The Impact of Foreign Trade on Employment and Regional Differences: An Empirical Study Based on EU and UK Panel Data

Siyuan Wang

University of Glasgow, UK
Email: 1540236418@qq.com
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***Abstract*—Foreign trade and employment have always been important influences on the stable development of a country's economy. As one of the most economically developed economies in the world, whether the EU's favourable conditions for foreign trade development can promote the stability of employment is a matter of concern. Therefore, this paper selected the EU countries as well as the UK as the research object for theoretical analysis, and used the monthly data of foreign trade and employment rate of these countries from 2000 to 2020 for empirical analysis. It is found that as developed countries where capital is more abundant than labour, exports in the EU and the UK adversely affect employment, while imports increase employment rate. Both the fixed effects model for static panels and the systematic GMM model for dynamic panels confirm this finding. In addition, the paper uses the fixed effects model to conduct a regionalised difference analysis and finds that the impact of foreign trade on employment is not identical for countries in different regions, even if they are all in Europe.**

***Keywords*—trade, employment, regional differences, European union.**

I. Introduction

Since the establishment of the EU, the economy has grown rapidly. From 1995 to 2008, the real GDP of the EU27 grew from 6,337.71 billion euros to 11,085.41 billion euros, with a growth rate of 75 per cent, nearly doubling the value of real GDP.

European economic growth is also linked to employment rates. To address the plight of high unemployment in the 1970s, Europe changed its strategy to promote employment from the 1990s onwards

According to traditional economic theory, firms facing competition from imported goods may gradually decline and reduce jobs while firms that develop foreign trade for foreign exports are able to provide more jobs.

So the purpose of this paper is to examine the impact of export and import volumes on employment in the EU and the UK in the post-21st century and the regional differences in the effects. In addition, it examines the relationship between export and import volumes and employment rates under the influence of Brexit and COVID-19. Provide effective proposals and measures for a more in-depth discussion on improving employment rates.

This paper is divided into the following parts to analyse the impact of foreign trade on employment both theoretically and empirically: the first part is a general introduction to the European economy and a preliminary discussion. The second section is a literature review, based on which the shortcomings and reflections of the literature are added and hypotheses are formulated. Section III is the methodology of the empirical analysis, and the fifth part is the empirical results. Section VI is the summary and research recommendations

II. Literature Review

A. Impact of Trade on Employment

Since the 1980s, the study of foreign trade and employment has become a hotspot for scholars in various countries, but there are divergences in the findings on the relationship between foreign trade and employment.

The first view is that international trade has a positive effect on employment. The effects of U.S. export expansion and import competition (especially from China) on employment show that while import competition reduces employment, export expansion also creates significant employment (Feenstra and Hanson, 1995). According to (Hine and Wright, 1998), increased import penetration stimulated an important defensive response from the UK industry. While this may have exacerbated unemployment in the short run, it was an important means of sustaining employment in the long run.

The second view is that international trade has a negative effect on employment. A reduction in employment is positively correlated with a decrease in the level of trade protection (Gaston, 1998). Foreign trade, whether it is importing or exporting, adversely affects employment in the UK (Greenaway *et al.*, 1999). In addition, (Hande, 2021) shows that contrary to the traditional foreign trade theory that exports increase employment, exports from 28 OECD countries have a significant negative impact on their employment.

The third argument is that the effects of international trade on employment need to be analysed specifically in terms of the volume of exports and imports. During the Clinton presidency, government officials claimed that trade created jobs in the U.S. However, (Scott, 2000) asserts that it is incorrect in inferring that the expansion of trade had a positive impact on economic growth and employment. He argues that trade has had a negative impact on economic growth and job creation during this economic expansion. Trade includes both imports and exports, if imports grow faster than exports, the net effect of trade will be to reduce growth and employment. (Gao, 2009) finds that exports have a positive effect on employment, with an employment elasticity of exports of 0.00035. This means for every 10 per cent increase in exports, employment increases by 0.35 per cent. Imports have a significant substitution effect on

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employment in China, with employment decreasing by 0.19 per cent for every 10 per cent increase in imports.

The fourth view is that international trade has little effect on employment. (Lee and Schluter 1999) analyse the effects of trade on the demand for skilled and unskilled labour in the United States and developing countries over the period 1972-1992 and argue that trade is not the main cause of changes in labour demand. The effects of wages and production on employment during the analysed period are in line with economic theory and that foreign trade policies are not sufficient to improve employment in Turkey (Polat et al., 2011) [9].

B. Regionalised Differences in the Impact of Trade on Employment

In addition to analysing foreign trade and employment in a given country as a whole, a number of scholars have further explored its regional differences. According to Frenken, (Van and Verburg, 2007), regionally uncorrelated diversity tends to dampen unemployment, as workers laid off in one declining sector may soon find jobs in other sectors in the region. (Boschma and Iammarino, 2009) conclude that trade has a significant positive impact on employment growth in Italian provinces. And except for central Italy, where trade similarity has a positive effect on employment, there is no significant growth in other regions. China's regions have different rates of economic development, and many studies have explored regional differences in trade and employment. (Zhang, 2005) finds that the employment effect of foreign trade is more significant in the East than in the Middle and West. Both exports and FDI have a significant pulling effect on employment, and the employment elasticity of both shows an increasing trend from the east to the west (Ca et al., 2009) [16]. (Xu and Tu, 2009) argue that the contribution of export openness to employment is in the order of central, western and eastern China and that the contribution of import openness to employment is in the order of eastern, central and western China.

C. Impact of Brexit and Covid-19

Brexit is a major event of historical significance on the international stage, with multiple effects on the United Kingdom, the European Union and even the world. Trade links between the EU and the UK are strong and the EU has been Britain's largest trading partner for a long time. Against the backdrop of a free trade agreement with the EU, the UK has been in a high-yielding position, and once the UK leaves the EU, it will have a serious impact on the UK's foreign trade. (Liu, 2019) argues that the UK's exit from the EU will lead to the UK negotiating with the EU, and its post-Brexit position is at a disadvantage. Once the UK leaves the EU, the tariff policy will be implemented between the EU and the UK, increasing the trade burden of the UK.

Some authors have also expressed different views, (Sun, 2022) quantitatively analysed the direct negative impact of the UK's departure from the EU on the competitiveness of the EU's trade in services. The study finds that, without considering the intervention of other factors, although the results of quantitative analysis are negative, the UK's exit from the EU gradually shows a positive impact on the EU's services trade competitiveness under the combined effect of the four mechanisms. The author concludes that the EU has fully understood the economic consequences of Brexit and has taken corresponding measures to enhance the competitiveness of its trade in services.

The major events that have affected international economic development in recent years are the Covid-19 pandemic besides Brexit. It has impacted both the state and employed workers to varying degrees. In terms of countries, the impact of Covid-19 on employment has been asymmetrical within and between countries. In particular, the countries most affected by the epidemic (Spain, Italy and the United Kingdom) are more likely to suffer the worst employment impacts due to their production specialisation and labour market institutions. As Covid-19 spread globally in the early 2020s, millions of workers around the world suddenly found themselves out of work or on leave as businesses struggled to meet costs (Kuderer *et al.*, 2020).

Through literature review and analysis, this paper proposes the following three hypotheses:

1. Imports lead to an increase in employment and exports lead to a decline in employment.
2. There is regional variability in the impact of imports and exports on employment
3. Brexit and the Covid-19 pandemic lead to a fall in EU and UK imports and exports and have a negative impact on employment

III. Empirical Analysis of the Influence of Foreign Trade on Employment

A. Static Panel Data Model

The empirical part of this paper uses panel data analysis with a sample of 27 EU countries and the UK on a monthly basis over the period 2000 to 2022. The cross-sectional sample size is 23 because data for Bulgaria, Croatia, Cyprus, Malta and Romania were not selected due to incomplete data. Dummy variables are used to examine the impact of Brexit and Covid-19.

Econometric structural models commonly used for panel data can generally be divided into two categories: static models and dynamic models. In this paper, both models are used separately to explore the proposed hypotheses. First, is a static model is:

$$LnY_{it} = \beta_0 + \beta_1 LnM_{it} + \beta_2 LnX_{it} + \beta_3 LnD_{it} + B_{it} + C_{it} + R_i + T_i + \mu_{it} \quad (1)$$

where the subscripts i and t represent the country i and month t respectively. Y_{it} is the explained variable and on the right side of the formula are explanatory variables, μ_{it} representing the error term. T_i is a time-fixed effect and R_i is a regional fixed effect, other main variables of the model are specified below.

B. Data

The research model defines the employment rate as the dependent variable. They come from employment divided number of people of working age. In the model, the employment rate is logged and is set as LnY_{it}.

The two main explanatory variables are LnM_{it} and LnX_{it}. M means import penetration and X means export penetration. In this model, M is import divided GDP, X is export divided GDP. D_{it} are control variables which contain Gross Domestic Product per capita (GDP_{it}), Consumer Price Index (CPI_{it}), industrial production index (IPI_{it}), stock exchange index (SEI_{it}), public financial assets (FA_{it}), public

revenue (PR_{it}), public expenditure (PE_{it}), manufacturing confidence index (MC_{it}), house price index (HPI_{it}) and tourist arrivals (TA_{it}).

In addition, there are two dummy variables: Brexit (B_{it}) and Covid-19 (C_{it}). To identify the influence of Brexit and Covid-19 pandemic on employment, the paper defines them as 0 if Brexit and Covid-19 did not happen while 1 means after Brexit and Covid-19.

C. Descriptive Statistics

Descriptive statistics are shown in Table 1.

Table 1. Descriptive statistics

Variable	Obs	Mean	Std. dev.	Min	Max
lnY	6,279	3.981	0.101	3.624	4.184
lnX	6,279	5.903	0.523	3.954	7.197
lnM	6,279	5.980	0.432	4.766	7.190
lnPOP	6,279	9.170	1.311	6.084	11.34
lnGDP	6,279	9.991	0.764	7.576	11.53
lnAW	6,279	10.30	0.561	8.967	11.24
lnCPI	6,279	4.604	0.244	4.000	5.640
lnIPI	6,279	4.567	0.222	3.632	5.142
lnSEI	6,279	4.511	0.496	2.602	6.596
lnFA	6,279	10.25	1.484	6.249	13.22
lnPI	6,279	8.988	1.522	5.334	11.98
lnPE	6,279	9.026	1.550	5.220	12.03
MC	6,279	−3.334	11.34	−54.70	32
lnHPI	6,279	4.653	0.220	3.730	5.191
lnTA	6,279	6.479	1.855	−0.884	16.04
Brexit	6,279	0.117	0.322	0	1
Covid19	6,279	0.0952	0.294	0	1

Table 1 represents descriptive statistics for the 23 countries that are not divided into regions, the sample size is 6279. The average of import and export penetration rates is similar, indicating that the difference between the overall export and import volumes of countries is small. However, the minimum and maximum values of import penetrations varied considerably, showing the high volatility of imports across countries. Export penetration rates are also the same as for imports. In contrast, the maximum value of the employment rate is not significantly different from the minimum value, and the standard deviation is close to zero (0.101).

D. Research Method

The choice between a Fixed Effect Model (FE) and a Random Effect Model (RE) is the first issue in the analysis of panel data models, and the choice of a different effect model can have a significant impact on the results. So it determines the choice of the fixed effect model based on the results of the Hausman test (Hausman, 1978). This paper firstly estimates model (1) using ordinary least squares and analyses the estimation results to draw basic conclusions. Then analyses the robustness of the estimation result. Afterwards, divided 25 countries into five regions based on geographical divisions and run regressions for each of them to do the differentiation analysis.

E. Dynamic Panel Data Model

Starting from the production function, the production function for each European country is written in the form of a Cobb-Douglas function:

$$Q_{it} = A_{it}K_{it}^{\alpha}L_{it}^{\beta} \tag{2}$$

where i represents Country and t means time period. Q is real output, K is capital and L is labour. A is the technology coefficient. α and β denote the output elasticity coefficients of capital and labour respectively. A profit-maximising enterprise will employ labour and capital at such a level that the product of marginal returns to labour is equal to the wage (w) and the product of marginal returns to capital is equal to its cost of use (c). Simultaneously solving this system by eliminating capital from the firm's output expression, we obtain the following expression

$$Q_{it} = A_{it}(\frac{\alpha L_{it}}{\beta}\frac{w_i}{c})^{\alpha}L_{it}^{\beta} \tag{3}$$

Taking logarithms of both sides of Eq. (3) and rearrange:

$$LnL_{it} = \gamma_0 + \gamma_1 Ln\frac{w_i}{c} + \gamma_2 LnQ_{it} \tag{4}$$

where $\gamma_0 = -\frac{LnA+\alpha Ln\alpha-\alpha Ln\beta}{\alpha+\beta}$; $\gamma_1 = -\frac{\alpha}{\alpha+\beta}$; $\gamma_2 = \frac{1}{\alpha+\beta}$

According to Greenway, Hine and Wright (1999), in an open economy, the technology coefficient A is a function of foreign trade and that the relationship between them can be written as:

$$A_{it} = e^{\delta_0 T_i}M_{it}^{\delta_1}X_{it}^{\delta_2},\ \delta_0, \delta_1, \delta_2 > 0 \tag{5}$$

In the equation, M means import penetration and X means export penetration. T is time trend, $\delta_0, \delta_1, \delta_2$ are parameters while i and t have same meaning as function (2). Use Y_{it} to represent labour L_{it}, use AW_{it} to represent average real wage and use GDP_{it} to represent Q_{it}. The final model will be:

$$LnY_{it} = \gamma_0^* - \lambda_0 T_i - \lambda_1 LnM_{it} - \lambda_2 LnX_{it} + \gamma_1 LnAW_{it} + \gamma_2 LnGDP_{it} + \varepsilon_{it} \tag{6}$$

With $\gamma_0^* = -\frac{\alpha Ln\alpha-\alpha Ln\beta}{\alpha+\beta}$; $\lambda = \frac{1}{\alpha+\beta}$; $\lambda_0 = \lambda\delta_0$; $\lambda_1 = \lambda\delta_1$; $\lambda_2 = \lambda\delta_2$

In Eq. (6) γ_0^* denotes the intercept term, ε denotes the error term and the rest of the terms have the same meaning as in the previous section. The model is a static model, thus employment in the period is affected by imports, exports and real output in the period.

In the real economy, many economic relationships are dynamic. Employment in the current period is influenced not only by exports in the current period but also by employment in previous periods. One of the advantages of panel data is that it enables the researcher to understand the dynamic adjustment process. Many empirical studies of the effects of trade employment have used dynamic models, such as those by Greenway, Hine and Wright (1999) and Kien and Heo (2009). Thus, the model of Eq. (6) is made dynamic in the sense that employment in the current period is affected by employment in the previous period, but also by the respective variables in the previous period. The order of the lagged period is denoted by a (in this paper a takes the value of 0 or 1).

This gives the econometric model to be estimated:

$$LnY_{it} = \lambda_i - \mu_0 T_i - \sum_{j=0}^{1}\lambda_{1j}LnM_{it-j} - \sum_{j=0}^{1}\lambda_{2j}LnX_{it-j} + \gamma_0 LnY_{i,\ t-1} + \sum_{j=0}^{1}\gamma_{1j}LnAW_{it-j} + \sum_{j=0}^{1}\gamma_{2j}LnGDP_{it-j} + \varepsilon_{it} \tag{7}$$

F. Research Method

Eq. (7) is a dynamic panel data model. As the lagged term of the dependent variable is used as the independent variable in the regression equation, this results in the independent variable being correlated with the error term. For example, the independent variable of the model is endogenous. Therefore, applying standard random or fixed effects to dynamic panel data would result in biased and non-consistent

parameter estimates. To address this problem, Arellano and Bond (1991) proposed the differential generalised moments (Difference GMM) estimation method. However, the differential generalised moments approach leads to a loss of some of the sample information, and when the explanatory variables are persistent in time, the validity of the instrumental variables will be reduced thus affecting the asymptotic validity of the estimation results. Later, Blundell and Bond (1998) further proposed the System Generalised Method of Moments (SGMM) estimation method, which is a modification of the Differential Generalised Method of Moments (DGM). System generalized moments can make use of the information in both the difference and level equations, thus well solving the problem of biased and non-consistent parameter estimation for dynamic panel data models. Therefore, in this paper, the (two-step) systematic generalised moments approach is used to estimate the regression model of Eq. (7).

IV. Results

A. Static Panel Data Model

The use of panel data to do regression mainly uses three common models, namely, mixed regression model, random effects model and fixed effects model, this paper uses the F-test and Hausman test to determine that this paper applies to the fixed effects model. In addition, due to the characteristics of the economic variables, as well as the lag effect, the variables may be autocorrelated. Thus, an autocorrelation test was conducted. The results showed that the p-value is approximately equal to 0, which means that there is autocorrelation in the static model. So robust standard errors were added to the fixed effects model. Table 2 shows the results of the benchmark regression.

Table 2 shows the impact of foreign trade on employment. Column (1) is the result of the FE model and Column (2) is the robust standard error. From the data, export penetration adversely affects employment in European countries with a coefficient of -0.0874. Whereas, an increase in import penetration increases employment in each country by 0.0518 per cent for every 1 per cent increase in imports/GDP. Both of them pass the 10% significance test. This is consistent with the H-O theory that EU countries and UK exports reduce labour and increase capital and imports increase labour and reduce capital as they are capital factor rich countries.

In addition to the two core variables, several other control variables pass the significance test. The effects of total population size and average wage were -0.297 and -0.128 respectively, both significantly negative. This indicates that the higher the population size, the lower the employment rate. This is due to the fact that the European economy has matured to the point where the number of jobs that the country can provide remains more or less the same. Once the population is too large, the greater the labour force, the greater the demand for jobs, and with a constant supply of jobs, the employment rate will fall. Average wages have a similar negative impact for similar reasons, as the growth in average wages exceeds the growth in demand for labour, and so leads to a fall in employment. Moreover, the limited number of high-paying jobs and the high number of job seekers lead to intense competition and many people are unable to find suitable jobs. Apart from these two variables, which have a significant negative impact on employment, the remaining GDP per capita, government revenues, the housing price index and the number of tourists all have a positive impact on employment.

Both dummy variables positively affect employment, but since only the results of the fixed-effects model passed the 10% significance test and the robustness test was not significant, the reasonableness of the results requires follow-up research and discussion

Table 2. Benchmark regression

	(1) FE	(2) FE_Robust
lnX	−0.0874***	−0.0874*
	(0.00406)	(0.0338)
lnM	0.0518***	0.0518*
	(0.00479)	(0.0383)
lnPOP	−0.297***	−0.297*
	(0.0110)	(0.138)
lnGDP	0.121***	0.121**
	(0.00523)	(0.0350)
lnAW	−0.128***	−0.128*
	(0.00575)	(0.0516)
lnCPI	0.0379***	0.0379
	(0.00573)	(0.0476)
lnIPI	0.0667***	0.0667
	(0.00359)	(0.0360)
lnSEI	0.00419**	0.00419
	(0.00135)	(0.00738)
lnFA	−0.0157***	−0.0157
	(0.00214)	(0.0181)
lnPI	0.0430***	0.0430*
	(0.00409)	(0.0162)
lnPE	−0.00850	−0.00850
	(0.00479)	(0.0218)
MC	−0.0000182	−0.0000182
	(0.0000432)	(0.000161)
lnHPI	0.115***	0.115***
	(0.00286)	(0.0191)
lnTA	0.00383***	0.00383**
	(0.000412)	(0.00132)
Brexit	0.00210*	0.00210
	(0.00229)	(0.00870)
Covid19	0.00525*	0.00525
	(0.00238)	(0.00614)
_cons	5.802***	5.802***
	(0.112)	(1.401)
N	6279	6279
R square	0.665	0.666

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

B. Robustness Test

Based on the above data, this paper applies mixed regression as well as random effects models to test the robustness of the data in this paper from the measurement approach. In addition, dummy variables were removed and re-run the fixed effects regression respectively. The results are shown in Table 3 below, the core explanatory variables of this paper are significant and pass the robustness test.

Table 3. Robustness test

	(1) OLS	(2) RE	(3) RE_Robust	(4) No Dummy
lnX	-0.0913***	-0.0737***	-0.0737*	-0.0850*
	(0.00464)	(0.00406)	(0.0311)	(0.0324)
lnM	0.0468***	0.0458***	0.0458*	0.0496*
	(0.00649)	(0.00487)	(0.0364)	(0.0368)
lnPOP	0.0512***	-0.196***	-0.196*	-0.296*
	(0.00451)	(0.00901)	(0.0968)	(0.136)
lnGDP	-0.00542***	0.117***	0.117***	0.122**
	(0.00159)	(0.00525)	(0.0337)	(0.0346)
lnAW	0.129***	-0.115***	-0.115*	-0.128*
	(0.00534)	(0.00579)	(0.0536)	(0.0514)
lnCPI	0.0211***	0.0221***	0.0221	0.0410
	(0.00460)	(0.00574)	(0.0477)	(0.0450)
lnIPI	0.0517***	0.0671***	0.0671	0.0661
	(0.00603)	(0.00365)	(0.0375)	(0.0353)
lnSEI	-0.00689*	0.00815***	0.00815	0.00432
	(0.00274)	(0.00135)	(0.00772)	(0.00732)
lnFA	0.0344***	-0.0201***	-0.0201	-0.0153
	(0.00332)	(0.00216)	(0.0177)	(0.0182)
lnPI	0.0712***	0.0463***	0.0463**	0.0404*
	(0.00949)	(0.00417)	(0.0156)	(0.0164)
lnPE	-0.145***	-0.00953	-0.00953	-0.00563
	(0.00977)	(0.00489)	(0.0227)	(0.0215)
MC	0.000929***	-0.0000897*	-0.0000897	-0.00000405
	(0.0000946)	(0.0000438)	(0.000151)	(0.000157)
lnHPI	0.0769***	0.106***	0.106***	0.118***
	(0.00518)	(0.00286)	(0.0188)	(0.0172)
lnTA	-0.0222***	0.00379***	0.00379***	0.00331*
	(0.000723)	(0.000421)	(0.00115)	(0.00156)
Brexit	0.0173**	0.00315	0.00315	
	(0.00575)	(0.00234)	(0.00888)	
Covid19	-0.0298***	0.00404	0.00404	
	(0.00604)	(0.00244)	(0.00598)	
_cons	1.782***	4.870***	4.870***	5.767***
	(0.0781)	(0.0979)	(1.050)	(1.398)
N	6279	6279	6279	6279
R square	0.487			0.665

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

C. Differentiation Analysis

In addition to the baseline regressions for 23 European countries, they are geographically divided into five regions, North, South, Centre, West and East. Then to explore the regional variability in the impact of exports and imports on employment. The results are shown in Table 4

Table 4. Differentiation analysis

	(1) North	(2) South	(3) Central	(4) West	(5) East
lnX	-0.0301	-0.0584**	-0.114	-0.0415*	-0.0631***
	(0.0344)	(0.0123)	(0.0644)	(0.0155)	(0.00175)
lnM	0.0600	0.0599*	0.107	0.0130*	-0.0172*
	(0.0329)	(0.0151)	(0.0471)	(0.0115)	(0.0310)
lnPOP	0.493	0.675**	-0.907**	0.161	-0.467
	(0.301)	(0.125)	(0.191)	(0.0822)	(0.112)
lnGDP	0.00582	0.535**	0.194	0.120**	0.0794
	(0.0396)	(0.0729)	(0.124)	(0.0211)	(0.0338)
lnAW	-0.0599	-0.355**	-0.186	−0.179	-0.0389*
	(0.0451)	(0.0706)	(0.119)	(0.0847)	(0.00843)
lnCPI	-0.452	-0.0701	0.00851	0.0129	0.0409
	(0.166)	(0.0528)	(0.0434)	(0.0648)	(0.0460)
lnIPI	0.140**	0.0682*	0.0298	−0.0353	0.0943
	(0.00629)	(0.0182)	(0.0294)	(0.0203)	(0.0348)
lnSEI	-0.0115	-0.0108	-0.00536	0.00838	-0.0307**
	(0.0107)	(0.00605)	(0.0135)	(0.0114)	(0.00289)
lnFA	-0.00904	-0.0751**	0.0557**	-0.0232	0.00467
	(0.0128)	(0.0108)	(0.0127)	(0.0253)	(0.0164)
lnPI	0.0601*	0.0116	0.0928*	0.0347***	-0.00769
	(0.0139)	(0.0111)	(0.0251)	(0.00449)	(0.0152)
lnPE	0.0168	0.00103	−0.0663	−0.0352	0.00121
	(0.0177)	(0.0154)	(0.0258)	(0.0217)	(0.0454)
MC	−0.000336*	−0.000281	0.00000359	−0.000249	0.000447
	(0.0000465)	(0.000344)	(0.000181)	(0.000127)	(0.000474)

lnHPI	0.0469	0.0967***	0.0835	0.0914*	0.215*
	(0.0409)	(0.00880)	(0.0466)	(0.0267)	(0.0480)
lnTA	0.00533*	0.00640***	0.00436	0.00148	0.00825**
	(0.00117)	(0.000720)	(0.00301)	(0.00214)	(0.000600)
Brexit	0.0376**	-0.000913	-0.0138	0.00996	-0.0112
	(0.00296)	(0.00716)	(0.0147)	(0.00754)	(0.0111)
Covid19	-0.0224	0.0352***	0.0280	-0.00678	-0.00215
	(0.00523)	(0.00332)	(0.0119)	(0.00552)	(0.00468)
_cons	0.736	-4.113*	11.35**	3.227*	6.158*
	(2.416)	(1.199)	(1.846)	(0.861)	(1.026)
N	819	1365	1638	1638	819
R square	0.796	0.875	0.832	0.678	0.859

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

First focus on the estimated results for export penetration, the coefficient on import penetration for the 23 countries is -0.0874, with a negative impact on employment. When analysed regionally, it can be seen that most regions have a negative impact on employment as in the benchmark regression. The Eastern region has the largest negative impact on employment with a coefficient of -0.0631. The North has the smallest impact but fails the significance test.

The aggregate import penetration shows that for every percentage point increase in imports/GDP, employment increases by 0.0518 per cent. The effect of import penetration on employment is significantly positive in both Southern and Western Europe, especially in Southern Europe, where the coefficient reaches 0.0599. Every 1 per cent increase in imports with the same GDP increases employment by 0.0599 per cent. Imports in Northern and Central Europe also have a positive but insignificant effect on employment. The employment impact of imports in Western Europe is significantly negative contrary to the results of the benchmark regression. An increase in import penetration does not lead to an increase in employment but instead decreases the coefficient ratio of -0.0172.

A further look at the coefficients on import penetration and export penetration by region shows that the South, West and East all pass the test of significance, except for the coefficients on the North and the Centre, which are not significant. However, as far as the coefficients are concerned, only the South's foreign trade is a catalyst for employment in the country, and as long as imports are greater than exports, employment in the South rises. The West, on the other hand, has a much larger negative impact of exports than a positive impact of imports, so when imports and exports are the same, employment in the West experiences a decline due to the negative impact of imports. The effect is more extreme in the East, where the number of imports and exports reduces employment, whether they are imports or exports.

Finally, the impact of the other control variables on employment by subregion is discussed. As can be seen from Table 4, the total population in Southern Europe has a significantly positive impact on employment, while the impact in Central Europe is significantly negative. It is possible that the population of Southern Europe behaves differently from the aggregate because of the increased labour supply in Southern Europe and the ability of the new labour force to adapt to market demand and fill the jobs that already exist. At the same time, a larger population stimulates economic growth, and a larger population creates more demand for consumption and investment. This may lead to new industries and employment opportunities, thus increasing employment. Thirdly, a larger population may bring more entrepreneurs and innovators who may create new businesses and industries, which in turn increase employment. The next variable is GDP, which is favourable to employment in either region and passed the test of significance in the South and West. The southern region has the greatest impact of GDP, with employment increasing by 0.535 per cent for every one per cent increase in GDP. This is consistent with the discussion that a larger population in the South stimulates economic growth and increases employment. In contrast to GDP, the average wage has a negative impact on employment, with the South and East passing the significance test. The consumer price index remains all insignificant, so it is not discussed. The benchmark coefficient of 0.0667 for the index of industrial production passes the significance test for Northern and Southern Europe out of the five regions, and both have a favourable impact on employment. Although the stock exchange index of the benchmark regression is not significant, Eastern Europe passes the test of significance after performing the regional differentiation analysis. The data show that a 1 per cent increase in the stock exchange index in Eastern Europe leads to a 0.0307 per cent decrease in employment. The government financial assets variable shows that government assets in Southern and Central Europe have opposite effects on employment, with 1 per cent more government financial assets in Southern Europe leading to a 0.0751 per cent decrease in employment. In contrast, 1 per cent more government financial assets in Central Europe is associated with a 0.0557 per cent increase in employment. All significant government revenue variables in the five regions turn out to be positive, indicating that for the most part government revenue still has a favourable impact on employment. Only the coefficient of the manufacturing confidence index for Northern Europe passes the test of significance, where an increase of 1 in citizens' confidence in the manufacturing sector leads to a decrease in employment by 0.000336 per cent. This indicates that the focus of economic development in Northern Europe is not on manufacturing. The effect of the housing price index on employment is positive in all five regions, indicating that people are more inclined to work more when housing prices rise. This is due to the fact that higher house prices stimulate the construction and real estate sectors, as higher house prices may encourage more housing construction and transaction activity. This may lead to an increase in the number of jobs associated with these industries. In addition, if higher housing prices cause people to feel wealthier, they may be more likely to spend and invest, which may contribute to economic growth and hence employment. Traveller arrivals also have a

significant positive effect on employment, as data from Northern, Southern and Eastern Europe show that higher arrivals are associated with higher employment. This indicates that the development of tourism has provided a good boost to the economy and employment.

The dummy variables show that Brexit has a significant impact on employment only in Northern Europe, with a coefficient of 0.0376, indicating that Brexit did not have a negative impact on employment in Northern Europe, but rather increased employment opportunities. The Covid-19 pandemic has a significant positive impact on employment only in Southern Europe, with a coefficient of 0.0376, indicating that Brexit did not have a negative impact on employment in Northern Europe, but rather increased employment opportunities.

D. The Impact of Brexit and Covid-19

The previous benchmark regressions show that the impact of Brexit and the Covid-19 pandemic on employment is positive, with coefficients of 0.00210 and 0.00525 respectively, and both pass the 5 per cent significance test. And whether Brexit and Covid-19 affect the relationship between exports and imports and employment could not be explored, so the paper divided the data into before and after Brexit (Before B/After B), before and after Covid-19 (Before C/After C). Then, used robust standard errors and ran separate fixed-effects regressions. Table 5 reports the regression results.

Table 5. The impact of Brexit and the Covid-19 pandemic

	(1) FE_Robust	(2) Before B	(3) After B	(4) Before C	(5) After C
lnX	-0.0874*	-0.0954*	-0.0163	-0.0922*	-0.00797
	(0.0338)	(0.0357)	(0.00972)	(0.0343)	(0.0147)
lnM	0.0518*	0.0550*	0.0365**	0.0528*	0.0252
	(0.0383)	(0.0390)	(0.0118)	(0.0384)	(0.0173)
lnPOP	-0.297*	-0.277	0.426	-0.279	0.279
	(0.138)	(0.141)	(0.215)	(0.141)	(0.300)
lnGDP	0.121**	0.133***	0.0810*	0.128***	0.0688
	(0.0350)	(0.0298)	(0.0377)	(0.0318)	(0.0346)
lnAW	-0.128*	-0.128*	-0.256***	-0.128*	-0.248***
	(0.0516)	(0.0471)	(0.0528)	(0.0483)	(0.0574)
lnCPI	0.0379	0.0144	0.0212	0.0196	0.0379
	(0.0476)	(0.0429)	(0.0343)	(0.0444)	(0.0730)
lnIPI	0.0667	0.0807*	-0.0196	0.0775*	-0.0312*
	(0.0360)	(0.0359)	(0.0128)	(0.0359)	(0.0126)
lnSEI	0.00419	0.00667	0.0301*	0.00639	0.0378**
	(0.00738)	(0.00782)	(0.0115)	(0.00767)	(0.0126)
lnFA	-0.0157	-0.00903	0.0224	-0.0109	0.0161
	(0.0181)	(0.0185)	(0.0204)	(0.0185)	(0.0253)
lnPI	0.0430*	0.0435**	0.0419*	0.0420*	0.0453*
	(0.0162)	(0.0152)	(0.0150)	(0.0151)	(0.0161)
lnPE	-0.00850	-0.0167	-0.0317	-0.0127	-0.0351
	(0.0218)	(0.0234)	(0.0161)	(0.0234)	(0.0173)
MC	-0.0000182	-0.000138	0.000121	-0.0000882	0.000122
	(0.000161)	(0.000177)	(0.000189)	(0.000172)	(0.000200)
lnHPI	0.115***	0.108***	-0.0293	0.109***	-0.0182
	(0.0191)	(0.0203)	(0.0386)	(0.0198)	(0.0469)
lnTA	0.00383**	0.00511***	0.00193*	0.00486***	0.00216*
	(0.00132)	(0.00116)	(0.000711)	(0.00114)	(0.000816)
Brexit	0.00210			0.00736	-0.00728*
	(0.00870)			(0.0102)	(0.00331)
Covid19	0.00525	0.0243***	0.00107		
	(0.00614)	(0.00454)	(0.00355)		
_cons	5.802***	5.591***	1.458	5.651***	2.839
	(1.401)	(1.380)	(1.789)	(1.394)	(2.716)
N	6279	5543	736	5681	598
R square	0.666	0.656	0.649	0.664	0.521

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Column (1) shows the base regression and the other four columns show the regressions before and after Brexit and before and after the Covid-19 pandemic. It can be seen that in both the base regression and the other time-period regressions, the impact of export penetration on employment is negative and the impact of imports is positive. Comparing the coefficients of the impact of imports on employment before and after Brexit it can be seen that although the impacts are all positive, the impact of import penetration on employment after Brexit becomes smaller by about 0.02 and both pass the significance test. It is difficult to define the impact of imports as the data on imports passing the significance test is incomplete.

Then there are other variables, the coefficient of GDP per capita variable after Brexit has decreased more significantly and its impact on employment has decreased from 0.133 to 0.0810. Brexit and Covid-19 have changed the impact of average wage on employment to a large extent. The coefficient of the impact of average wage on employment is -0.128 in both the base regression and before the event, while after Brexit and Covid-19, the impact of average wage on employment almost doubles to -0.256 and -0.248. indicating that the higher the average wage is, the lower the employment is, and that this is even worse after Brexit. The effect of the

stock exchange index on employment is not significant in the underlying regression, whereas the post-Brexit and post-Covid-19 effects pass the significance test. The coefficients indicate that a rise in the stock exchange index positively affects employment. The effect of government revenue on employment is stable, ranging from 0.04 to 0.05 both in the base regression and post-Brexit. In addition, the coefficient on the impact of passenger arrivals declines significantly after Brexit, with the increase in employment for each 1 per cent increase in arrivals changing from 0.00511 per cent to only 0.00193 per cent.

E. Dynamic Panel Data Model

The Xtabond2 command available on the official Stata website was used to perform the system generalised moment estimation for this paper. From the regression test statistics, the p-value of Sargan's test is 0.85, which is greater than 0.1, indicating that the instrumental variables are valid. Thus, the instrumental variables and the error term are not different. The p-values of AR (1) and AR (2) are 0.0515 and 0.504, respectively, with AR (1) being less than 0.1, and AR (2) being greater than 0.1. This indicates that there is no second-order autocorrelation of the residuals after the first-order difference and the model setting is reasonable. The estimation results are shown in Table 6.

Table 6. Dynamic panel data model results

VARIABLES	GMM lnY
LnY_{it-1}	0.750*** (0.202)
LnX_{it}	-0.078** (0.039)
LnX_{it-1}	0.027 (0.047)
LnM_{it}	0.049* (0.040)
LnM_{it-1}	-0.011 (0.047)
$LnGDP_{it}$	0.011 (0.051)
$LnGDP_{it-1}$	-0.020 (0.049)
$LnAW_{it}$	-0.209** (0.103)
$LnAW_{it-1}$	0.198 (0.173)
Constant	1.291 (2.346)
AR (1) AR (2)	0.0515 0.504
Sargan	0.85
N	6279

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The estimates in Table 6 show that exports have a negative effect on employment in the EU and the UK, while imports have a negative effect, both of which are statistically significant, which is consistent with the static panel regression results. Other things being equal, a 1 per cent increase in export penetration reduces employment by 0.078 per cent, suggesting that an increase in exports washes out employment. For every 1 per cent increase in import penetration, employment increases by 0.049 per cent. This indicates that exports have a strong pulling effect on employment in China. In terms of the degree of impact, the impact of imports on employment is much smaller than the impact of exports. In addition, the estimation results show that exports and imports in the previous period do not have a significant impact on employment in the current period, indicating that the impact of both imports and exports on employment is manifested in the current period. The regression results also show that employment in the previous period has a significant impact on employment in the current period, with a regression coefficient of 0.750. That is to say, all other things being equal, if employment in the previous period increases by 1 per cent, employment in the current period will increase by 0.75 per cent, indicating that there is a very large inertia in employment. This means that it is necessary to use a dynamic model to incorporate the lagged terms of the independent variables into the regression model. It also implies that the estimation results using the static model will have some bias. The empirical results also show that the average wage has a significant negative impact on employment, with a 1 per cent increase in the average wage leading to a 0.209 per cent decrease in the employment rate, all else being equal.

V. Conclusions

This paper empirically analyses the employment effects of countries' foreign trade using panel data for selected EU countries and the UK. Both for the static and dynamic panels, the results show that exports have a negative effect on employment across European countries and imports have a positive effect on employment. Besides, average wages have a negative effect on employment across countries. The results of the static panel also show that the larger the population size of the country, the more likely it is to cause employment to fall. Government revenue, the housing price index and the number of travellers have a significant contribution to employment. The results of the dynamic panel show that employment in the previous period has a significant effect on employment in the current period.

Apart from the panel analysis for all countries, the paper also conducts a regionalised difference analysis. The results show that exports negatively affect employment in all five regions but to varying degrees. The results for imports, on the other hand, are markedly different, with exports increasing employment in all four regions except the Eastern region, where it is the only region that significantly reduces employment. Population size in the Southern region leads to a significant positive impact on employment, while the baseline analysis shows a negative one. The other variables with significant results all show a uniformly positive or negative impact on employment across regions, with the extent of the impact requiring specific analysis.

Brexit and Covid-19 do affect the role of trade on employment and this role is negative. The positive impact of imports on employment becomes smaller and more imports are needed to get the same increase in employment as before Brexit. In addition, the negative effect of average wages on employment increases and the positive effect of the number of travellers on employment decreases.

Conflict of Interest

The authors declare no conflict of interest.

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