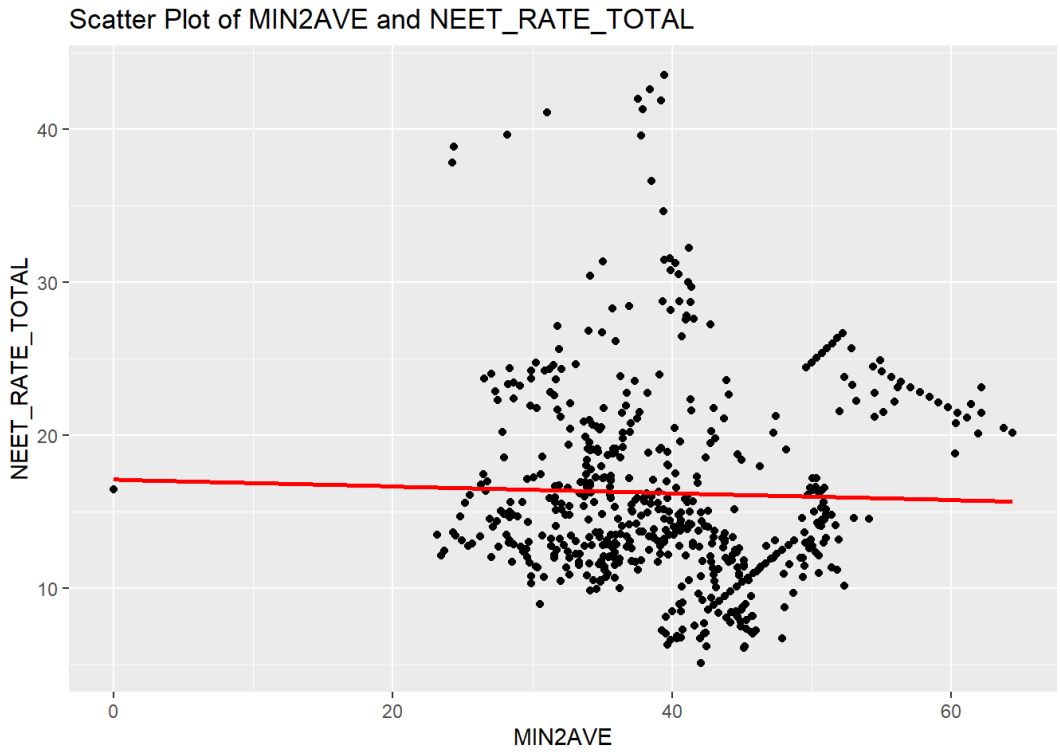
R&D_exp : Research and Development expenditure of %GDP of OECD countries

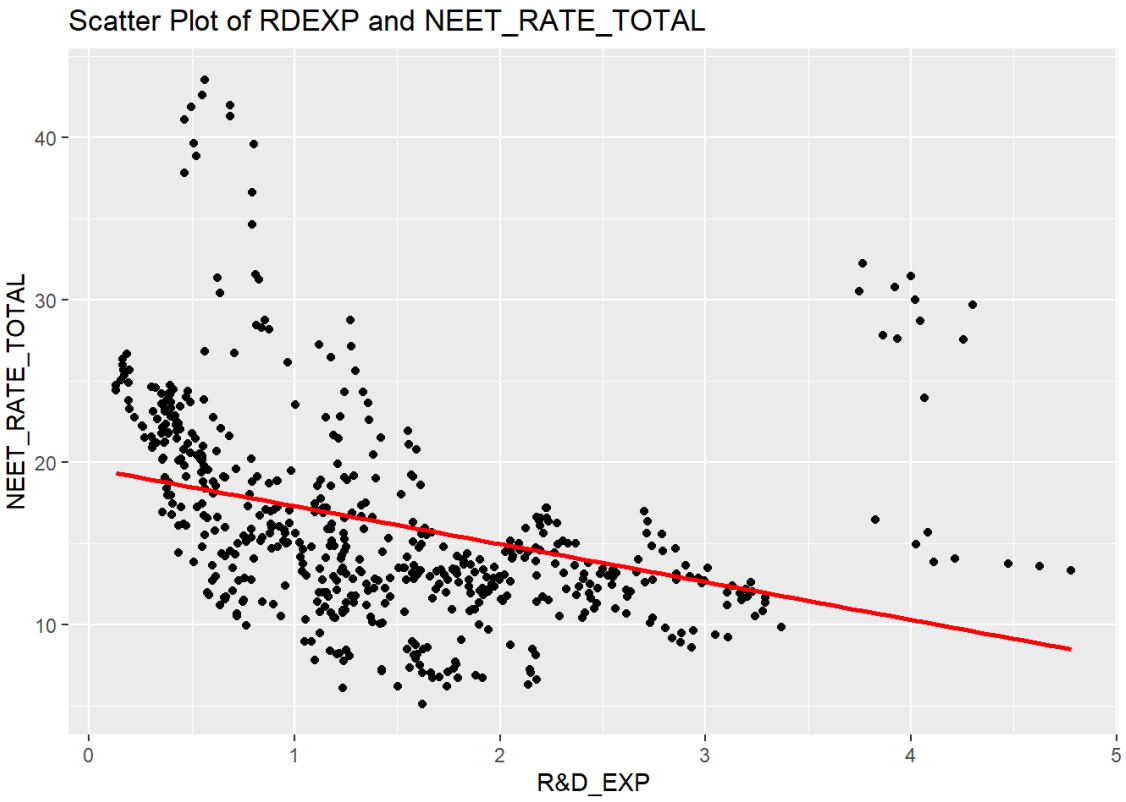
The data was structured as a *unbalanced panel*. In RStudio, interpolation has been performed on the data using the DPLYR package to fill in missing values that couldn't be found. There were also missing values such as; Germany's MIN2AVE missing until 2015 (block of missing data for a specific variable and country), Japan's NEET rates missing after 2015 (another block of missing data, but for a different variable and time period), Chile has only 5 NEET rates values (not consecutive), Lithuania only declared twice until 2013 which is very sparse data. So, we used both interpolation and getting value from different websites to prepare the data.

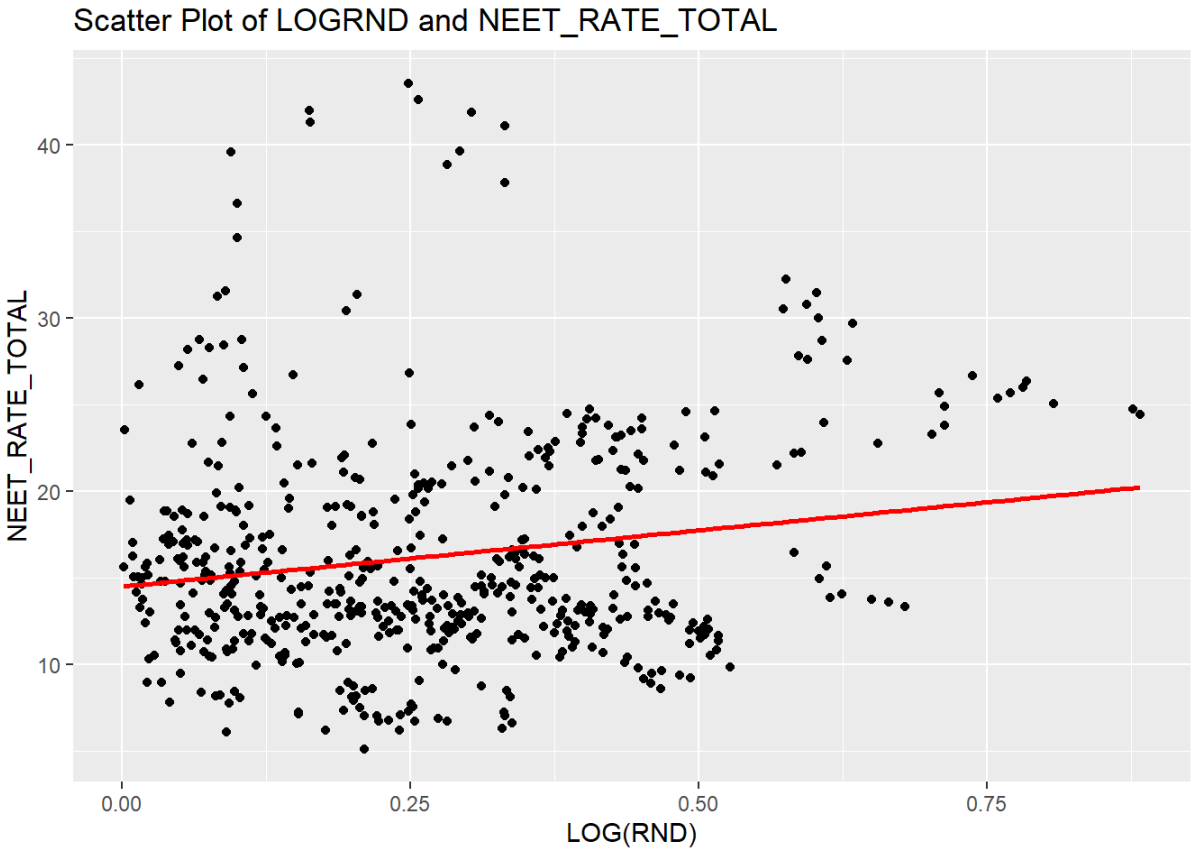
**Table: Summary statistics of OLS**

| Variables | Coefficient | Standard Error | t-value | p-value |
|---|---|---|---|---|
| Intercept | 20.43 | 1.24 | 16.49 | <2e-16 |
| MIN2AVE | -0.026 | 0.028 | -0.94 | 0.348 |
| R&D_EXP | -2.302 | 0.241 | -9.54 | <2e-16 |

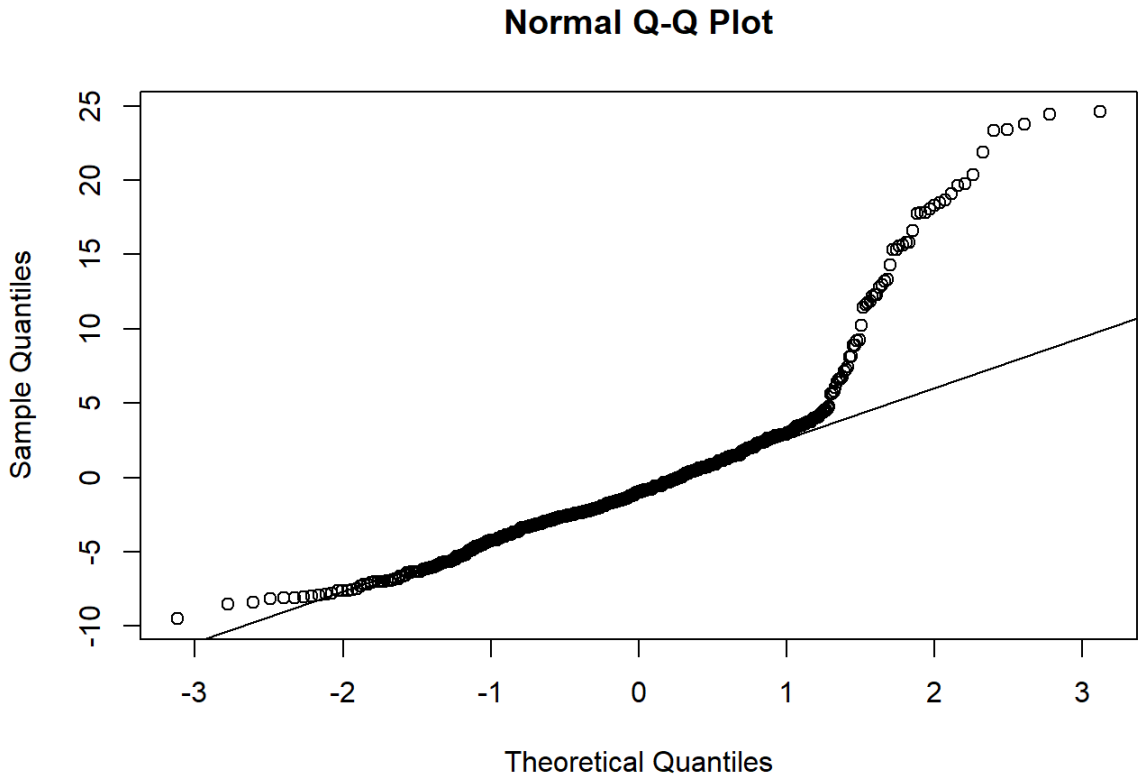
According to the results of the panel data regression, the estimated intercept term is 20.43 (SE = 1.24). It is observed that the ratio of minimum wage to average wage (MIN2AVE) does not have a statistically significant effect on the NEET rate (coefficient = -0.02638, SE = 0.02806, t-value = -0.94, p-value = 0.348). However, it has been determined that Research and Development (R&D_EXP) expenditures significantly decrease the NEET rate (coefficient = -2.30210, SE = 0.24134, t-value = -9.539, p-value < 2.2e-16). The R-squared value, which measures the explanatory power of the model, is calculated as 0.1205, and the adjusted R-squared value is 0.1179, indicating that the independent variables explain approximately 12% of the variance in the NEET rate. Additionally, the F-statistic, which indicates the overall significance of the model, is 45.5 with a p-value < 2.2e-16. These results suggest that while the ratio of minimum wage to average wage is ineffective in influencing the NEET rate, Research and Development expenditures have a significant reducing effect.




Scatter Plot of RDEXP and NEET_RATE_TOTAL
NEET_RATE_TOTAL
40
30
20
10
0
1
2
3
4
5
R&D_EXP


Scatter Plot of LOGRND and NEET_RATE_TOTAL
NEET_RATE_TOTAL
40
30
20
10
0.00
0.25
0.50
0.75
LOG(RND)

As we observe graphs, wee see that there is a non-linearity in R&D graph. To fix that, adding logarithmic R&D variable added to model. Also we can clearly see insignificant Minimum wage in second graph. Then we looked at normality assumption:




We couldn't see an entire heteroscedastic pattern here. Also low R-square did show a significant model to us. To be sure, we tested our regression with heteroscedasticity test and autocorrelation test.

Breusch-Pagan test was suitable for panel data and we found out BP = 1.1207, df = 2, p-value = 0.571. Assuming ,

H0: variances in the model are homogeneous

H1: Heterogenous

Meaning that our p value is greater than 0.05, we failed to reject null hypotesis. So, there's no heteroscedasticity in our model.

But in aoutocorrelation test (Breusch Godfrey), our results LM test = 576.13, df = 3, p-value < 2.2e-16 meaning that p value smaller than 0.05 and where H0: No Autocorrelation, reject null hypotesis shows there's autocorrelation. So, the model inefficient and there is a lack of precision. But it is not about unbiasedness.

Adittionally, we added fixed and random models. We used these models to control for out-of-time country-specific effects and time-specific effects in the panel data.

**Fixed & Time Effects (One-way Individual Effect) Model:** This analysis is based on a fixed effects model that controls for unrelated pre-existing effects over time (RDEXP) and differences between individual countries (MIN2AVE). This model allows us to examine the variables affecting the NEET rate while also considering time-invariant effects such as cultural factors or institutional differences between countries.

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FIXED EFFECT

        | Coefficient | Std..Error | t.value | Pr...t..  |
        |  0.108737   |  0.040819  | 2.6639  | 0.0079730 |
        |  -1.925104  |  0.611202  | -3.1497 | 0.0017320 |
        |  8.440634   |  1.658896  | 5.0881  | 0.0000005 |
        |  -0.229496  |  0.732809  | -0.3132 | 0.7542800 |
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Here, it is seen that the effect of "LOGRND" and "RDEXP" variable on NEET rates is statistically significant. However, for some time periods (TIME_PERIOD) the coefficients may not be statistically significant. So we will test Time Fixed models.. Furthermore, the model's R-squared value is relatively low (0.14), indicating that only a small portion of the variance in the NEET rate is explained by MIN2AVE and RDEXP.

factor(TIME_PERIOD): The effect of time periods (years) shows that there is a statistically significant change in the NEET rate in some years. (The NEET rate decreased statistically significantly in 2017 and 2018.) Considering all these statistics, the explanatory power of the

model is low. This indicates that variables that will fit the model better or provide more explanatory power should be added or the model should be restructured.

**Random Effects Model**: The Random Effects Model assumes that unobserved differences between countries are random and not correlated with the explanatory variables, making it a suitable method when the unit-specific effects are assumed to be randomly distributed.

| | Coefficient | Std..Error | z.value | Pr...z.. |
|---|---|---|---|---|
| | 15.019210 | 1.812299 | 8.2874 | < 2.2e-16 |
| MIN2AVE | 0.061867 | 0.036665 | 1.6873 | 0.09154 |
| RND | -2.443771 | 0.490886 | -4.9783 | 6.415e-07 |
| LOGRND | 8.736603 | 1.637899 | 5.3340 | 9.606e-08 |

According to the analysis, the MIN2AVE coefficient was estimated as 0.108737 and the corresponding p-value was 0.007973, indicating its significance at the 5% level. This shows that there is a decrease in NEET_RATE_TOTAL as the ratio of minimum wage to average wages (MIN2AVE) increases. Similarly, the coefficient for R&D expenditure was estimated as -1.925104 and the p-value was 0.001732, indicating its high significance. This SHOWS that an increase in R&D spending is associated with a significant decrease in NEET_RATE_TOTAL. Additionally, the R-squared value of the model is 0.14637, indicating that approximately 14.637% of the variability in the NEET rate is explained by the included variables. This highlights the model's ability to capture a significant portion of the variability in NEET rates and demonstrates the importance of both minimum wage policies and R&D investments on NEET .

The Durbin-Watson test is used to check the autocorrelation of the error terms of the model. In our case, the DW statistic is 0.13764 and the p-value is very small (< 2.2e-16), indicating significant autocorrelation in our model. The Breusch-Godfrey test is used to check the first order of serial correlation in the model. According to the results, the LM test statistic is 477.85 and the p-value is < 2.2e-16, indicating that there is serial correlation in our model. The Hausman test compares between the fixed effects model and the random effects model. If the p-value is high (usually greater than 0.05), a random effects model is preferred. In our case, the p-value is 0.3255, meaning it is not high enough to prefer the random effects model.

In the time fixed effects model, the effect of time periods (years) shows a statistically significant change in the NEET rate in some years (in 2017 and 2018, the NEET rate decreased statistically significantly).

Based on these test results, the explanatory power of the model is low and that better-fitting variables or structural changes that will provide more explanatory power are needed ( may be omitted variable bias).

## Conclussions and Recommendations

Our analysis shows a weak and insignificant relationship between NEET rates and MIN2AVE (Minimum wage Average), while there are strong and statistically significant relationships between R&D_EXP (R&D Expenditures) and NEET. The increase in R&D expenditures has contributed to the decrease in NEET rates. These findings guide policymakers to increase youth participation in education and the labor market. In particular, encouraging R&D spending and reviewing the minimum wage limit (i.e. separate determination of youth minimum wage by age) could help reduce NEET rates.

To have more reliable analysis, I will add GDP goods and services cariable to compare R&D rates. Also in our case, R&D investments may be FDI, we may find how to seperate those variables.

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- Rstudio
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## Data

- OECD Data explorer: Minimum relative to average wages of full-time workers, NEET rates
- World Bank: Research and development expenditure (%GDP)