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Article

An econometric analysis of the impact of economic growth, information and communication technology goods exports and unemployment on NEET rates: the case of Nordic countries

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Abstract. This study aims to empirically analyze the impact of economic growth, information and communication technology (ICT) goods exports and unemployment on NEET rates for the Nordic countries (Denmark, Norway, Sweden, Finland and Iceland). The study covers the period 2005-2022 and the data are annual. In the analysis, the LLC unit root test was applied. Then, panel VAR based on GMM and panel Granger causality analysis were employed. Accordingly, an increase in economic growth was found to reduce the NEET rate. On the other hand, an increase in the unemployment rate and ICT goods exports leads to an increase in the NEET rate. According to the results obtained from the panel Granger causality analysis, bidirectional Granger causality relationship was determined between the NEET rate and economic growth, the NEET rate and unemployment, economic growth and unemployment, economic growth and ICT goods exports and unemployment and ICT goods exports. In addition, a unidirectional Granger causality relationship from the NEET rate to ICT goods exports was found.

Keywords: NEET; economic growth; information and communication technology goods exports; unemployment; Nordic countries
JEL classification: O11; O33; O4; I25

1. Introduction

In today's economies, youth participation in the labor market provides benefits such as increasing the welfare of individuals, acquiring skills and improving the quality of life at the micro level, while at the macro level, it plays a critical role in accelerating social development and supporting economic growth.

The young population has the potential to make significant contributions to economic growth due to its dynamic structure, creativity and openness to new ideas (Günaydın and Çetin, 2015: 18). In this context, the concept of NEET, which refers to young people who are "neither in

education nor in employment" has been at the forefront of the policy agenda in many countries in recent years. It can be said that the high NEET rates are closely related to various social and macroeconomic indicators such as economic growth, information and communication technology goods exports and unemployment of countries.

NEET, which refers to individuals who are not in employment, education or training, encompasses young people who are neither working nor pursuing any form of education. The concept includes various characteristics of inactivity such as early school leaving, unemployment and disengagement from the labor market (Pacelli et al., 2023: 69). Moreover, NEET represents a multidimensional situation involving exclusion from education, employment and active participation in social life (Çolak, 2025: 71). In other words, the concept of NEET describes the young population that is "not in employment, education, or training," regardless of their level of education. The OECD defines NEET as the proportion of young people who are not engaged in any form of employment, formal education or training. The term NEET first appeared in the United Kingdom in the late 1980s, emerging from policy discussions on the need to reintegrate young people aged 16-18 who had left education but were unable to enter the labor market. Later, the definition was expanded to include young people aged 15-24 and 15-29 (OECD, 2025; Eurofound, 2016: 1-9). According to the OECD, the NEET rate is calculated as the proportion of young people aged 15-29 classified as NEET (Kabakçı Günay, 2025: 230). The NEET indicator typically includes young people who have left school early, are unemployed or discouraged and individuals who have responsibilities to care for family members or are out of the workforce due to illness or disability (ETF, 2015: 6). Eurofound classified the NEET population into five main subgroups: 1) young people who are traditionally unemployed, 2) young carers, those with family responsibilities and those unable to work due to illness or disability, 3) young people who are not seeking work or training, have no other obligations or incapacities, are discouraged or pursuing dangerous or asocial lifestyles, 4) young people actively seeking a job or training but waiting for opportunities that match their skills and status, and 5) young people travelling and engaging in activities such as art, music or self-directed learning (Eurofound, 2012: 24).

A common characteristic of these groups is their lack of participation in productive economic activities. The NEET group, which remains inactive among the young population leads to significant economic losses as it does not take part in the production process (Özen Atabey, 2021: 574). The young population constitutes a critical demographic segment that shapes a country's future workforce potential, innovation capacity and social dynamism. High NEET rates not only deepen inequalities of opportunity at the individual level but also lead to a loss of economic productivity and an increase in social problems at the macro level (Çolak, 2025: 71).

In this context, the main objective of this study is to empirically examine the impact of economic growth, information and communication technology (ICT) goods exports and the unemployment rate on NEET rates in the Nordic countries (Denmark, Sweden, Norway, Finland and Iceland) using a panel data analysis approach. For this purpose, annual data covering the period 2005-2022 were used. This study investigates a relationship that has been examined only a limited number of times in the existing literature by analyzing the effects of economic growth, ICT goods exports and unemployment on NEET rates. As a matter of fact, the literature review indicates that relatively few studies have considered these variables together. This demonstrates the originality of

the study and its potential to fill a significant gap in the literature.

However, it is also important that the study is conducted specifically for the Nordic countries using panel data analysis methods. In fact, the study employs panel VAR and panel Granger causality as methods, allowing for the examination of dynamic interrelationships and causal linkages among the variables. The inclusion of ICT goods exports, which has received limited attention in empirical studies on NEET rates, further enriches the analysis by adding a technology-related perspective. Moreover, the study focuses on the Nordic countries, which have been relatively less studied in the literature. These countries are characterized by strong welfare and education systems, inclusive labor market policies and advanced digital infrastructure. Their similar socio-economic and institutional structures also allow for a more consistent analysis of the relationships among economic growth, unemployment, ICT goods exports and NEET rates, making the country group a suitable sample for analysis. Thus, the study provides original contributions to the literature in terms of the variables, methods and country group considered, while also offering empirical findings that can guide policymakers in developing effective strategies to reduce NEET rates. Within this framework, the study is structured as follows: after the introduction, information about the socio-economic situation of the Nordic countries will be provided. Then, a literature review will be conducted. Afterward, the dataset will be explained. Thereafter, the method will be introduced and the empirical findings obtained from the analysis will be presented, followed by a discussion of the findings. Finally, the study will be concluded with the conclusion section.

The socio-economic profile of the Nordic countries

The Nordic countries are known for their high standards of living, low unemployment rates, strong welfare systems and advanced levels of digitalization. The general socio-economic structure of these countries is important in the context of economic growth, ICT goods exports, unemployment rates and NEET rates, which are examined in the study. In this section, the socio-economic situation of the Nordic countries is presented with the help of tables with relevant indicators.

Table 1. Economic growth, unemployment, ICT goods exports and NEET indicators: Denmark.

	Denmark				
	2005	**2010**	**2015**	**2020**	**2022**
Population, total	5,419,432	5,547,683	5,683,483	5,831,404	5,903,037
GDP per capita (constant 2015 US$)	52015.18	51209.45	53094.01	55934.56	60248.67
GDP growth (annual, %)	2.36	1.58	2.10	-1.78	1.54
Unemployment, total (% of total labor force)	4.83	7.75	6.28	5.64	4.43
Unemployment, youth total (% of total labor force ages 15-24)	8.60	15.55	12.15	11.59	10.53
ICT goods exports (% of total goods exports)	4.94	3.65	3.66	3.95	3.71
NEET, total (%)	4.37	6.86	7.03	7.44	6.77
NEET, female (%)	5.16	6.20	6.93	7.18	6.98
NEET, male (%)	3.60	7.48	7.13	7.70	6.56

Source: World Bank, 2025.

Table 1 presents selected socio-economic indicators for Denmark. When the table is examined, it is seen that the population showed a steady increase between 2005 and 2022. GDP per capita also rose over this period, despite a decline to $51,209.45 in 2010. When economic growth rates are examined, it is seen that there are fluctuations over the years. The growth rate was 2.36% in 2005 and declined to 1.58% in 2010. This decrease can be considered to be due to the effects of the global economic crisis. Although the growth rate increased to 2.10% in 2015, it turned negative at -1.78% in 2020 due to the COVID-19 pandemic. Economic recovery was observed in 2022. In terms of total unemployment rates, the rate was 4.83% in 2005, peaked at 7.75% in 2010, and declined to 4.43% in 2022, indicating an overall improvement in the labor market. When youth unemployment rates are examined, while the rate was 8.60% in 2005, there was a significant increase to 15.55% in 2010. However, it decreased again to 10.53% in 2022. The youth unemployment rate remained higher than the total unemployment rate. While ICT goods exports were 4.94% in 2005, it decreased to 3.71% in 2022. Regarding NEET rates, an increasing trend was observed during the period. In fact, the rate in question increased from 4.37% to 6.77%. The NEET rate for women was 5.16% in 2005 and reached 6.68% in 2022. The NEET rate for men increased from 3.60% to 6.56% in the same periods. During the period under review, NEET rates for both men and women increased.

Table 2. Economic growth, unemployment, ICT goods exports and NEET indicators: Norway.

	Norway				
	2005	**2010**	**2015**	**2020**	**2022**
Population, total	4,623,291	4,889,252	5,188,607	5,379,475	5,457,127
GDP per capita (constant 2015 US$)	73524.25	72804.4	74809.97	75287.21	79620.16
GDP growth (annual, %)	2.69	0.79	1.86	-1.28	3.25
Unemployment, total (% of total labor force)	4.38	3.53	4.30	4.42	3.23
Unemployment, youth total (% of total labor force ages 15-24)	11.25	9.19	9.78	11.19	9.90
ICT goods exports (% of total goods exports)	1.22	1.43	1.08	1.38	0.47
NEET, total (%)	6.40	5.81	6.24	6.15	6.23
NEET, female (%)	6.61	5.49	5.53	5.14	5.55
NEET, male (%)	6.20	6.11	6.91	7.10	6.86

Source: World Bank, 2025.

Table 2 shows selected socio-economic indicators for Norway. The table indicates that the population increased steadily between 2005 and 2022. GDP per capita also rose during this period. After declining to $72,804.40 in 2010, it reached $79,620.16 in 2022. Economic growth rates fluctuated over the years. The growth rate, which was 2.69% in 2005, decreased to 0.79% in 2010 due to the impact of the global economic crisis. The growth rate subsequently increased to 1.86% in 2015, but dropped to -1.28% in 2020, largely due to the COVID-19 pandemic. Economic recovery was observed by 2022. Regarding total unemployment, the rate decreased from 4.38% in 2005 to 3.53% in 2010, but rose to 4.42% in 2020. However, it declined again to 3.23% in 2022. The youth unemployment rate was 11.25% in 2005 and decreased to 9.90% in 2022. However, the youth unemployment rate remained higher than the overall unemployment rate. ICT goods exports were 1.22% in 2005 and decreased to 0.47% in 2022, indicating a significant reduction in exports of ICT goods. When total NEET rates are examined, it can be seen that the overall rate remained largely stable between 2005 and 2022. While the total NEET rate was 6.40% in 2005, it decreased slightly

to 6.23% in 2022. The NEET rate for women was 6.61% in 2005 and it decreased to 5.55% in 2022. The NEET rate for men increased from 6.20% to 6.86% in the same years.

Table 3. Economic growth, unemployment, ICT goods exports and NEET indicators: Sweden.

	Sweden				
	2005	**2010**	**2015**	**2020**	**2022**
Population, total	9,029,572	9,378,126	9,799,186	10,353,442	10,486,941
GDP per capita (constant 2015 US$)	46188.84	48204.66	51197.95	51715.78	54878.29
GDP growth (annual, %)	2.79	5.75	4.41	-2.01	1.46
Unemployment, total (% of total labor force)	7.81	8.61	7.43	8.29	7.39
Unemployment, youth total (% of total labor force ages 15-24)	22.83	24.76	20.37	23.90	21.61
ICT goods exports (% of total goods exports)	11.22	9.72	6.92	6.58	5.27
NEET, total (%)	9.40	7.79	6.81	6.52	4.96
NEET, female (%)	8.79	7.67	6.60	6.41	4.82
NEET, male (%)	9.99	7.90	7.01	6.61	5.08

Source: World Bank, 2025.

Table 3 demonstrates selected socio-economic indicators for Sweden. As shown in the table, the population increased between 2005 and 2022. GDP per capita exhibited a steady upward trend over the period. Economic growth rates fluctuated over the years. The rate was 2.79% in 2005 and increased to 5.75% in 2010. In 2015, the growth rate was 4.41%, but in 2020, it became negative due to the impact of the COVID-19 pandemic and the rate was recorded as -2.01%. By 2022, a moderate recovery was observed with growth reaching 1.46%. When total unemployment rates are examined, it is seen that Sweden has relatively high values. The unemployment rate, which was 7.81% in 2005, increased to 8.61% in 2010. It was 8.29% in 2020 and decreased to 7.39% in 2022. Although recoveries have occurred from time to time, Sweden's unemployment rate remained higher than that of Denmark and Norway. Youth unemployment was also notably high, rising from 22.83% in 2005 to a peak of 24.76% in 2010 and then decreasing to 21.61% in 2022. Youth unemployment rates were consistently higher than total unemployment rates, which is concerning. When evaluated in terms of ICT goods exports, the rate, which was 11.22% in 2005, decreased to 5.27% in 2022. There is a continuous decreasing trend in Sweden's ICT exports. When total NEET rates are examined, a steady downward trend is observed in the period 2005-2022. This development can be considered positive. The NEET rate for women decreased from 8.79% in 2005 to 4.82% in 2022, while the NEET rate for men decreased from 9.99% to 5.08% in the same period. Consequently, there was a significant decline in NEET rates for both men and women during the period under review.

Table 4. Economic growth, unemployment, ICT goods exports and NEET indicators: Finland.

	Finland				
	2005	**2010**	**2015**	**2020**	**2022**
Population, total	5,246,096	5,363,352	5,479,531	5,529,543	5,556,106
GDP per capita (constant 2015 US$)	42529.35	43556.54	42560.35	44690.98	46016.15
GDP growth (annual, %)	2.78	3.17	0.47	-2.49	0.76
Unemployment, total (% of total labor force)	9.60	8.39	9.38	7.76	6.72
Unemployment, youth total (% of total labor force ages 15-24)	26.78	21.29	22.30	21.19	14.14
ICT goods exports (% of total goods exports)	20.29	6.36	2.46	2.50	2.60
NEET, total (%)	7.90	8.65	10.59	9.37	8.07
NEET, female (%)	7.74	7.95	9.01	8.44	7.26
NEET, male (%)	8.05	9.32	12.11	10.24	8.83

Source: *World Bank, 2025.*

Table 4 shows selected socio-economic indicators for Finland. When the table is examined, it is observed that the population showed a slow and limited increase between 2005 and 2022. GDP per capita followed a relatively stable course, with a slight increase in recent years. Economic growth rates fluctuated over the years. The economic growth rate, which was 2.78% in 2005, reached 3.17% in 2010. However, in 2015, economic growth was weak at 0.47% and in 2020, it declined to -2.49%, largely due to the impact of the COVID-19 pandemic. In 2022, the growth rate was 0.76% and a limited recovery was experienced. When total unemployment rates are examined, it is seen that it remained relatively high but tended to decrease over time. The unemployment rate, which was 9.60% in 2005, decreased to 8.39% in 2010. In 2015, an increase was observed again with 9.38%. The unemployment rate, which was 7.76% in 2020, decreased to 6.72% in 2022. There is a significant improvement in youth unemployment rates. The youth unemployment rate, which was 26.78% in 2005, decreased to 14.14% in 2022. This situation can be considered a positive development in the participation of young people in the labor market. However, although youth unemployment has improved, the rate for young people is still higher than the total unemployment rate. ICT goods exports decreased sharply from 20.29% in 2005 to 2.60% in 2022. When the total NEET rates are examined, it is seen that they followed a fluctuating course between 2005 and 2022, showing an upward trend. The NEET rate for women decreased slightly from 7.74% in 2005 to 7.26% in 2022, whereas the NEET rate for men increased from 8.05% in 2005 to 8.83% in 2022. Although NEET rates for women improved slightly, rates for men increased during the period under review.

Table 5. Economic growth, unemployment, ICT goods exports and NEET indicators: Iceland.

	Iceland				
	2005	**2010**	**2015**	**2020**	**2022**
Population, total	296,734	318,041	330,815	366,463	382,003
GDP per capita (constant 2015 US$)	48850.77	48193.7	52951.68	52641.72	57804.76
GDP growth (annual, %)	6.12	-2.83	4.44	-6.94	8.98
Unemployment, total (% of total labor force)	2.55	7.56	3.98	5.48	3.79
Unemployment, youth total (% of total labor force ages 15-24)	7.05	15.85	8.57	9.87	8.42
ICT goods exports (% of total goods exports)	0.10	0.07	0.18	0.24	0.19
NEET, total (%)	5.07	7.89	4.75	6.66	4.44
NEET, female (%)	5.08	7.83	3.18	6.22	2.78
NEET, male (%)	5.05	7.94	6.25	7.07	6.04

Source: World Bank, 2025.

Table 5 presents selected socio-economic indicators for Iceland. When the table is examined, it is seen that the country's population increased steadily between 2005 and 2022. Although GDP per capita experienced temporary declines during the global economic crisis and the COVID-19 pandemic, it showed an upward trend. Economic growth rates have followed a fluctuating course over the years. The growth rate, which was 6.12% in 2005, decreased to -2.83% in 2010. It reached 4.44% in 2015 and dropped to -6.94% in 2020 as a result of the COVID-19 pandemic. However, a strong recovery was achieved in 2022, reaching a high value of 8.98%. When total unemployment rates are examined, it is seen that they are generally at low levels except during crisis periods. The unemployment rate, which was 2.55% in 2005, rose to 7.56% in 2010. It decreased to 3.98% in 2015 and rose again to 5.48% in 2020. By 2022, unemployment had recovered, falling to 3.79%. Iceland's youth unemployment rate rose from 7.05% in 2005 to 8.42% in 2022. This situation reveals that youth unemployment rates are at higher levels compared to total unemployment rates. ICT goods exports remained at very low levels throughout the period. The rate, which was 0.10% in 2005, reached 0.19% in 2022. Although total NEET rates have fluctuated over the period 2005-2022, they are generally on an improving trend. The NEET rate for women declined from 5.08% in 2005 to 2.78% in 2022. However, the NEET rate for men increased from 5.05% to 6.04% in the same period. These data indicate a significant decrease in the NEET rate for women, while the NEET rate for men has shown a slight increase.

2. Literature review

Numerous studies have examined the factors affecting NEET rates. However, only a limited number of studies have specifically addressed this issue in the context of economic growth, ICT goods exports and unemployment rates particularly for the Nordic countries. Therefore, it is important to review the existing approaches to the topic. In this direction, this section will include studies in the existing literature on the subject.

Bruno et al. (2013) evaluated the impact of the crisis on the NEET rate and youth unemployment rate in EU regions for the period 2000-2011 using GMM and bias-corrected LSDV dynamic panel data estimators. The findings showed that NEET rates are persistent. It has been

determined that persistence has increased during the crisis period and is close to the youth unemployment rate. It was also concluded that the sensitivity of NEET rates to GDP decreased during the crisis period.

Bäckman and Nilsson (2016) studied cohorts born in Sweden in 1975, 1980 and 1985 and showed that being NEET in early adulthood increases the risk of being excluded from the labor market later in life. The effects were found to be independent across gender and to increase over time across cohorts.

Ruesga-Benito et al. (2018) evaluated the impact of socio-economic variables related to the prosperity level of the European Union and social protection as well as the risk of poverty and social exclusion on young NEETs for 2016 using a structural equation model. The findings revealed that the main factors determining the NEET status are more strongly related to poverty and exclusion than the economic environment.

Wickremeratne and Dunusinghe (2018) analyzed the youth NEET rate in Sri Lanka in terms of national, sectoral, gender, education, ethnicity and marital status and revealed the determinants of NEET. For this purpose, they used the 2015 Sri Lanka Labor Force Survey. Descriptive statistics tool and logistic regression analysis were used as methods. The findings show that the youth NEET rate was as high as 25.8% in 2015, which is unsatisfactory for the Sri Lankan labor market. It has also been found that there are significant NEET disparities among young people by sector, gender, age, education, ethnicity and marital status. The study revealed that age, gender, education, residential sector and marital status are key determinants of youth NEET.

Bingöl (2020) examined the impact of macroeconomic indicators on NEET for the Fragile Five countries for the period 2005-2018, using panel data analysis methods and a fixed effects model. According to the findings, human development index, GDP per capita, foreign direct investment and adjusted savings for education expenditure had a statistically significant effect on NEET rates. A 1% increase in the human development index and foreign direct investment leads to a 2.14% and 0.03% increase in the NEET rate, respectively, while a 1% increase in GDP per capita and adjusted savings for education expenditure leads to a 0.77% and 0.38% decrease, respectively. In addition, according to the correlation matrix of the residuals, it was found that the highest correlation between countries was between India and Brazil and the lowest was between Russia and Indonesia.

Dias and Vasconcelos (2020) examined NEET youth in the Brazilian context using data from the 2014 National Household Sample Survey. According to the results, there is a significant socio-economic heterogeneity in the group composition. It was also found that a significant proportion of young people are in this status due to structural problems and social inequalities, and for another significant portion of cases, NEET status does not constitute a problem in itself.

Özen Atabey (2021) investigated the relationship between young people who are neither in education, employment or training and economic growth in Turkey. In the study covering the period 1990-2020, the analysis was carried out using the Toda-Yamamoto causality test. The findings revealed a one-way causality relationship from the NEET rate to economic growth.

Maynou et al. (2022) examined the convergence of NEET youth across 274 European

regions. The study covers the period from 2000 to 2019 and club convergence and spatio-temporal econometric models were used. According to the findings, the unemployment rate and the percentage of early leavers from education and vocational training stand out as the main drivers of NEET rates.

Jakobsen (2023) studied the transition from compulsory school to education and work for children of immigrant and native Danes within the framework of NEET status. The findings indicate that immigrant children have higher NEET rates than native Danes.

Pacelli et al. (2023) analyzed the trajectories of NEET rates in Europe in the decade after the financial crisis using EU-SILC and examined the structural characteristics of the countries before the crisis. The findings suggest that family support policies, training, labor market flexibility and economic growth are effective in reducing the probability of becoming NEET in the long run.

Şahin et al. (2023) examined the relationship between the reasons for young people becoming NEET and its effects, specifically in Turkey. To this end, an in-person field survey was conducted by Istanbul University with 3,158 NEET youth between September and December 2020. The collected data were analyzed using multivariable regression. Research findings revealed that the effects of the individual, familial, educational, environmental and labor market dimensions of the causes of being NEET scale on the effects of being NEET scale were significant.

Çolak (2025) examined the relationship between NEET rates, Sustainable Development Goals scores and economic growth in 23 OECD countries using the two-stage generalized method of moments. The study covers the period 2000-2022. According to the findings, it was concluded that both economic growth and improvements in Sustainable Development Goals indicators reduce NEET rates. Education and gender equality were also found to reduce NEET rates.

Kabakçı Günay (2025) investigated the effects of real GDP per capita, inflation rate, the share of education expenditure in GDP and the proportion of wage and salaried workers in total employment on NEET rates for the BRICST countries employing the AMG estimator using data from 1999 to 2023. According to the findings, a 1% increase in GDP reduces NEET rates in India and China by 0.008% and 0.0009%, respectively. A 1% increase in inflation rate raises NEET rates in Russia and India by 0.029% and 0.424%, respectively. A 1% increase in the share of education expenditure in GDP reduces NEET rates in Russia and Turkey by 2% and 7%, while it increases NEET rates in China, Brazil and South Africa by 9%, 3% and 0.003%, respectively. A 1% rise in the proportion of wage and salaried workers in total employment reduces NEET rates by 0.5% in Russia and by 0.11% in South Africa, whereas in India, it increases NEET rates by 1.2%.

The literature review shows that existing studies address the NEET issue from different perspectives and that many factors influence NEET youth. Moreover, it indicates that the effects of indicators such as economic growth, ICT goods exports and unemployment, which can be considered both macroeconomic and social indicators, on NEET have not been sufficiently examined in the context of the Nordic countries. Therefore, this study aims to fill an important gap in the literature by analyzing the Nordic countries while taking into account the macroeconomic and social indicators in question, thereby contributing to the existing literature.

3. Dataset

In this study, the impact of economic growth, ICT goods exports and unemployment rate on NEET rates in the Nordic countries (Denmark, Norway, Sweden, Finland and Iceland) was analyzed using panel data for the period 2005-2022. The analysis starts from 2005 due to data availability. All variables were obtained from the World Bank's World Development Indicators (WDI) database and the analysis was conducted using the Stata program.

The dependent variable in the study is the share of youth not in education, employment or training, total (% of young population) and is briefly referred to as NEET in the analysis. This variable captures the extent of youth disengagement from both the labor market and educational opportunities, making it a key indicator of social and economic challenges. Economic growth is included as one of the independent variables and for this purpose the GDP growth (annual %) was used, shown as GDP in the model. Economic growth is selected because it may help reduce NEET rates. In this context, higher economic growth can expand employment and enable more young people to participate in the workforce.

ICT goods exports are included in the model as another independent variable, represented by ICT goods exports (% of total goods exports) and denoted as ICT. It can be said that the growing role of digitalization may have placed the ICT sector in a strategic position. Higher ICT exports could indicate a technologically advanced economy, potentially generating new employment opportunities in high-skilled sectors and indirectly encouraging youth participation in education and the labor market. Additionally, export growth in the ICT sector may play an important role in overall foreign trade performance, which may promote economic growth and create employment opportunities. Therefore, it is thought that it would be important to analyze the impact of ICT goods exports on NEET rates in order to better understand the role of the digital economy in youth employment.

The unemployment rate is also included as an independent variable and is represented by unemployment, total (% of total labor force) indicator. This variable is expressed as U in the model. Unemployment is one of the fundamental indicators reflecting the overall performance of the labor market and is considered to be related to NEET rates. A higher unemployment rate can reduce job opportunities for youth, increasing the likelihood that they remain outside education and employment, which is generally viewed as an unfavourable outcome. Therefore, it is considered essential to include this variable in the model. The following expression represents the functional form of the empirical model employed in this study:

$$NEET_{it} = \gamma_0 + \gamma_1 GDP_{it} + \gamma_2 ICT_{it} + \gamma_3 U_{it} + \mu_{it} \quad (1)$$

Here, NEET stands for youth not in education, employment or training, GDP represents economic growth, ICT denotes ICT goods exports and U indicates unemployment. Additionally, i stands for the country and t represents time.

4. Method and empirical findings

Determining whether the series are stationary is crucial for econometric analyses to reach reliable results. For this reason, in the econometric analysis, firstly, Levin, Lin and Chu (LLC) unit root test, a widely used test in panel data analysis was used to determine whether the series contain a unit root. According to the test hypotheses, the null hypothesis (H_0) assumes that the series contains a unit root, that is, it is not stationary. The alternative hypothesis (H_1) states that the series does not contain a unit root and is stationary.

The LLC test suggests that individual unit root tests have limited power against alternative hypotheses that show persistent deviations from equilibrium. This situation can have serious implications, especially when small samples are involved. Therefore, the LLC recommends a more robust panel unit root test rather than performing individual unit root tests for each series separately (Baltagi, 2005: 240).

The VAR model is one of the models used to easily analyze and predict multiple economic indicators (Yang et al., 2023: 2). The inclusion of lagged values of the dependent variables in VAR models allows for forecasting future values based on past information (Köse and Özdemir, 2016: 460). In the present study, panel VAR analysis was conducted using the Generalized Method of Moments (GMM). Panel VAR analysis is based on determining the optimal lag length (Abrigo and Love, 2016: 781). The panel VAR model considers all variables in an unrestricted manner by establishing an endogenous system, making it suitable when variables are strongly correlated and interact with each other (Bellos, 2019: 146). Therefore, it is thought that this method is appropriate for the analysis phase. Within the scope of panel data analysis, the GMM-based panel VAR method was chosen to examine the dynamic relationships among the variables. Additionally, panel Granger causality analysis was conducted to assess whether causal relationships exist among the variables and to identify which variables significantly influence others. This approach allows for the evaluation of the direction of interactions among the variables.

The causal relationship among the variables and their directions were examined using panel Granger causality analysis. In causality analysis, the cause-effect relationship between variables is focused on the directional effects of variables, without distinguishing between dependent and independent variables (Akyüz, 2023: 24). Granger causality analysis was first proposed by C. W. J. Granger (1969). For panel Granger causality analysis, all series included in the model must be stationary (Baskak, 2023: 443). Panel Granger causality analysis can reveal one-way or two-way causality relationship from X to Y and/or from Y to X or indicate the absence of causality relationship between the variables. The hypotheses of the test are as follows: H_0: There is no causal relationship between the variables and H_1: There is a causal relationship between the variables.

In this study, the LLC unit root test was first applied to determine the stationarity of the series. Table 6 presents the test results. According to these results, all variables were found to be stationary at level. In this respect, the H_0 hypothesis was rejected, indicating that the variables do not contain a unit root and that the series are stationary.

Table 6. LLC unit root test results.

Variables	No Trend		Trend		Conclusion
	Statistic	p-value	Statistic	p-value	
NEET	-4.0236	0.0000	-3.1902	0.0007	I(0)
GDP	-4.8945	0.0000	-4.0907	0.0000	I(0)
ICT	-1.9339	0.0266	-2.7512	0.0030	I(0)
U	-4.0207	0.0000	-3.1395	0.0008	I(0)

After determining the stationarity of the series using the unit root test, the optimal lag length should be selected. Information criteria were used to determine the optimal lag length in the panel VAR analysis. In this context, the lag length with the lowest value among the MBIC, MAIC and MQIC criteria was considered the most appropriate. Based on the results presented in table 7, the optimal lag length was determined to be 1.

Table 7. Determination of optimal lag length.

Lag	CD	J	J pvalue	MBIC	MAIC	MQIC
1	0.9992184	46.82104	0.5211656	-153.5496	-49.17896	-90.35985
2	0.9968215	25.82822	0.7711551	-107.7522	-38.17178	-65.6257
3	0.9979051	13.04707	0.6693131	-53.74313	-18.95293	-32.67989

After determining the optimal lag length, GMM panel VAR analysis was performed. Table 8 presents the findings of the GMM panel VAR analysis for the Nordic countries. According to the estimation results, the NEET rate decreases as economic growth increases. It is observed that an increase in ICT goods exports increases the NEET rate. Finally, an increase in the unemployment rate also increases the NEET rate.

Table 8. GMM panel VAR analysis results.

Variables	Coef.	Std. Err.	Z	p-value
NEET				
NEET	-0.2604197	0.1059099	-2.46	0.014
GDP	-0.1979848	0.0159348	-12.42	0.000
ICT	0.2417831	0.0224474	10.77	0.000
U	0.3533216	0.080839	4.37	0.000

Then, whether there is a causal relationship among the variables and, if so, the direction of this relationship is revealed through panel Granger causality analysis. Table 9 shows the results of this analysis. According to the findings, there is a bidirectional Granger causality relationship between NEET and economic growth, NEET and unemployment, economic growth and unemployment, economic growth and ICT goods exports and unemployment and ICT goods exports. In addition, a unidirectional Granger causality running from NEET to ICT goods exports was found.

Table 9. Granger causality analysis results

Variables	chi2	df	Prob
NEET			
GDP	17.247	1	0.000
ICT	0.01	1	0.884
U	115.182	1	0.000
GDP			
NEET	32.800	1	0.000
ICT	8.975	1	0.003
U	91.852	1	0.000
ICT			
NEET	14.606	1	0.000
GDP	7.204	1	0.007
U	30.641	1	0.000
U			
NEET	21.233	1	0.000
GDP	18.174	1	0.000
ICT	12.624	1	0.000

Following GMM panel VAR and Granger causality analyses, the validity of the panel VAR model was tested. The stationarity of the panel VAR model is shown in figure 1 and table 10.

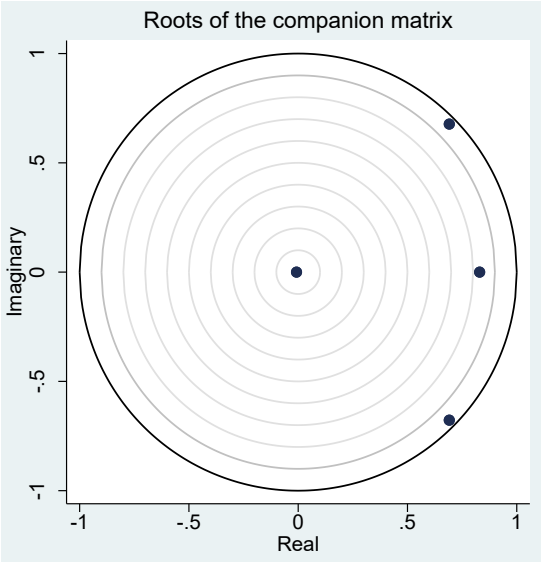

Figure 1. Roots of the Companion Matrix.

Table 10. Roots of the companion matrix

Eigenvalue		Modulus
Real	Imaginary	
0.6912997	-0.6773559	0.9678359
0.6912997	-0.6773559	0.9678359
0.8301803	0	0.8301803
-0.0076963	0	0.0076963

When the figure is examined, all points are observed to lie within the circle. Additionally, table 10 shows that all modulus values are below 1. These findings indicate that the model is stable. Accordingly, it can be concluded that there is no problem with the estimated model.

5. Discussion

In this study, the relationship among economic growth, ICT goods exports, unemployment and NEET was analyzed for five Nordic countries, namely Denmark, Norway, Sweden, Finland and Iceland for the period 2005-2022 using panel VAR analysis. Examination of the findings from the GMM panel VAR analysis indicates that an increase in economic growth reduces the NEET rate in the Nordic countries during this period. This finding can be interpreted as economic growth increasing youth participation in education and the labor market, thus reducing youth unemployment rate. On the other hand, the finding that a rise in ICT goods exports increases the NEET rate is striking. As a matter of fact, although ICT goods exports are generally expected to reduce the share of young people who are neither in education nor employment by creating high-skilled job opportunities, the observed positive relationship between NEET rates and ICT goods exports is thought to stem from several factors. The ICT sector generally requires highly skilled and experienced individuals, which may restrict access to the sector for young people who lack the necessary qualifications. Furthermore, ICT-related employment may be concentrated in certain regions, thereby limiting opportunities for young people in other areas. In addition, mismatches between the education system and the skill requirements of the ICT sector, as well as insufficient work experience may also lead to this situation. Besides, this issue can be explained by the fact that young people find it difficult to enter the workforce due to rapid technological advancements.

According to an OECD (2016) report, while a significant share of young people are open to interacting with technology, a notable number still have low levels of digital proficiency. An absence of digital skills can be a significant factor in disadvantaging certain groups. In particular, for young people, this deficiency may limit their ability to fully benefit from the opportunities offered by today's information society and the increasingly digitised labor market. This challenge may be even greater for NEETs (Bettencourt et al., 2025: 3).

In general, young individuals in the NEET group are in the process of finishing their education, figuring out their career path and getting their first working experience. However, the high skill expectations brought about by digitalization may lead to some young people in this age group facing the job market without adequate preparation. In this process, young individuals without

digital skills risk being excluded from the system and have trouble finding employment. Consequently, the likelihood of these individuals being classified as NEET rises, which may explain why ICT exports are associated with higher NEET rates. The finding that the increase in the unemployment rate also raises the NEET rate shows that contractions in the labor market push young people out of the system. This result highlights that in the fight against youth unemployment, there is a need for both employment creation and also for holistic social and economic policies that will ensure that young individuals remain within the system. According to findings obtained from the panel Granger causality analysis, a bidirectional Granger causality relationship was determined between NEET and economic growth, NEET and unemployment, economic growth and unemployment, economic growth and ICT goods exports, and unemployment and ICT goods exports. Besides, the existence of a unidirectional Granger causality relationship running from NEET rates to ICT goods exports was also determined.

6. Conclusion

This study empirically examined the relationship among economic growth, unemployment rates, ICT goods exports and NEET rates using a panel dataset covering the period 2005-2022 for the Nordic countries. Panel VAR based on the GMM approach and panel Granger causality analysis were applied. According to the GMM panel VAR estimation results, an increase in economic growth reduces the NEET rate. In contrast, a rise in ICT goods exports increases the NEET rate. Finally, an increase in the unemployment rate also raises the NEET rate. The panel Granger causality analysis revealed bidirectional Granger causality relationship between NEET and economic growth, NEET and unemployment, economic growth and unemployment, economic growth and ICT goods exports and unemployment and ICT goods exports. In addition, a unidirectional Granger causality was observed from NEET rates to ICT goods exports. The finding that economic growth reduces NEET rates is consistent with the study by Çolak (2025) in the literature.

Considering the reducing effect of economic growth on NEET rates, policies that support economic growth and foster employment creation should be prioritized. Furthermore, programs aimed at enhancing digital skills among the NEET group should be expanded. The Nordic countries are among the most developed economies. Besides, this country group possesses strong institutional frameworks, inclusive labor markets and comprehensive social policy instruments, which provide a favorable environment for implementing such measures effectively. Therefore, these countries have an advantageous position in this regard due to their strong economic structures and comprehensive social policy instruments. For this reason, it is possible to design such policy approaches more in an effective manner. Thus, steps taken to reduce NEET rates in these countries can be expected to produce more sustainable results.

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