

Heterogeneous output-employment relationship in the EU: The effects of international trade and regulation

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ABSTRACT

Objective: The objective of the article is to assess the impact of economic growth on employment mediated by international trade and regulation, considering the gender-, age- and educational attainment levels of employed in the European Union (EU).

Research Design & Methods: The analysis incorporates the role of international trade and its interaction with regulation in 27 European Union countries over the 2000-2020 period, utilizing an unbalanced panel dataset. The mediating effect of international trade on employment elasticities specific to gender, age, and educational attainment levels is assessed by introducing multiplicative terms involving changes in Gross Domestic Product (GDP) and various international trade variables. A three-way interaction model is employed to capture the mediating effects of international trade and regulation, i.e. labour market and business regulation, on the relationship between output and employment in the EU.

Findings: The findings suggest that the increased imports and exports in the EU are generally associated with a decline in the employment response to economic growth, especially for youth. Notably, we may observe a possible positive impact in the context of women's employment response to economic growth. The results confirm the significance of regulation and international trade in strengthening the impact of economic growth on employment, especially for highly educated 40-64-year-old women.

Implications & Recommendations: The study revealed the mediating effect of international trade and regulation on the relationship between output and employment in the EU. The findings indicate that global trade plays an important role in decreasing the employment response to economic growth. Policymakers should focus on creating adaptive regulatory frameworks to address the relationship between regulation and the demand for skilled and unskilled labour as the reaction to output growth when a high volume of imports and exports occurs in a country. Strategies to mitigate the negative impact of international trade on employment reaction to economic growth need to address issues related to labour productivity growth, emphasising on-going research on the mediating effect of total factor productivity.

Contribution & Value Added: Our contribution is to complement the previous research by considering regulation as the factor which simultaneously to international trade can boost the impact of economic growth on gender-, age-, and educational attainment level-specific employment in the EU.

Article type: research article

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INTRODUCTION

Increasing employment due to economic growth is one of the primary goals of every country. However, it is observed that many countries face the problem of 'jobless growth,' which means that a growing economy does not ensure the creation of new jobs. The relationship between economic

growth and employment can be measured by employment to output elasticity (Anderson, 2016; Dauda & Ajeigbe, 2021), which shows how employment reacts to a 1% increase in output. Analysis of the impact of economic growth on employment allowed us to assess whether economic growth is related to the growth of jobs, labour productivity, or both. As stated by Kapsos (2006), employment growth must be met by an equal and opposite decline in labour productivity growth for a given change in output. Scientific literature notes that each economy needs a balance between these two variables (Perugini, 2009; Dahal & Rai, 2019). However, balancing employment with labour productivity in a growing economy is quite a challenging problem (Herman, 2011).

Previous research on output-employment elasticities already indicated that employment reaction to economic growth is heterogeneous across countries (Kapsos, 2006; Burggraeve *et al.*, 2015; Slimane, 2015; Ben-Salha & Zmami, 2021; Mihajlović & Marjanović, 2021), regions (Furceri *et al.*, 2012; Richter & Witkowski, 2014; Ali *et al.*, 2018), time (Kapsos, 2006; Thuku *et al.*, 2019; Adegboye *et al.*, 2019) and business cycle phase (Coşar & Yavuz, 2019; Butkus *et al.*, 2022; 2023). The research by Dargenyte-Kacileviciene *et al.* (2022) also revealed the heterogeneity of output-employment elasticity across age, gender, and educational attainment levels. The results showed that employment reaction to output growth is higher for males compared to females, youth compared to other age cohorts, and uneducated compared to highly educated. The main question most research addresses is what factors are the main drivers of this heterogeneity.

While output-employment elasticity is also closely related to the changes in productivity growth, previous research focuses on indicators related to both employment and productivity growth. Among these factors are economic structure (Ali *et al.*, 2018; Dahal & Rai, 2019; Thuku *et al.*, 2019; Mkhize, 2019; Zaki *et al.*, 2020; Ben-Salha & Zmami, 2021; Butkus *et al.*, 2022; 2023), foreign direct investment (Furceri *et al.*, 2012; Anderson & Braunstein, 2013; Slimane, 2015; Farole *et al.*, 2017; Adegboye *et al.*, 2019; Dargenyte-Kacileviciene *et al.*, 2022), international trade (Kapsos, 2006; Furceri *et al.*, 2012; Anderson & Braunstein, 2013; Goaid & Sassi, 2015; Slimane, 2015; Anderson, 2016; Farole *et al.*, 2017; Ghazali & Mouelhi, 2018; Adegboye *et al.*, 2019; Ben-Salha & Zmami, 2021) and institutional environment (Kapsos, 2006; Furceri *et al.*, 2012; Richter & Witkowski, 2014; Ali *et al.*, 2018; Farole *et al.*, 2017; Ben-Salha & Zmami, 2021; Görg *et al.*, 2023). Butkus *et al.*'s (2022, 2023) research already revealed that we could define service and construction sectors (considering the size of each sector in the economy) as the most employment-intensive in the EU. The research of Dargenyte-Kacileviciene *et al.* (2022) also confirmed the weak and negative impact of foreign direct investment (FDI) on the output-employment relationship in the EU, indicating that FDI is more related to labour productivity growth than employment growth.

The objective of the article is to assess the impact of economic growth on employment mediated by international trade and regulation, considering the gender-, age- and educational attainment levels of employed in the EU.

The literature studying the impact of international trade on employment and the impact of regulation on employment is ample, but there is a scarcity of research analysing the joint effect of both on employment reaction to output changes, especially in the context of the EU. The novelty of the article lies in investigating how the regulation together with international trade affects the output-employment relationship within the EU since various macroeconomic characteristics can simultaneously affect this relationship. Another contribution is the analysis of the heterogeneous impact of economic and regulatory variables on the employment reaction of different worker cohorts to output growth. The two and three-way interaction models are used to assess the effects of international trade and regulation in 27 European Union countries over the period 2000 to 2020, utilizing an unbalanced panel dataset and applying the Pooled OLS estimator.

The rest of the article is organised as follows. Firstly, we will summarise theoretical and empirical aspects related to the mediating effect of international trade and regulation on heterogeneous output-employment relationship. Next, we will present the estimation strategy and the data. Subsequently, we will discuss the main findings. We will close the article with a conclusion, policy implications and suggestions for future work.

LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

Extensive previous research has been conducted to investigate the influence of international trade separately on economic growth (Fetahi-Vehapi *et al.*, 2015; Keho, 2017; Opong-Baah *et al.*, 2022) or employment (Alkhateeb *et al.*, 2017; Nwosa *et al.*, 2020; Ngouhouo & Nchofoung, 2021). However, the research investigating the impact of international trade on the relationship between economic growth and employment is scarce, especially in the context of the EU. Based on the literature that analyses the relationship between international trade, economic growth, and employment, several directions *i.e.* positive or negative impact of international trade on the response of employment to economic growth can be distinguished.

The scientific literature emphasizes the positive effect of international trade on employment when economic growth accelerates due to a more efficient allocation of resources and aggregate demand increases (Pilinkiene, 2016; Asaleye *et al.*, 2017; Van Ha & Tran, 2017). The negative effect occurs if exports and imports increase labour productivity, leading to decreased employment (Alkhateeb *et al.*, 2017; Rath & Ridhwan, 2020). On the other hand, increased productivity can stimulate firms' competitiveness, or as noted by Pilinkiene (2016), Asaleye *et al.* (2017), and Van Ha and Tran (2017), can increase the production scale of companies as well as the demand for labour. Alkhateeb *et al.* (2017) indicate that international trade can increase domestic consumption, but imports can also push local producers out of the market and thus increase unemployment.

The impact of international trade on employment is theoretically related to the Heckscher–Ohlin model, thus, the benefits of international trade are explained by comparative advantage (Keho, 2017; Asaleye *et al.*, 2017; Ghazali & Mouelhi, 2018). According to this model, a higher level of exports can increase employment in labour–abundant exporting countries, but it can also decrease if capital-intensive goods are produced and exported (Alkhateeb *et al.*, 2017; Nwosa *et al.*, 2020). As Ngouhouo and Nchofoung (2021) note, based on the Heckscher–Ohlin model, trade openness can be assumed to positively affect the employment of unskilled labour in developing countries with a relatively large volume of labour force. Such countries will specialize in labour-intensive products and import capital-intensive products.

To achieve cost-effective production of goods compared to other nations, employing a labour force with lower wages is crucial. Banerjee and Veeramani (2015) identify four main channels through which international trade can have gender-specific employment effects: the cost reduction effect, the resource reallocation effect, the technology effect and the scale effect. According to the comparative advantage, a higher degree of trade openness results in increased imports, consequently fostering greater competition within the domestic market. This competition encourages local companies to minimize their costs by employing women, whose wages are lower compared to men. Anderson and Braunstein (2013) emphasize that exports can be related to higher employment of women and import competition is more important to employment of men. However, the relative demand for women as a labour factor increases to the extent that international trade encourages the reallocation of labour resources to sectors in which they have a comparative advantage. Anderson (2016), Alkhateeb *et al.* (2017), and Nwosa *et al.* (2020) note that the results depend on the structure of the economy, *i.e.* depending on whether a country specializes in the production of labour- or capital-intensive goods. On the contrary, the technology channel is associated with a positive effect on male employment. As Banerjee and Veeramani (2015) stated, the augmented inflow of technology and capital goods facilitated by FDI can lead to an expansion in male employment, if male workers possess higher qualifications than females. The scale effect of production due to international trade should increase employment for both men and women.

Kapsos (2006), Furceri *et al.* (2012), Anderson and Braunstein (2013), Goaid and Sassi (2015), Slimane (2015), Anderson (2016), Ghazali and Mouelhi (2018), Ben-Salha and Zmami (2021) assessed the impact of international trade on the employment response to economic growth. Kapsos (2006) analysed the effect of economic openness on employment response to economic growth in 154 countries. The results confirmed the statistically insignificant effect of trade openness on the relationship between economic growth and employment. The results of the empirical study also

revealed that higher exports in countries are associated with a stronger response of female employment to economic growth. The author associates these results with relatively cheaper female labour. Based on panel data from 90 countries around the world, Slimane (2015) estimated the effect of trade openness on the employment reaction to economic growth. The study's results confirmed the negative effect of trade openness and the statistically insignificant impact of exports on output-employment elasticities. As the main reason for such results, Slimane identifies the opportunity for companies to acquire newer technologies that increase labour productivity.

Ben-Salha and Zmami (2021) assessed the impact of trade openness on employment reaction to economic growth in six GCC countries. The results confirmed the positive effect of trade openness (measured by the KOF trade openness index) on output-employment elasticities. Anderson (2016) found either a weak or statistically insignificant relationship between trade openness and the employment response to economic growth in 80 countries, depending on the model specification. Additionally, no significant differences in this effect between genders were found. Furceri *et al.* (2012) conducted a study based on data from 167 countries, confirming that trade openness is one of the factors that can explain the heterogeneous effect of economic growth on employment across countries. The study results lead to the conclusion that in more developed and closed economies, employment response to economic growth is stronger.

Anderson and Braunstein (2013) assessed the impact of international integration on the gender-specific employment response to economic growth in 145 countries from 1990 to 2010. The study results revealed that a deterioration in the terms of trade leads to a lower employment response to economic growth for both genders. No statistically significant differences in effects between genders were found in this study. Furthermore, Ghazali and Mouelhi (2018) included trade openness and import penetration ratio as additional variables to examine their potential impact on the relationship between output and employment in Tunisia. The study confirmed that both indicators are associated with a decline in employment in the country. Goaid and Sassi (2015) analysed changes in sectoral employment to output elasticities before and after joining the Free Trade Agreement. The study confirmed that trade liberalization in Tunisia strengthened the employment response to growth in the exporting sectors of the economy. Still, the job creation potential of these sectors remained limited.

The results of empirical studies provide ambiguous results. We may attribute the differences in the impact of trade openness on the relationship between output and employment to the unequal institutional contexts of different nations. As Agyei and Idan (2022) indicate, trade openness depends on the quality of institutions and political, legal, economic, and socio-cultural structures. According to Hadhek and Mrad (2015), a favourable institutional environment and good governance promote trade by reducing transaction costs and increasing trust. On the contrary, the low quality of governance, political instability, and corruption reduce international trade, because they increase the risk and uncertainty associated with international transactions. Researchers also emphasise that labour market institutions play an important role in coordinating the impact of trade liberalisation on labour market outcomes due to stricter labour market regulation which determines increased wage costs (Selwaness & Zaki, 2019).

Other researchers (Parcon, 2008; Radulescu & Robson, 2013; Ketteni & Kottaridi, 2019) emphasize that any restrictions lead to the inflexibility of the labour market. Due to the inflexibility of the labour market, companies incur higher costs, which leads to a decrease in the country's competitiveness. It can either directly affect international trade or approximate it through the technology channel, as FDI flows will be higher in countries with more flexible labour markets. As emphasized by Radulescu and Robson (2013), it is important for multinational companies to have the lowest possible employee dismissal costs and to make it easy to adapt to changes in aggregated demand. The results of empirical studies show that better institutional quality can lead to higher trade openness and, at the same time, economic growth (Hadhek & Mrad, 2015; Conteh *et al.*, 2021; Akinlo & Okunlola, 2021), so it can also have an impact on the relationship between output and employment.

The scientific literature analyses the impact of the institutional environment on the response of employment to economic growth (Kapsos, 2006; Furceri *et al.*, 2012; Anderson & Braunstein, 2013; Richter & Witkowski, 2014; Farole *et al.*, 2017; Ali *et al.*, 2018; Ben-Salha & Zmami, 2021; Görg *et al.*, 2023), but only the study by Adegboye *et al.* (2019) analysed how economic freedom

changes the impact of economic, structural and demographic factors on the relationship between output and employment in Sub-Saharan Africa. The study found that as economic freedom increases, the effect of the share of the service and industrial sectors on the relationship between output and employment becomes statistically insignificant. We may observe a similar situation for other indicators, such as FDI and trade openness.

Previous research has mainly analysed developing countries, with few studies examining the employment response to changes in output in developed countries. International trade and regulatory frameworks have a significant impact on the interplay between output and employment in both developed and developing countries. In developed countries, trade liberalisation can boost output and employment in sectors with comparative advantages, while potentially leading to job displacement, especially in less competitive industries. Strict labour regulations in developed countries can raise production costs, potentially leading to outsourcing and job losses, although they can also ensure better working conditions. Conversely, in developing countries, trade liberalisation offers opportunities for specialisation in labour-intensive industries, potentially increasing output and employment, but with challenges such as worker exploitation and vulnerability to external shocks. Weaker labour regulations may attract foreign investment but perpetuate low-wage cycles, while stronger standards may improve wages and conditions but hinder competitiveness. Trade imbalances and technological advances further shape employment patterns, highlighting the nuanced impact of international trade and regulation on output and employment, and balancing growth opportunities with challenges such as job displacement and economic vulnerability. Despite less research in developed countries, there is a need to analyse the relationship between employment and output as developed countries face the problem of 'jobless growth' and there is a need to analyse what determines this relationship and to draw appropriate policy implications.

Previous research has shown that international trade can have diverse effects on the relationship between economic growth and employment, with both positive and negative impacts depending on factors such as comparative advantage, gender-specific employment effects, and the institutional environment. The impact of trade on employment response to economic growth is influenced by variables like trade openness, terms of trade, and labour market institutions, and varies across countries. However, there is a gap in research analysing both international trade and regulation as mediating factors and this is addressed in our research by introducing multiplicative terms.

The analysis of prior empirical results allowed us to assume the following research hypotheses:

- H1:** Due to international trade, the reaction of employment to output growth in the EU decreases.
- H2:** International trade increases female employment outcomes as a response to output growth in the EU.
- H3:** Regulation simultaneously to international trade strengthens the impact of the output on employment in the EU.

RESEARCH METHODOLOGY

This article aims to analyse the impact of international trade on the output-employment relationship and follows the methodology developed by Islam and Nazara (2000), and applied by Kapsos (2006), Slimane (2015), Ali *et al.* (2018), Thuku *et al.* (2019), Mkhize (2019), *etc.* According to this methodology, output-employment elasticities can be estimated using the log-linear specification of the econometric model. The primary model to estimate employment to output elasticities for panel data is defined in Equation 1.

$$\Delta \ln E_{i,t} = \alpha + \beta \cdot \Delta \ln Y_{i,t} + \theta_t + \Delta \varepsilon_{i,t} \quad (1)$$

In which:

$\Delta \ln E_{i,t}$ - denotes the growth of employment, measured as a thousand persons employed;

$\Delta \ln Y_{i,t}$ - denotes the growth of real output, measured as GDP at constant 2015 prices, million euro, in country i at the year t .

The coefficient β is the output-employment elasticity. α is the intercept, θ_t represents time – fixed effects, $\Delta\varepsilon_{i,t}$ is the idiosyncratic error.

The dependent variable consists of different types of employment considering gender, age, and educational attainment levels. Employment by gender is divided into three groups *i.e.* total, males and females. By age, the employed are divided into four groups of working age population: 15-64 years, 15-24 years, 25-39 years, and 40-64 years old. Considering education, the employed are divided into four groups based on the International Standard Classification of Education (ISCED). ISCED0–8 covers all levels of education. The ISCED0–2 level represents less than primary, primary, and less than secondary education. The ISCED3–4 level represents secondary and other education not classified as higher education. ISCED5–8 represents higher education.

To analyse the impact of international trade on the output-employment relationship, we modify Equation 1 by including the multiplicative term between output growth and international trade variable (Equation 2). Following the idea that exports and imports may be differentially related to employment dynamics depending on gender (Anderson & Braunstein, 2013; Anderson, 2016), we used two different variables to approximate international trade instead of the trade openness (imports plus exports divided by GDP) indicator.

$$\Delta \ln E_{i,t} = \alpha + \beta_1 \cdot \Delta \ln Y_{i,t} + \beta_2 \cdot \ln(IT_{i,t}) + \delta_1 \cdot \Delta \ln Y_{i,t} \times \ln(IT_{i,t}) + \theta_t + \Delta \varepsilon_{i,t} \quad (2)$$

In which:

$\Delta \ln E_{i,t}$ - denotes the variable of international trade, *i.e.* exports and imports, measured as per cent of GDP, in country i at the year t . Other parameters were the same as in Equation 1.

The multiplicative term $\Delta \ln Y_{i,t} \times \ln(IT_{i,t})$ denotes the conditional output-employment relationship mediated by international trade. We constructed equation 3 following the equation suggested by Friedrich (1982) and used to estimate the conditional effect of economic growth on employment.

$$\Delta \ln E_{i,t} = \alpha + \beta_2 \cdot \ln IT_{i,t} + [\beta_1 + \delta_1 \cdot \ln(IT_{i,t})] \cdot \Delta \ln Y_{i,t} + \theta_t + \Delta \varepsilon_{i,t} \quad (3)$$

In which:

$[\beta_1 + \delta_1 \cdot \ln(IT_{i,t})]$ - is a slope coefficient that shows the conditional effect of economic growth on employment at the different levels of international trade variables.

Studies that analyse the impact of economic growth on employment take into account various institutional factors that reflect the quality of institutions (Anderson & Braunstein, 2013; Richter & Witkowski, 2014; Farole *et al.*, 2017; Ali *et al.*, 2018), labour market regulation (Kapsos, 2006; Furceri *et al.*, 2012; Richter & Witkowski, 2014; Farole *et al.*, 2017; Ali *et al.*, 2018; Ben-Salha & Zmami, 2021; Görg *et al.*, 2023), business regulation (Furceri *et al.*, 2012; Richter & Witkowski, 2014; Farole *et al.*, 2017), the size of the public sector (Furceri *et al.*, 2012; Seyfried, 2014; Richter & Witkowski, 2014), the tax system (Kapsos, 2006), the degree of participation in trade unions, and the prevalence of fixed-term contracts (Seyfried, 2014), the number of self-employed people (Farole *et al.*, 2017), economic freedom (Adegboye *et al.*, 2019), etc.

Moreover, we assumed that institutional factors can directly and indirectly affect the output-employment relationship through international trade. For that reason, we also assessed the conditional output-employment relationship mediated by both: international trade and regulation. To measure regulation, authors use the Organization for Economic Cooperation and Development (OECD) employment protection legislation index (Görg *et al.*, 2023), or labour market and product market regulation indexes proposed by the Fraser Institute (Furceri *et al.*, 2012; Richter & Witkowski, 2014; Farole *et al.*, 2017; Ali *et al.*, 2018; Adegboye *et al.*, 2019; Ben-Salha & Zmami, 2021). Since the OECD index does not estimate the index for all 27 EU countries, we chose indexes of labour market regulation and business regulation to approximate the regulatory framework. Both of these indicators directly affect the costs of firms related to hiring and firing employees and starting and maintaining the business.

The labour market regulation index includes such aspects as regulation of minimum wage, regulation of hiring and firing of employees, collective bargaining, regulation of working hours, mandatory expenses in case of dismissal of an employee, and military conscription. The business regulation index includes administrative requirements for companies, bureaucratic costs, time and

money costs for starting a new business, additional payments and bribes, licensing restrictions, and costs related to the payment of taxes. Both indices are sub-indexes of the Economic Freedom Index. The index values range from 0 to 10. A lower index value means a more rigid regulation of the labour market and business. We made the estimations using Equation 4.

$$\Delta \ln E_{i,t} = \alpha + \beta_1 \cdot \Delta \ln Y_{i,t} + \beta_2 \cdot \ln IT_{i,t} + \delta_1 \cdot \Delta \ln Y_{i,t} \times \ln IT_{i,t} + \beta_3 \cdot \ln IR_{i,t} + \delta_2 \cdot \Delta \ln Y_{i,t} \times \ln IR_{i,t} + \delta_3 \cdot \ln IT_{i,t} \times \ln IR_{i,t} + \delta_4 \cdot \Delta \ln Y_{i,t} \times \ln IT_{i,t} \times \ln IR_{i,t} + \theta_t + \Delta \varepsilon_{i,t} \quad (4)$$

In which:

- $\ln IR_{i,t}$ - denotes the indicator of regulation (labour market regulation or business regulation index) in country i at the year t ;
- $\Delta \ln Y_{i,t} \times \ln IT_{i,t}$ - denotes the conditional output-employment relationship mediated by international trade;
- $\ln IT_{i,t} \times \ln IR_{i,t}$ - denotes the international trade impact on employment mediated by regulation;
- $\Delta \ln Y_{i,t} \times \ln IR_{i,t}$ - denotes the conditional output-employment relationship mediated by regulation;
- $\Delta \ln Y_{i,t} \times \ln IT_{i,t} \times \ln IR_{i,t}$ - denotes the conditional output-employment relationship mediated by both international trade and regulation. Other parameters are the same as in Equation 1.

To estimate the conditional effect of economic growth on employment mediated by international trade and regulation, we applied the methodology used by Butkus *et al.* (2021). We estimated the slope coefficients using Equation 5.

$$\Delta \ln E_{i,t} = \alpha + \beta_2 \cdot \ln IT_{i,t} + \beta_3 \cdot \ln IR_{i,t} + \delta_3 \cdot \ln IT_{i,t} \times \ln IR_{i,t} + [\beta_1 + \delta_1 \cdot \ln IT_{i,t} + \delta_2 \cdot \ln IR_{i,t} + \delta_4 \cdot \ln IT_{i,t} \times \ln IR_{i,t}] \cdot \Delta \ln Y_{i,t} + \theta_t + \Delta \varepsilon_{i,t} \quad (5)$$

In which:

$[\beta_1 + \delta_1 \cdot \ln IT_{i,t} + \delta_2 \cdot \ln IR_{i,t} + \delta_4 \cdot \ln IT_{i,t} \times \ln IR_{i,t}]$ – denotes the conditional effect of economic growth on employment at a certain combination of indicators reflecting international trade and regulation. Other parameters are the same as in Equation 4. Standard errors of the slope coefficients and student's t-statistics are estimated using the standard delta method.

Following Kapsos (2006), Furceri *et al.* (2012), Richter and Witkowski (2014), and Slimane (2015) to estimate the employment reaction to economic growth we used a pooled OLS estimator. The alternative fixed-effects (FE) estimator would produce rather different and probably inconsistent results. FE applied on a serially correlated output (in levels) data would mean that there is a very substantial, positive serial correlation in $\varepsilon_{i,t}$. In such a case the difference $\Delta \varepsilon_{i,t}$ is serially uncorrelated, and the first differencing along with OLS estimator is preferable. To overcome the shortcomings of this method we made some modifications to the regression model. The log-linear specification of the model transforms the relationship between variables into a linear one and deals with the possible heteroscedasticity in the data. Both the dependent and independent variables were expressed in the first differences. Using this specification, we expected to eliminate the unobserved time-invariant country-fixed effects from the model and deal with autocorrelation. Moreover, to test for the remaining autocorrelation, we used the Wooldridge autocorrelation test and the heteroscedasticity – Breusch Pagan (LM) test. Since autocorrelation, heteroscedasticity or both were detected, regression models were modified by including the heteroscedasticity and autocorrelation consistent Arellano standard errors. To test the cross-sectional dependence we use the Pesaran CD test. All of the regression models where cross-sectional dependence were detected were corrected by including the Driscoll-Kraay standard errors. Conditional output-employment elasticities were represented graphically in the ranges of observed values of indicators. We took data on output and employment – from Eurostat, data on imports and exports – from the World Bank, and data on labour market and business regulation indexes – from Fraser Institute. The panel covers data from 27 EU countries from 2000 to 2020. Appendix A (Tables A1 and A2) presents summary statistics of variables.

RESULTS AND DISCUSSION

Empirical results of estimations made using Equation 2 show that both indicators, *i.e.* imports and exports, tend to decrease the employment reaction to economic growth in most analysed cases (Appendix B, Tables B1, B2, B3, and B4). However, this impact lacks statistical significance. Such results are consistent with the results of studies conducted by Kapsos (2006), Slimane (2015), Anderson (2016), Ghazali and Mouelhi (2018), which confirmed a weak or insignificant relationship between trade openness and employment response to economic growth. As noted by Anderton *et al.* (2014), international trade relates to the capital-intensive production sector, so such results can be determined by the opportunity to acquire labour productivity-enhancing technologies through international trade (Slimane, 2015; Ghazali & Mouelhi, 2018).

The highest negative impact of imports is observed in the response of youth employment to economic growth. The conditional output-employment elasticities estimated using Equation 3 (Appendix C, Figure C1) show that economic growth has a statistically significant effect on the employment of youth when imports are lower than 85% of GDP for the entire sample, 96% of GDP for young men and 66% of GDP for young women. Almost the same conclusions can be made in the case of exports where results show that if exports are higher than 80% of GDP, the effect of economic growth on youth employment becomes statistically insignificant. These results indicate that in countries such as Ireland, Luxembourg or Malta, which are characterised by high levels of both, *i.e.* imports and exports (according to the data in 2020), further economic growth will not stimulate the growth of youth employment. Moreover, the results also revealed that both imports and exports decrease the employment reaction to output growth for young women with ISCED 3-4 levels of educational attainment. We may explain these results by the increasing possibilities to attract foreign direct investment (FDI) through trade openness. Previous research by Dargenyte-Kacileviciene *et al.* (2022) already revealed that the higher inward FDI level in a country is associated with a decreasing employment reaction to economic growth for youth. Since inward FDI is considered to bring new and more advanced technologies and managerial practices, it requires a more educated and experienced workforce to absorb these changes.

According to estimation results, for some demographic groups, international trade is a factor that positively affects employment reaction to economic growth. Estimation results show that imports and exports strengthen the employment response to the economic growth of 25-39-year-old men with ISCED3-4 educational attainment levels. The estimated conditional output-employment elasticities show that economic growth has a statistically significant effect on the employment growth of men this age and education only when the imports level is higher than 42% of GDP and the exports level higher than 31%. (Appendix C, Figure C3). Analysing the impact of international trade on employment to output elasticities in more detail, we found that due to higher import and export levels in the EU, the employment reaction of uneducated 40-64-year-old women tends to increase (positive slope of the curve) and this increase is statistically significant at 5% level. Despite that, estimated conditional output-employment elasticities revealed that economic growth impact on employment of uneducated 40-64-year-old women remains statistically insignificant at any level of imports or exports. The same conclusion can be made by analysing the output-employment elasticities of uneducated 40-64-year-old men (Appendix C, Figure C2).

Results also indicated that due to higher import levels, employment reaction to the economic growth of highly educated 40-64-year-old women tends to increase but remains statistically insignificant. In contrast to imports, exports tend to strengthen the employment response to economic growth, not only for 40-64-year-old highly educated women but also for men of the same age and education level. Nevertheless, the effect of economic growth on the employment of 40-64-year-old highly educated men remains statistically insignificant at any level of exports (Appendix C, Figure C4). These results support the theoretical assumption that trade openness, depending on the sectoral structure of the economy, through the technology channel increases the demand for a more skilled and experienced workforce. According to the results, we can reject the hypothesis proposed by Anderson and Braunstein (2013) that exports and imports can relate differently to employment dynamics, depending on gender. The results show that

the effect of exports and imports on the response of employment to economic growth is similar, both for the whole sample and considering the gender of the employed.

Following the idea that regulation can affect and boost the output-employment relationship through international trade, we assume that at a certain combination of international trade level and regulation, the output-employment relationship can turn statistically significant. Since we were interested in conditions where economic growth can boost employment outcomes, we distinguished 7 cases where empirical results revealed that higher exports or imports tend to increase the employment reaction to economic growth, but this impact remains statistically insignificant. Such tendencies were revealed only for 40-64-year-old males and females with 0-2 and 5-8 levels of educational attainment (except 40-64-year-old males with higher education in the case of imports). We made estimations using Equation 4 and results represented in Appendix D, Tables D1 and D2. Table 1 presents generalized information.

Table 1. Economic growth impact on employment mediated by international trade and regulation in the EU

Age	Gender	Educational attainment level	Moderator	Labour market regulation	Business regulation
			Moderator		
40-64	Males	0-2	Imports	No	Yes
	Females	0-2		No	Yes
		5-8		Yes	Yes
	Males	0-2	Exports	No	Yes
		5-8		No	Yes
	Females	0-2		No	Yes
		5-8		Yes	Yes

Note: 'No' in Table 1 means that there is no effect of international trade and regulation on output-employment relationship i.e. economic growth impact on employment remained statistically insignificant. 'Yes' means that at a certain combination of international trade and regulation, economic growth impact on employment turned to statistically significant.

Source: own study.

According to the results, we can state that the mediating effect of business regulation is more important compared to labour market regulation. We detected statistically significant effect of economic growth on employment in all 7 cases, while in the context of labour market regulation only in 2 cases. To evaluate the specific effect of economic growth on employment mediated by international trade and regulation, conditional output-employment elasticities were estimated using Equation 5 and represented in Figures 1 and 2. Figures are made only for cases where the impact of economic growth on employment mediated by international trade and regulation is statistically significant.

In countries with extremely liberal labour market regulation and high levels of imports, the effect of economic growth on the employment of highly educated 40-64-year-old women becomes statistically significant. The effect is positive, *i.e.* economic growth increases the employment of women in this age group and educational attainment level. We found the same situation when assessing the effect of economic growth on employment mediated by the level of imports and the degree of business regulation. In countries with very liberal business regulations and high levels of imports, economic growth had a statistically significant effect on the employment of highly educated 40-64 women, and this effect was positive.

We found the opposite situation in cases of uneducated 40-64-year-old women and men. In countries with extremely high levels of imports and extremely liberal business regulation, the effect of economic growth on employment also becomes statistically significant, but this effect is negative. This means that as the economy grows, the employment of uneducated 40-64-year-old women and men decreases. We also identified a negative impact at the combination of strict business regulation and low levels of imports. We observed that in the presence of strict business regulation, but extremely high levels of imports, the effect of economic growth on the employment of uneducated 40-64-year-old women and men was positive and statistically significant.

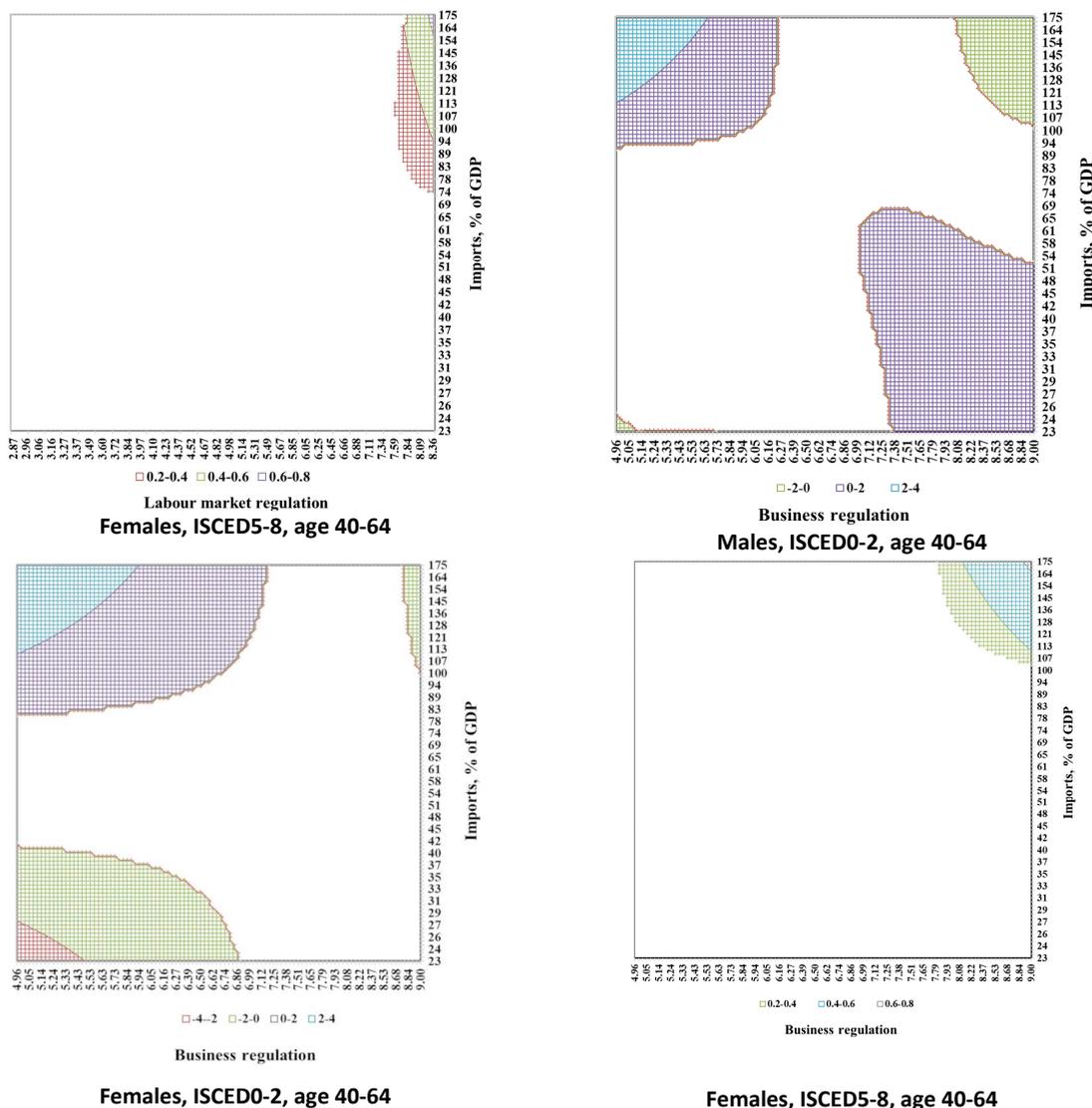


Figure 1. Economic growth impact on employment mediated by the level of imports (% of GDP) and regulation. White colour represents combinations of imports and degree of regulation for which the effect of economic growth on employment is not statistically significant

Source: own elaboration based on Eurostat, World Bank, and Fraser Institute data.

Such results revealed several trends. With strict business regulations and high levels of imports, economic growth is increasing employment growth for uneducated 40-64 women and men. As business becomes less regulated and import levels rise to high levels, the employment of uneducated 40-64 women and men falls, while for educated women – increases. We may also explain such results by comparative advantage. According to Banerjee and Veeramani (2015), Ngouhouo and Nchofoung (2021), trade openness increases imports, leading to increased domestic market competition. The greater competition encourages companies to cut costs by hiring women, who are still paid less than men, or unskilled but at least experienced labour, which is cheaper when compared to highly skilled. Stricter business regulation is also associated with higher costs for companies. For this reason, companies tend to hire cheaper, uneducated labour to save money in the face of strict business regulations. Meanwhile, the deregulation of business creates free funds for companies and the opportunity to hire a better-paid and educated workforce. Imports also related to FDI, *i.e.* as FDI grows, new technologies are imported, which are used not only for capital but also for labour-intensive sectors of the economy, about which women have a comparative advantage. As a result, the need for unskilled labour is decreasing, and for skilled labour – increasing.

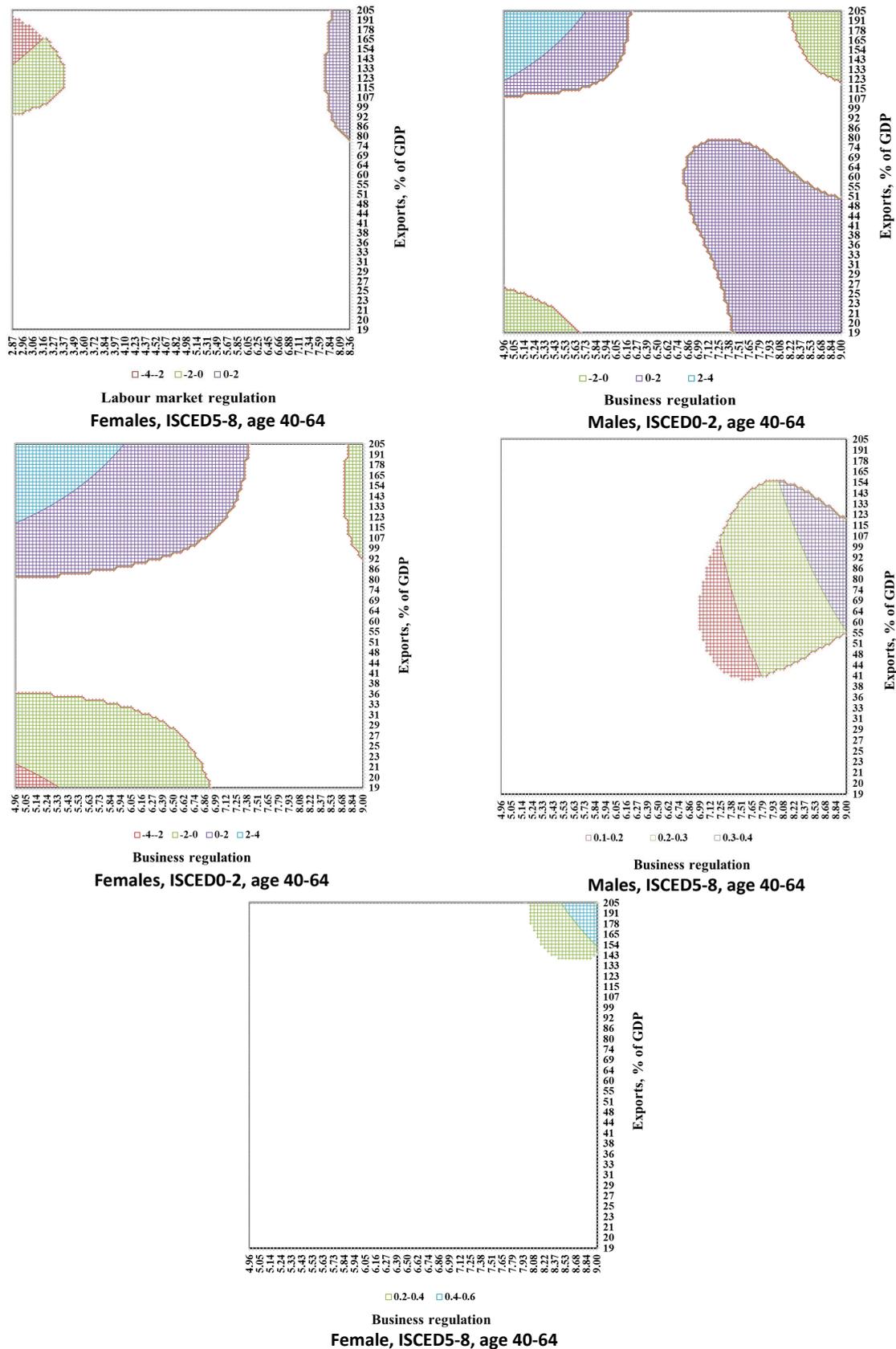


Figure 2. Economic growth impact on employment mediated by the level of exports (% of GDP) and regulation. White colour represents combinations of exports and degree of regulation for which the effect of economic growth on employment is not statistically significant
 Source: own elaboration based on Eurostat, World Bank and Fraser Institute data.

In countries with very liberal labour and business regulation and high levels of exports, economic growth has a statistically significant effect on the employment of 40-64-year-old women with higher education and this effect is positive. Thus, the trends were similar to imports. In contrast to imports, we found that the combination of strict labour market regulation and the high level of exports, economic growth reduces the employment of 40-64-year-old highly educated women. Results also support the theoretical statement that when strict labour market regulation is imposed, companies incur higher costs and seek to save by hiring a less skilled and less paid labour force. Other results also confirmed that in the case of strict business regulation and extremely high export levels, the effect of economic growth on the employment of uneducated 40-64-year-old women and men was positive and statistically significant. Similarly, in the case of imports, we found that in countries with high exports and extremely liberal business regulations, the effect of economic growth on employment also becomes statistically significant but negative. This shows that as the economy grows, the employment of 40-64 uneducated women and men decreases.

The results also show that in the case of liberal business regulation and exports levels between 40% and 154% of GDP, economic growth boosts the employment of highly educated 40-64-year-old men, but when exports reach a high level, economic growth boosts the employment of the women instead of men. Thus, in the presence of liberal business regulation in the EU, due to the impact of imports, economic growth promotes the growth of the employment of 40-64-year-old highly educated women. Due to the effect of exports, economic growth increases the employment not only of women but also of 40-64-year-old educated men. We may explain these differences with the different distribution of women and men in the importing and exporting industries.

CONCLUSIONS

This article complements the limited literature where the employment reaction to economic growth in the EU is evaluated considering the age-, gender- and educational attainment levels of the employed. While previous research focused on the impact of international trade and regulation separately, this article analyses the output-employment elasticities mediated by international trade. Then, the output-employment elasticities mediated by international trade and regulation are assessed. This method allows for the evaluation of the employment reaction to economic growth at different levels of international trade volume and a certain combination of international trade and different kinds of regulation.

Empirical estimations indicated that imports and exports negatively related to output-employment relationship in most of the analysed cases but this impact was barely statistically significant. This implies that the H1 hypothesis was confirmed. The results also showed that due to international trade the employment reaction to output growth of uneducated and highly educated 40-64-year-old women tends to increase but this effect remains statistically insignificant at any level of imports and exports revealing that H2 hypothesis was rejected.

When examining how international trade and regulation mediate the relationship between output and employment, we revealed that business regulation's influence was more substantial than labour market regulation. The results also showed that when high import and export levels were present, going from rigid business regulation to liberal, results in a decreased demand for unskilled labour and increased demand for skilled labour, especially women. Our results confirmed hypothesis H3 which reflected that regulation simultaneously to international trade strengthens the impact of the output on employment in the EU.

The results of the article can be important for policymakers who develop specific strategies to address the employment challenges in the economy. First of all, our results suggest discussing international trade as the important factor which can explain the decreasing employment reaction of different demographic groups, especially youth. While creating adaptive regulatory frameworks policymakers should, first of all, focus on improving institutional quality, increasing labour market flexibility, and decreasing business regulations, especially those responsible for higher costs. Introducing targeted education and training programs for women in industries with high export potential, such as technology, manufacturing, and services has to be considered. Moreover, it is suggested to prioritize investments in

education and skills development programs, to ensure workers have the necessary skills to participate and benefit from international trade. This could include vocational training programs, STEM education initiatives, and support for lifelong learning opportunities. Develop trade and investment policies that promote economic diversification, value-added production, and the creation of high-quality jobs. This could involve targeted incentives for industries that have the potential to absorb both skilled and unskilled labour, as well as measures to address structural barriers to trade and investment.

The used methodology gives valuable information about the conditional output-employment relationship mediated by important economic and institutional factors. However, it has limited abilities to include interaction with more than three variables at the same time, meaning that is possible to analyse the employment reaction to economic growth only at a certain level of two other factors. Furthermore, by using this methodology we have limited abilities to include more multiplicative terms and other indicators due to possible multicollinearity. Estimation results showed that international trade with several exceptions tends to decrease the employment reaction to economic growth. Due to the higher exports and imports, employment reaction to economic growth becomes statistically insignificant. These results indicate that decreasing employment reaction to output changes can be determined by labour productivity growth. The evaluation of the mediating effect of total factor productivity on the output-employment relationship is under consideration in our future research.

REFERENCES

- Adegboye, A.C., Egharevba, M.I., & Edafe, J. (2019). Economic regulation and employment intensity of output growth in Sub-Saharan Africa. In A.B. Elhiraika, G. Ibrahim, & W. Davis (Eds.) *Governance for structural transformation in Africa* (pp. 101-143). Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-030-03964-6_4
- Agyei, S.K., & Idan, G.A. (2022). Trade openness, institutions, and inclusive growth in Sub-Saharan Africa. *Sage Open*, 12(2), 1-12. <https://doi.org/10.1177/21582440221099008>
- Akinlo, T., & Okunlola, C.O. (2021). Trade openness, institutions and economic growth in Sub-Saharan Africa. *Journal Perspektif Pembiayaan Dan Pembangunan Daerah*, 8(6), 541-560. <https://doi.org/10.22437/ppd.v8i6.10653>
- Ali, A.A., Ghazi, T., & Msadfa, Y. (2018). Manufacturing employment elasticity and its drivers in developing and emerging countries: Focus on Sub-Saharan Africa. *OCP Policy Center Research Paper*, 17/03, 1-36. Retrieved from <https://www.policycenter.ma/sites/default/files/OCPPC-RP1703.pdf> on May 2, 2023.
- Alkhateeb, T., Yousef, T., Mahmood, H., Sultan, Z.A., & Ahmad, N. (2017). Trade Openness and Employment Nexus in Saudi Arabia. *International Journal of Economic Research*, 14, 59-66. Retrieved from https://mpr.ub.uni-muenchen.de/109451/1/MPRA_paper_109451.pdf on May 2, 2023.
- Anderson, B. (2016). Do Macroeconomic Structures and Policies Shape the Employment Intensity of Growth Differently for Women and Men?. *Journal of Economic Issues*, 50(4), 940-962. 2. <https://doi.org/10.1080/00213624.2016.1249744>
- Anderson, B., & Braunstein, E. (2013). Economic growth and employment from 1990-2010: explaining elasticities by gender. *Review of Radical Political Economics*, 45(3), 269-277. <https://doi.org/10.1177/0486613413487158>
- Anderton, R., Aranki, T., Bonthuis, B., & Jarvis, V. (2014). Disaggregating Okun's law: decomposing the impact of the expenditure components of GDP on euro area unemployment. *ECB Working Paper*, 1747, 1-24. <https://doi.org/10.2139/ssrn.2533387>
- Asaleye, A.J., Okodua, H., Oloni, E.F., & Ogunjobi, J.O. (2017). Trade Openness and Employment: Evidence from Nigeria. *Journal of Applied Economic Sciences*, 12(4), 1194-1209. <https://doi.org/10.1108/ijse-06-2018-0320>
- Banerjee, P., & Veeramani, C. (2015). Trade Liberalization and Women's Employment Intensity: Analysis of India's Manufacturing Industries. *Indira Gandhi Institute of Development Research Working Paper*, 2015-018, 1-45. Retrieved from <http://www.igidr.ac.in/pdf/publication/WP-2015-018.pdf> on May 2, 2023.
- Ben-Salha, O., & Zmami, M. (2021). The effect of economic growth on employment in GCC countries. *Scientific Annals of Economics and Business*, 68(1), 25-41. <https://doi.org/10.47743/saeb-2021-0004>
- Burggraeve, K., de Walque, G., & Zimmer, H. (2015). The relationship between economic growth and employment. *Economic Review*, (i), 32-52. Retrieved https://www.nbb.be/doc/ts/publications/economicreview/2015/ecorevi2015_h2.pdf on May 10, 2023.

- Butkus, M., Dargenytė-Kacilevičienė, L., Matuzevičiūtė, K., Ruplienė, D., & Šeputienė, J. (2022). Do Gender and Age Matter in Employment–Sectoral Growth Relationship Over the Recession and Expansion. *Ekonomika*, 101(2), 38-51. <https://doi.org/10.15388/Ekon.2022.101.2.3>
- Butkus, M., Dargenytė-Kacilevičienė, L., Matuzevičiūtė, K., Šeputienė, J., & Ruplienė, D. (2023). Age-and Gender-specific Output-employment Relationship across Economic Sectors 1. *Ekonomicky Casopis*, 71(1), 3-22. <https://doi.org/10.31577/ekoncas.2023.01.01>
- Butkus, M., Maciulyte-Sniukiene, A., Macaitiene, R., & Matuzeviciute, K. (2021). A new approach to examine non-linear and mediated growth and convergence outcomes of cohesion policy. *Economies*, 9(3), 103. <https://doi.org/10.3390/economies9030103>
- Conteh, S.B., Yijun, Y., & Sesay, B. (2021). Economic growth effects of the interaction of trade openness and institutions quality: empirical evidence from Sub-Saharan Africa. *International Journal of Economics and Financial Issues*, 11(1), 34. <https://doi.org/10.32479/ijefi.10098>
- Coşar, E.E., & Yavuz, A.A. (2019). Is There Asymmetry between GDP and Labor Market Variables in Turkey under Okuns Law?. *Working Papers of Central Bank of the Republic of Turkey*, 1927, 1-24. <https://doi.org/10.1016/j.cbrev.2021.03.002>
- Dahal, M.P., & Rai, H. (2019). Employment Intensity of Economic Growth: Evidence from Nepal. *Economic Journal of Development Issues*, 34-47, <https://doi.org/10.3126/ejdi.v28i1-2.33195>
- Dargenyte-Kacileviciene, L., Butkus, M., & Matuzeviciute, K. (2022). Gender-, Age-and Educational Attainment Level-Specific Output–Employment Relationship and Its Dependence on Foreign Direct Investment. *Economies*, 10(11), 265. <https://doi.org/10.3390/economies10110265>
- Dauda, R.S., & Ajeigbe, O.M. (2021). Sectoral Analysis of Employment Intensity of Growth in Nigeria. *Global Business & Economics Anthology*, 1, 87-99. <https://doi.org/10.47341/GBEA.21037>
- Farole, T., Ferro, E., & Gutierrez, V.M. (2017). Job Creation in the Private Sector: An Exploratory Assessment of Patterns and Determinants at the Macro, Sector, and Firm Levels. *Jobs Working Paper 5*, 1-48. World Bank, Washington, DC. <https://doi.org/10.1596/28370>
- Fetahi-Vehapi, M., Sadiku, L., & Petkovski, M. (2015). Empirical analysis of the effects of trade openness on economic growth: An evidence for South East European countries. *Procedia Economics and Finance*, 19, 17-26. [https://doi.org/10.1016/S2212-5671\(15\)00004-0](https://doi.org/10.1016/S2212-5671(15)00004-0)
- Furceri, D., Crivelli, E., & Toujas-Bernate, M.J. (2012). Can policies affect employment intensity of growth? A cross-country analysis. *International Monetary Fund Working Paper*, WP/12/218, 1-31. <https://doi.org/10.5089/9781475505689.001>
- Ghazali, M., & Mouelhi, R. (2018). The employment intensity of growth: evidence from Tunisia. *Journal of Economic Development*, 43(3), 85-117. <https://doi.org/10.35866/caujed.2018.43.3.004>
- Goaied, M., & Sassi, S. (2015). Trade liberalisation and employment intensity of sectoral output growth: Lessons from Tunisia. *The Economic and Labour Relations Review*, 26(2), 261-275. <https://doi.org/10.1111/j.1564-913X.2015.00034.x>
- Görg, H., Hornok, C., Montagna, C., & Onwordi, G.E. (2023). Employment to output elasticities and reforms towards flexicurity: Evidence from OECD countries. *Bulletin of Economic Research*, 75(3), 641-670. <https://doi.org/10.1111/boer.12375>
- Hadhek, Z., & Mrad, F. (2015). Trade openness, institutions and economic growth. *European Journal of Economics, Finance and Administrative Sciences*, 75, 96-104. <https://doi.org/10.4236/tel.2018.81127>
- Herman, E. (2011). The impact of economic growth process on employment in European Union countries. *The Romanian Economic Journal*, 14(42), 47-67. <https://doi.org/10.19030/iber.v13i3.8596>
- Islam, I., & Nazara, S. (2000). Estimating Employment Elasticity for the Indonesian Economy. *Jakarta, Indonesia: International Labour Office*, 1-29. Retrieved from https://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/---ilo-jakarta/documents/publication/wcms_123743.pdf on May 10, 2023.
- Kapsos, S. (2006). Employment intensity of growth: The trends and macroeconomic determinants. *Employment Strategy Papers 2005/12*, 1-55. https://doi.org/10.1057/9780230627383_4
- Keho, Y. (2017). The impact of trade openness on economic growth: The case of Cote d'Ivoire. *Cogent Economics & Finance*, 5(1), 1-14. <https://doi.org/10.1080/23322039.2017.1332820>

- Ketteni, E., & Kottaridi, C. (2019). The impact of regulation on the FDI-growth nexus within the institution-based view: A nonlinear specification with varying coefficients. *International Business Review*, 28(3), 415-427. <https://doi.org/10.1016/j.ibusrev.2018.11.001>
- Mihajlović, V., & Marjanović, G. (2021). Challenges of the Output-Employment Growth Imbalance in Transition Economies. *Naše gospodarstvo/Our economy*, 67(2), 1-9. <https://doi.org/10.2478/ngoe-2021-0007>
- Mkhize, N.I. (2019). The sectoral employment intensity of growth in South Africa. *Southern African Business Review*, 23(1), 1-24. <https://doi.org/10.25159/1998-8125/4343>
- Ngouhouo, I., & Nchofoung, T.N. (2021). Does trade openness affects employment in Cameroon?. *Foreign Trade Review*, 56(1), 105-116. <https://doi.org/10.1177/0015732520961307>
- Nwosa, P., Keji, S., Adegboyo, S., & Fasina, O. (2020). Trade openness and unemployment rate in Nigeria. *Oradea Journal of Business and Economics*, 5(2), 52-62. <https://doi.org/10.47535/1991ojbe111>
- Opong-Baah, T., Bo, Y., Twi-Brempong, C., Amoah, E.O., Prempeh, N.A., & Addai, M. (2022). The Impact of Trade Openness on Economic Growth: The Case of Ghana and Nigeria. *Journal of Human Resource and Sustainability Studies*, 10(1), 142-160. <https://doi.org/10.4236/jhrss.2022.101010>
- Parcon, H. (2008). Labor market flexibility as a determinant of FDI inflows. University of Hawaii at Manoa, Department of Economics. *Working Papers*, 08-07, 1-50. Retrieved from <https://core.ac.uk/download/pdf/7163267.pdf> on May 10, 2023.
- Perugini, C. (2009). Employment Intensity of Growth in Italy: A Note Using Regional Data. *Regional and Sectoral Economic Studies*, 9(1), 59-105.
- Pilinkiene, V. (2016). Trade openness, economic growth and competitiveness. The case of the Central and Eastern European countries. *Inžinerinė Ekonomika*, 27(2), 185-194. <https://doi.org/10.5755/j01.ee.27.2.14013>
- Radulescu, R., & Robson, M. (2013). Does labour market flexibility matter for investment? A study of manufacturing in the EBPO. *Applied Economics*, 45(5), 581-592. <https://doi.org/10.1080/00036846.2011.607633>
- Rath, B.N., & Ridhwan, M.M. (2020). The Nexus Among Employment, Productivity And Trade Openness: Evidence From Brics And Indonesia. *Buletin Ekonomi Moneter Dan Perbankan*, 23(4), 463-484. <https://doi.org/10.21098/bemp.v23i4.1363>
- Richter, K., & Witkowski, B. (2014). Does growth generate jobs in Eastern Europe and Central Asia?. *World Bank Policy Research Working Paper*, 6759, 1-20. <https://doi.org/10.1596/1813-9450-6759>
- Seyfried, W. (2014). Examining the employment intensity of economic growth of the PIIGS. *International Business & Economics Research Journal (IBER)*, 13(3), 593-598. <https://doi.org/10.19030/iber.v13i3.8596>
- Selwaness, I., & Zaki, C. (2019). On the interaction between exports and labor market regulation: Evidence from the MENA countries. *The Quarterly Review of Economics and Finance*, 73, 24-33. <https://doi.org/10.1016/j.qref.2018.05.011>
- Slimane, S.B. (2015). The relationship between growth and employment intensity: evidence for developing countries. *Asian Economic and Financial Review*, 680-692. <https://doi.org/10.18488/journal.aefr/2015.5.4/102.4.680.692>
- Thuku, G.K., Omolo, J., & Muniu, J. (2019). Employment Intensity of Output Growth in Kenya. *Journal of Economics and Finance*, 10, 9-21.
- Van Ha, H., & Tran, T.Q. (2017). International trade and employment: A quantile regression approach. *Journal of Economic Integration*, 531-557. <https://doi.org/10.11130/jei.2017.32.3.531>
- Zaki, C., Alshyab, N., & Seleem, N. (2020). Employment intensity of growth and sectoral output growth: a comparative analysis of Egyptian and Jordanian economies. *Analysis of Egyptian and Jordanian Economies*, 19(1), 35-54. <https://doi.org/10.30682/nm2001c>

Appendix A:

Table A1. Summary statistics of dependent variables

Education attainment level	Gender	Age	Mean	Min	Max	Standard deviation
Employment growth,%						
ISCED 0-8	Both	15-64	0.66	-13.09	11.00	2.42
		15-24	-1.58	-29.28	58.68	7.68
		25-39	-0.05	-10.93	29.23	3.10
		40-64	1.61	-12.13	7.65	2.35
	Males	15-64	0.45	-17.18	13.34	2.69
		15-24	-1.51	-33.33	50.00	8.08
		25-39	-0.16	-14.26	27.71	3.27
		40-64	1.36	-14.71	11.09	2.57
	Females	15-64	0.97	-8.96	10.50	2.58
		15-24	-1.59	-23.83	70.91	8.62
		25-39	0.13	-12.26	31.17	3.50
		40-64	2.15	-12.85	19.17	2.92
ISCED 0-2	Both	15-64	-2.67	-27.57	39.47	6.92
		15-24	-2.97	-57.58	83.33	14.89
		25-39	-2.70	-33.76	89.64	10.35
		40-64	-2.26	-37.50	45.61	7.79
	Males	15-64	-2.12	-31.93	48.26	7.55
		15-24	-2.59	-50.00	84.62	15.24
		25-39	-2.04	-32.20	105.92	11.46
		40-64	-1.77	-40.44	58.88	8.94
	Females	15-64	-2.99	-28.02	45.16	7.67
		15-24	-2.39	-51.85	157.14	20.22
		25-39	-3.45	-49.06	66.33	12.73
		40-64	-2.53	-42.05	65.48	9.18
ISCED 3-4	Both	15-64	0.68	-20.21	37.56	4.42
		15-24	-0.91	-32.21	53.01	8.84
		25-39	-0.94	-18.36	32.96	4.93
		40-64	2.51	-40.00	57.26	5.58
	Males	15-64	0.77	-22.60	37.08	4.74
		15-24	-0.49	-32.14	60.00	10.33
		25-39	-0.54	-19.92	33.72	5.35
		40-64	2.32	-43.33	41.46	5.80
	Females	15-64	0.59	-17.12	44.72	4.88
		15-24	-1.11	-37.78	55.40	10.75
		25-39	-1.47	-23.02	32.16	5.88
		40-64	2.90	-38.46	78.23	6.97

Source: own study based on Eurostat, World Bank and Fraser Institute data.

Table A2. Summary statistics of the independent variable

Variable	Mean	Min	Max	Standard deviation
$\Delta Y, \%$	2.09	-14.84	25.18	3.84
Exports, % of GDP	60.40	18.54	205.48	34.12
Imports, % of GDP	58.53	22.85	174.60	228.83
Labour market regulation index	6.26	2.90	8.40	1.08
Business regulation index	7.19	4.96	9.00	0.85

Source: own study based on Eurostat, World Bank and Fraser Institute data.

Appendix B:

Table B1. The impact of imports on the heterogeneous relationship between economic growth and employment (ISCED0–8 and ISCED 0-2) in the EU

Age	15-64			15-24			25-39			40-64		
Gender	Both	Males	Females	Both	Males	Females	Both	Males	Females	Both	Males	Females
ISCED	0-8											
β_1	0.5810 (0.4079) [0.3116]*	0.8796* (0.4332) [0.3767]**	0.1767 (0.4390) [0.2856]	2.8192*** (1.1920) [1.3479]**	2.7476** (1.1703) [1.5553]*	2.9239** (1.3655) [1.1268]**	0.9956** (0.4650) [0.3656]**	1.2016** (0.4551) [0.4107]***	0.7447 (0.5226) [0.3629]*	0.0809 (0.4349) [0.3006]	0.5221 (0.4510) [0.3210]	-0.6511 (0.4870) [0.4154]
δ_1	-0.0701 (0.0940) [0.0601]	-0.1211 (0.1003) [0.0751]	0.0066 (0.1028) [0.0598]	-0.5327* (0.2907) [0.2978]*	-0.4820* (0.2804) [0.3447]	-0.5968* (0.3388) [0.2468]**	-0.1739 (0.1139) [0.0770]**	-0.2043* (0.1116) [0.0887]**	-0.1368 (0.1258) [0.0782]*	0.0389 (0.0986) [0.0615]	-0.0484 (0.1050) [0.0617]	0.2022* (0.1125) [0.0999]*
n	538	538	538	538	538	538	538	538	538	538	538	538
Adj. R²	0.41	0.45	0.28	0.27	0.27	0.21	0.31	0.36	0.19	0.24	0.28	0.15
Pesaran CD test p-value	0.0118	0.0325	0.0058	0.0143	0.0182	0.0098	0.0222	0.0124	0.0200	0.0175	0.0180	0.0128
ISCED	0-2											
β_1	0.1096 (0.8894)	0.9395 (1.0031)	-1.3021 (0.8214) [0.9023]	2.7260 (1.7396)	2.5998 (1.6950)	3.1048 (1.8492)	2.0320** (0.8062)	2.6451*** (0.9108)	0.8369 (0.8705)	-0.7925 (0.9498)	0.1837 (0.9819)	-2.2987** (1.0912)
δ_1	0.0632 (0.2073)	-0.1030 (0.2413)	0.3491* (0.1909) [0.2502]	-0.4361 (0.4124)	-0.4225 (0.4019)	-0.5717 (0.4196)	-0.3200 (0.2147)	-0.4301* (0.2434)	-0.1164 (0.2049)	0.2131 (0.2128)	0.0047 (0.2392)	0.5487** (0.2498)
n	538	538	538	538	538	504	538	538	533	538	538	538
Adj. R²	0.16	0.16	0.11	0.13	0.12	0.09	0.12	0.12	0.04	0.08	0.07	0.06
Pesaran CD test p-value	0.2610	0.2880	0.0444	0.0998	0.0958	0.1260	0.0911	0.0617	0.0873	0.9490	0.9270	0.4510

Note: **, *** denotes statistical significance at 10%, 5% and 1% levels, respectively. Values in parentheses represent the Arellano HAC robust standard errors and values in brackets – Driscoll-Kraay standard errors.

Source: own study based on Eurostat, World Bank and Fraser Institute data.

Table B2. The impact of imports on the heterogeneous relationship between economic growth and employment (ISCED3–4 and ISCED 5-8) in the EU

Age	15-64			15-24			25-39			40-64		
Gender	Both	Males	Females	Both	Males	Females	Both	Males	Females	Both	Males	Females
ISCED	3-4											
β_1	0.4635 (0.6266) [0.3506]	0.1616 (0.6730)	0.8646 (0.6110) [0.4343]*	2.7212** (1.2017) [1.2226]**	2.6115** (1.2652) [1.5687]	2.8828** (1.3085) [1.1077]**	0.4856 (0.6600) [0.4915]	0.1765 (0.8057) [0.5286]	0.7852 (0.5925) [0.6045]	0.0247 (0.6845)	-0.3450 (0.7428)	0.6227 (0.6683)
δ_1	-0.0266 (0.1512) [0.0784]	0.0665 (0.1644)	-0.1487 (0.1445) [0.1255]	-0.5051* (0.2901) [0.2613]*	-0.4471 (0.3094) [0.3393]	-0.5828* (0.3121) [0.2413]**	-0.0539 (0.1565) [0.1097]	0.0395 (0.1965) [0.1130]	-0.1518 (0.1346) [0.1541]	0.0924 (0.1758)	0.2003 (0.1939)	-0.0727 (0.1592)
n	538	538	538	538	538	538	538	538	538	538	538	538
Adj. R ²	0.15	0.16	0.09	0.19	0.15	0.12	0.12	0.13	0.08	0.07	0.08	0.03
Pesaran CD test p-value	0.0239	0.1050	0.0217	0.0065	0.0155	0.0106	0.0044	0.0240	0.0069	0.1520	0.3600	0.1050
ISCED	5-8											
β_1	0.4046 (0.5304)	0.4749 (0.5448)	0.2853 (0.5632)	2.7270 (1.9212) [2.4139]	2.0798 (2.1420) [2.6069]	3.4454 (2.0359) [2.6689]	0.8520 (0.7723)	0.8668 (0.8150)	0.7273 (0.8471) [0.5991]	-0.1192 (0.5867)	0.1156 (0.5600)	-0.6901 (0.6592)
δ_1	-0.0955 (0.1124)	-0.1022 (0.1189)	-0.0734 (0.1185)	-0.6035 (0.4882) [0.5374]	-0.4487 (0.5293) [0.5548]	-0.8116 (0.5311) [0.6125]	-0.1957 (0.1642)	-0.2070 (0.1755)	-0.1622 (0.1824) [0.1483]	0.0171 (0.1413)	-0.0137 (0.1230)	0.1746 (0.1477)
n	538	538	538	533	485	519	538	538	538	538	538	537
Adj. R ²	0.03	0.04	0.03	0.01	0.002	-0.004	0.05	0.04	0.05	0.01	0.02	0.02
Pesaran CD test p-value	0.694	0.9610	0.1080	0.0186	0.0278	0.0075	0.1190	0.1230	0.0295	0.5830	0.4820	0.5540

Note: *, **, *** denotes statistical significance at 10%, 5% and 1% levels, respectively. Values in parentheses represent the Arellano HAC robust standard errors and values in brackets – Driscoll-Kraay standard errors.

Source: own study based on Eurostat, World Bank and Fraser Institute data.

Table B3. The impact of exports on the heterogeneous relationship between economic growth and employment (ISCED0–8 and ISCED 0-2) in the EU

Age	15-64			15-24			25-39			40-64		
Gender	Both	Males	Females	Both	Males	Females	Both	Males	Females	Both	Males	Females
ISCED	0-8											
β_1	0.4831 (0.3236) [0.2491]**	0.7301* (0.3620) [0.2875]**	0.1545 (0.3193) [0.2398]	2.2918** (1.0385) [1.0283]**	2.1941** (1.0121) [1.2019]*	2.3972 (1.1804) [0.8685]**	0.8391** (0.3287) [0.2836]**	1.0195*** (0.3499) [0.3117]**	0.6239* (0.3486) [0.2921]**	0.0607 (0.3524) [0.2384]	0.4294 (0.3725) [0.2606]	-0.5218 (0.3746) [0.2923]*
δ_1	-0.0465 (0.0748) [0.0507]	-0.0858 (0.0850) [0.0595]	0.0131 (0.0745) [0.0529]	-0.4149 (0.2557) [0.2251]	-0.3576 (0.2462) [0.2650]	-0.4794 (0.2940) [0.1860]**	-0.1332 (0.0807) [0.0638]**	-0.1580* (0.0860) [0.0721]**	-0.1037 (0.0841) [0.0658]	0.0435 (0.0802) [0.0467]	-0.0274 (0.0880) [0.0491]	0.1727* (0.0868) [0.0699]**
n	538	538	538	538	538	538	538	538	538	538	538	538
Adj. R²	0.40	0.45	0.28	0.27	0.27	0.21	0.30	0.36	0.19	0.25	0.28	0.16
Pesaran CD test p-value	0.0127	0.0327	0.0067	0.0160	0.0192	0.0107	0.0206	0.0117	0.0183	0.0163	0.0186	0.0109
ISCED	0-2											
β_1	0.1083 (0.7832)	0.8166 (0.8803)	-1.1095 (0.6884) [0.8888]	2.2374 (1.5097)	1.9635 (1.4014)	2.0405 (1.6424)	2.0861*** (0.6980)	2.5997*** (0.8446)	1.0134 (0.6277)	-0.8172 (0.7917)	0.0012 (0.8220)	-2.0149** (0.8913)
δ_1	0.0618 (0.1854)	-0.0762 (0.2141)	0.3030* (0.1627) [0.2530]	-0.3311 (0.3658)	-0.2776 (0.3415)	-0.3231 (0.3769)	-0.3323* (0.1889)	-0.4204* (0.2246)	-0.1555 (0.1522)	0.2176 (0.1770)	0.0458 (0.1948)	0.4813** (0.2002)
n	538	538	538	538	536	504	538	538	533	538	538	538
Adj. R²	0.16	0.16	0.11	0.13	0.12	0.09	0.12	0.12	0.04	0.08	0.07	0.08
Pesaran CD test p-value	0.2620	0.2890	0.0450	0.1000	0.0981	0.1220	0.0894	0.0601	0.0875	0.9400	0.9360	0.4570

Note: *, **, *** denotes statistical significance at 10%, 5% and 1% levels, respectively. Values in parentheses represent the Arellano HAC robust standard errors and values in brackets – Driscoll-Kraay standard errors.

Source: own study based on Eurostat, World Bank and Fraser Institute data.

Table B4. The impact of exports on the heterogeneous relationship between economic growth and employment (ISCED3–4 and ISCED 5-8) in the EU

Age	15-64			15-24			25-39			40-64		
Gender	Both	Males	Females	Both	Males	Females	Both	Males	Females	Both	Males	Females
ISCED	3-4											
β_1	0.3597 (0.4644) [0.2619]	0.1160 (0.5031)	0.6883 (0.4539) [0.3174]	2.2129** (0.9742) [0.9392]	2.0280 (1.0726) [1.1970]	2.4573** (1.0145) [0.9142]	0.3391 (0.4887) [0.3650]	0.0990 (0.6015) [0.3723]	0.5833 (0.4597) [0.4659]	0.0349 (0.5335)	-0.2202 (0.5893)	0.4592 (0.5419)
δ_1	-0.0000 (0.1138) [0.0587]	0.0791 (0.1260)	-0.1047 (0.1075) [0.0979]	-0.3914 (0.2387) [0.1947]*	-0.3149 (0.2673) [0.2495]	-0.4897 (0.2415) [0.1994]**	-0.0133 (0.1163) [0.0806]	0.0634 (0.1501) [0.0742]	-0.0978 (0.1012) [0.1223]	0.0913 (0.1410)	0.1712 (0.1605)	-0.0314 (0.1268)
n	538	538	538	538	538	538	538	538	538	538	538	538
Adj. R ²	0.15	0.16	0.09	0.19	0.15	0.12	0.12	0.13	0.07	0.07	0.08	0.03
Pesaran CD test p-value	0.0240	0.1030	0.0233	0.0042	0.0165	0.0069	0.0042	0.0233	0.0070	0.1460	0.3440	0.1080
ISCED	5-8											
β_1	0.3925 (0.4561)	0.4497 (0.4625)	0.2855 (0.4895)	2.7861 (1.6915) [2.0222]	2.4680 (1.7858) [2.5996]	2.8952 (1.8264) [1.9967]	0.8258 (0.6435)	0.8159 (0.6914)	0.7355 (0.7076) [0.3937]*	-0.1430 (0.5080)	0.0329 (0.4610)	-0.5799 (0.5631)
δ_1	-0.0874 (0.0965)	-0.0917 (0.1020)	-0.0677 (0.1014)	-0.6252 (0.4380) [0.4469]	-0.5485 (0.4436) [0.5617]	-0.6848 (0.4858) [0.4510]	-0.1821 (0.1341)	-0.1868 (0.1476)	-0.1571 (0.1496) [0.0961]	0.0271 (0.1210)	0.0087 (0.1111)	0.1511 (0.1238)
n	538	538	538	533	485	519	538	538	538	538	538	537
Adj. R ²	0.03	0.04	0.03	0.02	0.003	-0.004	0.05	0.04	0.05	0.01	0.02	0.02
Pesaran CD test p-value	0.6630	0.9320	0.1030	0.0178	0.0269	0.0073	0.1180	0.1220	0.0286	0.5700	0.4660	0.5530

Note: *, **, *** denotes statistical significance at 10%, 5% and 1% levels, respectively. Values in parentheses represent the Arellano HAC robust standard errors and values in brackets – Driscoll-Kraay standard errors.

Source: own study based on Eurostat, World Bank and Fraser Institute data.

Appendix C:

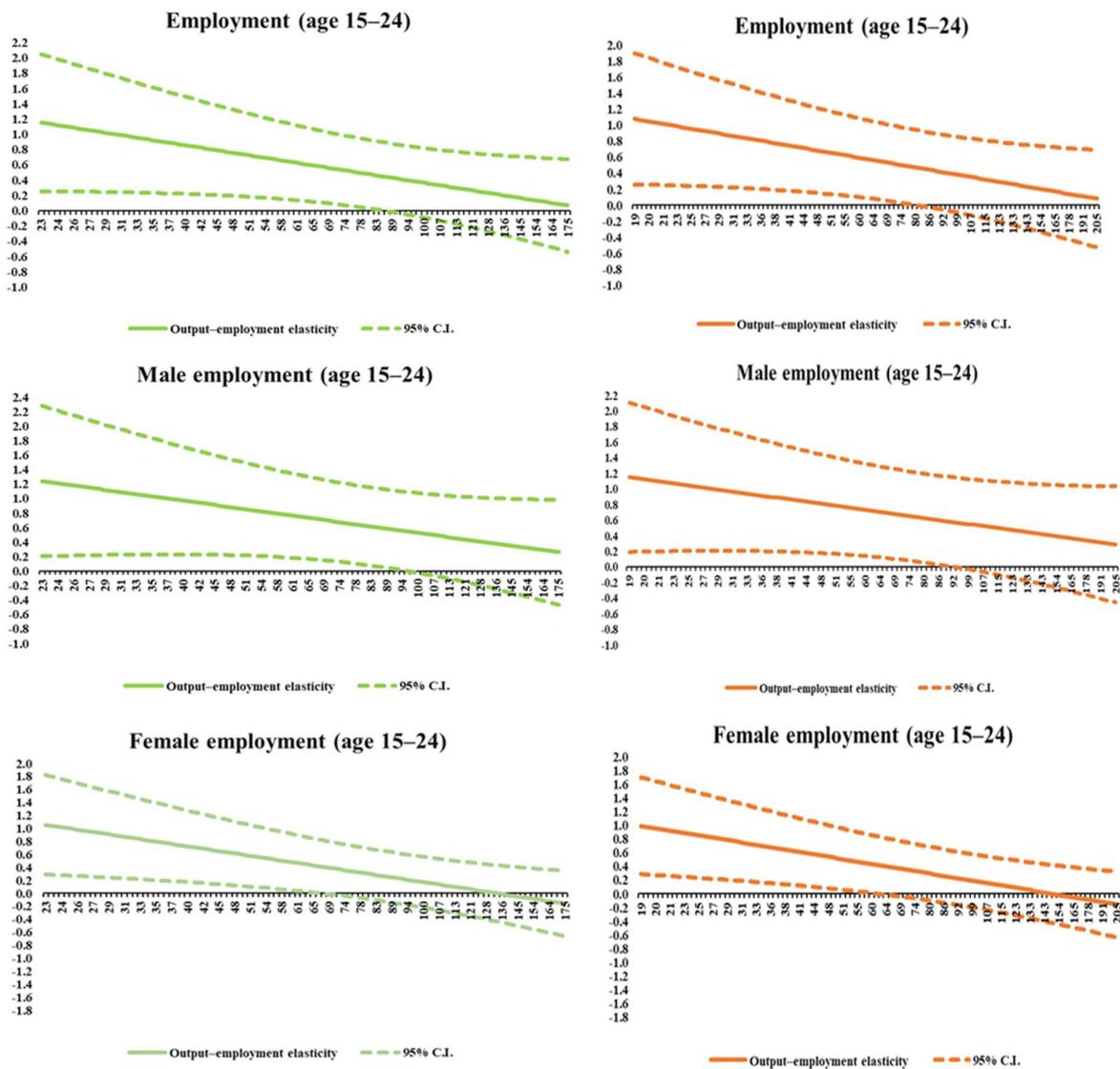


Figure C1. The impact of imports (green curves) and exports (orange curves) on the heterogeneous relationship between economic growth and youth employment by gender
 Source: own elaboration based on Eurostat, World Bank and Fraser Institute data.



Figure C2. The impact of imports (green curves) and exports (orange curves) on the heterogeneous relationship between economic growth and employment by age, gender and education (ISCED0–2)
 Source: own elaboration based on Eurostat, World Bank and Fraser Institute data.

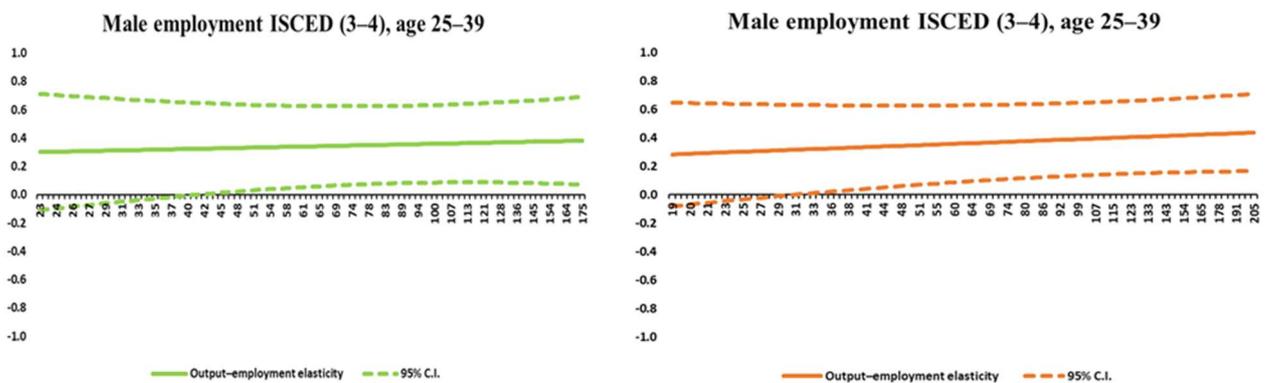


Figure C3. The impact of imports (green curves) and exports (orange curves) on the heterogeneous relationship between economic growth and employment of 25-39-year-old males with ISCED3–4 level of educational attainment
 Source: own elaboration based on Eurostat, World Bank and Fraser Institute data

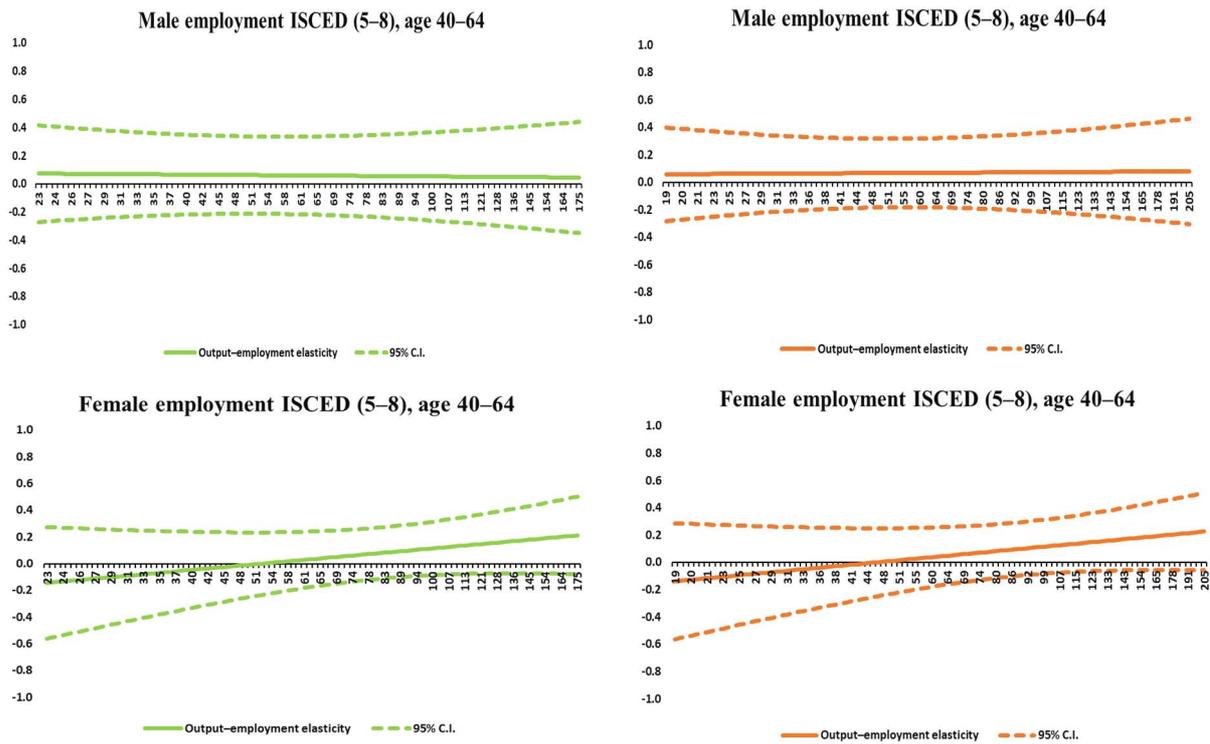


Figure C4. The impact of imports (green curves) and exports (orange curves) on the heterogeneous relationship between economic growth and employment by age, gender and education (ISCED5-8)

Note: the horizontal axis shows the level of imports and exports respectively, % of GDP, and the vertical axis shows the coefficient of employment to output elasticity.

Source: own elaboration based on Eurostat, World Bank and Fraser Institute data.

Appendix D:

Table D1. Economic growth impact on employment mediated by import and regulations in the EU

Moderator	Labour market regulation		Business regulation		
Imports	Age	40-64		40-64	
	Gender	Males	Females	Males	Females
	ISCED	0-2			
	β_1	-7.1602 (7.8800)	2.5703 (9.1891)	-46.5532*** (15.9375)	-54.4374*** (14.8657)
	δ_1	1.7906 (1.9108)	-0.6446 (2.2125)	11.7635*** (4.1008)	13.5000*** (3.7197)
	δ_2	4.0329 (4.4054)	-2.5257 (5.2175)	23.8560*** (7.8964)	26.6584*** (7.5946)
	δ_4	-0.9760 (1.0368)	0.6127 (1.2135)	-5.9817*** (2.0209)	-6.6051*** (1.8913)
	n	536	536	534	534
	Adj. R ²	0.07	0.06	0.08	0.07
	Pesaran CD test p-value	0.769	0.463	0.559	0.309
	ISCED	5-8			
	β_1	–	12.3052 (9.3761)	–	10.3912 (10.2387)
	δ_1	–	-3.5071 (2.3187)	–	-2.8227 (2.4641)
	δ_2	–	-6.4445 (4.9240)	–	-5.6124 (5.1614)
	δ_4	–	1.8358 (1.2112)	–	1.5112 (1.2382)
	n	–	535	–	534
	Adj. R ²	–	0.03	–	0.02
	Pesaran CD test p-value	–	0.262	–	0.276

Note: *, **, *** denotes statistical significance at 10%, 5% and 1% levels, respectively. The Arellano HAC robust standard errors are represented in parentheses.

Source: own study based on Eurostat, World Bank and Fraser Institute data.

Table D2. Economic growth impact on employment mediated by export and regulations in the EU

Moderator	Labour market regulation		Business regulation		
Exports	Age	40-64		40-64	
	Gender	Males	Females	Males	Females
	ISCED	0-2			
	β_1	-8.6077 (7.2968)	-4.8631 (8.1750)	-39.4038*** (12.2991)	-41.7386*** (10.6259)
	δ_1	2.2183 (1.6715)	1.3046 (1.8166)	10.0452*** (3.2985)	10.5940*** (2.7317)
	δ_2	4.6854 (4.1301)	1.5524 (4.7985)	20.0794*** (6.0363)	20.2192*** (5.4954)
	δ_4	-1.1733 (0.9170)	-0.4476 (1.0406)	-5.0700*** (1.6051)	-5.1277*** (1.3952)
	n	536	536	534	534
	Adj. R ²	0.07	0.07	0.09	0.08
	Pesaran CD test p-value	0.739	0.406	0.551	0.299
	ISCED	5-8			
	β_1	10.6246 (6.9819)	9.2197 (7.1115)	0.9925 (6.5046)	0.7748 (8.7775)
	δ_1	-3.3082 (1.9999)	-2.7783 (1.7735)	-0.4826 (1.5462)	-1.8919 (2.1106)
	δ_2	-5.1004 (3.5280)	-4.7766 (3.7346)	-0.4907 (3.2663)	-3.6968 (4.4366)
	δ_4	1.6214 (0.9867)	1.4407 (0.9222)	0.2633 (0.7749)	1.0219 (1.0579)
	n	536	535	534	534
	Adj. R ²	0.03	0.03	0.05	0.02
	Pesaran CD test p-value	0.419	0.259	0.499	0.285

Note: *, **, *** denotes statistical significance at 10%, 5% and 1% levels, respectively. The Arellano HAC robust standard errors are represented in parentheses.

Source: own study based on Eurostat, World Bank and Fraser Institute data.

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The contribution share of authors is equal and amounted to $\frac{1}{3}$ for each of them.
The contribution share of authors was equal. LDK, MB, KM – conceptualisation,
LDK, MB – methodology, formal analysis and investigation. LDK - data curation.
KM – literature review. LDK, MB, KM – writing—original draft preparation

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Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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