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Brexit Spillovers through International Trade and Foreign Investment: Empirical Evidence from EU-27 and the UK

Summary: This study examines the Brexit spillovers upon the European Union Member States (MS) (EU-27) and the UK through two fundamental freedoms of regional integration: goods and services (international trade), and capital (foreign investment, FDI). We have applied cluster analysis and structural equation modelling on a strongly balanced panel of EU-27 and the UK. Both techniques explore two scenarios that focus on the performances achieved by the EU-MS in terms of GDP per capita and GDP growth, under the impact of trade and FDI, before and after the Brexit (1995-2019 and 2020-2025 periods). Our results show that the UK's economy will be affected both related to GDP growth and GDP per capita levels, particularly on the short-run. The EU-27 impact largely differs across countries and types of international activities, being decisively influenced through the FDI relations. Overall, the spillovers induced by international flows are positive, but significantly diminished after the Brexit.

Keywords: Brexit, Trade, Foreign direct investment, Econometric procedures, European Union.

JEL: F15, F21, F43, F47.

Globalisation 2.0 (Paul Hirst and Grahame Thompson 2002) and the regional integration process have brought significant challenges for the European economies that are facing a reconfiguration of the European Union (EU) after the Brexit vote in June 2016.

Among the inquiries that considered the Brexit implications for the EU, to the best of our knowledge, only one research has analysed each country's configuration with respect to the effects of Britain's leaving the EU (Gregor Irwin 2015); the other studies have considered the effects on the EU as an integrated region and did not follow an individualized approach on each MS. Based on previous research limitations, we assess the Brexit spillovers upon *each of the EU-27 MS and the UK (cluster analysis)*, *as well as overall EU-28 (SEM procedures)*, through *two fundamental freedoms of regional integration*, namely: (i) free movement of goods and services - *international trade*; and (ii) capital - *foreign direct investment (FDI)*. Unlike previous studies and in line with Irwin's (2015) limitations (the analysed period was up to 2015), we have configured a panel of EU-27 MS and the UK, analysed during 1995-2019 period (2019

being the first milestone for the Brexit negotiations that have started in 2017) and 2020-2025 period (extrapolation).

The paper is structured as follows: Section 1 presents a substantiated description of the specialised literature; Section 2 details the methodology and data used in the empirical analysis, being pursued by discussions of the obtained results in Section 3, and concluding remarks in Section 4. A large amount of information and empirical proofs are listed in the Appendix.

1. Literature Review

Although relatively recent, the UK's decision to leave the EU has generated numerous scenarios of analysis made by specialists regarding its effects on multiple levels (Appendix, Table A1), both before and after the decision vote (June 2016).

While various studies shed significant lights on the Brexit effects (in terms of trade, foreign direct investments, labour migration, fiscal implications, living standards), they were however not free from limitations. Most of the studies have analysed the Brexit effects only for the UK (e.g. Nigel Pain and Garry Young 2004; Nicholas Crafts 2016; Swati Dhingra et al. 2016), yet fewer studies took into account the effects on both the UK, and the EU-27 Member States (MS). Previous researches have revealed that the Brexit effect will be predominantly induced through international flows, trade (Pain and Young 2004; Stephen Booth et al. 2015; Irwin 2015; Dhingra et al. 2016; European Commission 2016; Rafal Kierzenkowski et al. 2016; Yaghoob Jafari and Wolfgang Britz 2017), foreign direct investment - FDI (Pain and Young 2004; Irwin 2015; European Commission 2016; Kierzenkowski et al. 2016; Jafari and Britz 2017), labour mobility and migration (Booth et al. 2015; Irwin 2015; Iain Begg and Fabian Mushövel 2016; Kierzenkowski et al. 2016; Jafari and Britz 2017; Marta C. Suciu, Mirela Cristea, and Gratiela G. Noja 2018), FDI projects (Mihaela Simionescu 2016), fiscal implications, liberalisation and regulation, industrial policy, financial services, uncertainty, living standard (income) and confidence.

Thus far, as early as 2004, Pain and Young (2004) analysed the effects for the UK as a result of Brexit on four pillars: FDI reduction; increasing barriers to trade in relation with the EU, fiscal effects as a result of reducing transfers to the EU, and lower food prices. By applying a set of simulations hinged on the National Institute model of the UK's economy (NiDEM) compared with a baseline model of no exit, their results showed that "the withdrawal from the EU would mean that the level of output in the UK economy would be $2\frac{1}{4}$% permanently lower than it otherwise would have been" (Pain and Young 2004, p. 406).

Booth et al. (2015) assessed the Brexit effects upon the UK's economy through trade, migration and regulations. The authors have applied a Computable General Equilibrium (CGE) model using four scenarios and obtained the following results: the 1st scenario, when UK does not negotiate a new agreement with the EU, is the worst one for all variables, with a loss of 2.2% of GDP; the 2nd scenario is when the UK establishes a Free Trade Agreement (FTA) with the remaining EU MS, generating 0.80% of GDP loss; the 3rd one is when the UK establishes an FTA with the EU, that it combined with a unilateral approach to free trade with the rest of the world, with

positive spillovers reflected in a 0.64% increase of GDP; and in the 4th scenario, the UK can avoid any contribution to the EU budget, gaining 1.55% of GDP. Also, considering different scenarios of what policies the UK adopts following Brexit, Dhingra et al. (2016) investigated the effects upon trade and living standard (income). The authors have estimated that the Brexit effects on "trade and the UK's contribution to the EU budget would be equivalent to a fall in income of between 1.3% and 2.6% (£850 to £1,700 per household per year) … the long-run effects of Brexit on productivity, the decline in income increases from 6.3% to 9.5% which is about £4,200 to £6,400 per household per year)" (Dhingra et al. 2016, p. 10). Crafts (2016) investigated the Brexit impact upon the UK's GDP and entailed ambiguous resulting outcomes that largely depend on the terms negotiated. In another approach, the Brexit effects related to confidence, trade, FDI, skills, immigration, and deregulation for the UK were investigated by Kierzenkowski et al. (2016) for the near term (until 2020) and longer term (until 2030). They found that by 2020 (near term), GDP would be over 3% smaller than continued EU membership and over 5% smaller by 2030 (longer term). "In the longer term, structural impacts would take hold through the channels of capital, immigration and lower technical progress" (Kierzenkowski et al. 2016, p. 5).

One of the most comprehensive studies was conducted by Irwin (2015) in which he analysed the Brexit effects on the UK and the other EU countries, based on multiple metrics score, following the impact through ten channels: trade, FDI, liberalisation and regulation, industrial policy, immigration, financial services, trade policy, international influence, budget, uncertainty.

The main effects induced by the Brexit upon the remaining EU-27 economies (Table 1) were grouped into four categories considering the impact intensity, as follows: very high impact for three countries (Netherlands, Ireland, Cyprus), due to the geographic proximity, tight trade, investment, and financial relations, close trade policy objectives; high/significant impact for 14 countries, the most exposed in this respect being Germany (commercial and investment interests), Sweden (close policies) and Belgium (close trade links); medium impact (of the niche) for six countries, the most exposed being France (trade, investment, financial links) and Poland (migration); and low impact for four countries (Italy, Croatia, Romania, Slovenia), considering geographical distance, different cultures, policies, and limited trade relations.

Another study that approached the Brexit effects both for the UK and the EU was the one undertaken by Begg and Mushövel (2016), in which they conducted a debate on the main contributions of the findings and conclusions of various economists, mainly: Centre for Economic Performance (CEP), National Institute of Economic and Social Research (NIESR), HM Treasury (Her Majesty's Treasury), Open Europe, PricewaterhouseCoopers (PwC), Oxford Economics, Lyons, and Minford. Thus, they analysed the long-term and short-term effects on GDP, jobs, public finances and migration. Their main findings are: (i) *long-term*: a loss of GDP, with estimates ranging from a 4% gain (according to Minford) to nearly 10% (according to CEP and NIESR); (ii) *short-term*: there is a consensus among economists, being estimated a short-term negative shock to the EU economy; a lower level of employment; saving on its current payments into the EU budget; positive and negative effects for migration (some migrants will remit a part of their income to their home countries).

Table 1 BREXIT Effects upon the Remaining EU-27 Economies, 2013-2015, According to Irwin's Findings

Impact intensity	EU-27 MS	Comments
Very high	Netherlands, Ireland, Cyprus	Geographic proximity, tight trade, investment and financial relations, close trade policy objectives
High/ significant	Portugal, Greece, Malta, Sweden, Denmark, Czech Republic, Belgium, Latvia, Lithuania, Germany, Luxembourg, Slovak Republic, Spain, Finland	The most exposed are Germany (commercial and investment interests), Sweden (close policies) and Belgium (close trade links)
Medium (of the niche)	Estonia, France, Hungary, Poland, Bulgaria, Austria	The most exposed are France (trade, investment, financial links) and Poland (migration)
Low	Italy, Croatia, Romania, Slovenia	Geographical distance, different cultures and policies, limited trade relations

Source: Compiled by authors from Irwin (2015, p. 31).

In the same framework of analysis of the Brexit effects related to the labour markets, financial markets, inflation, investment, trade, uncertainties, risks, the European Commission (2016) conducted a study for the UK, Eurozone, EU-27 and EU-28. The analysis was made on two scenarios, "mild" and "severe", for 2016 and 2017, respectively. The highest loss in terms of GDP growth after the referendum was estimated for the UK (-0.9% considering the mild scenario, and -2.6% for the severe scenario), and the lowest, for the Eurozone Area and EU-27 (each of them, -0.2% in case of a mild scenario, and -0.5% in a severe scenario) (European Commission 2016, p. 14). The study is complex, it considers both the UK and the EU, however it approaches the effects on the EU as a whole and not separately on each MS.

As a novelty with regard to the channels investigated, Simionescu (2016) examined the effects for the UK through FDI projects. Simionescu (2016, p. 1) found that "Brexit significantly and negatively affects the new jobs created in FDI projects" for regions from the whole world. The combination of three potential consequences of Brexit - trade, labour and population (immigration), and FDI, analysed using the Computable General Equilibrium model in manufacturing sectors in the UK, revealed that "total output for the UK economy decreases by about -3.36%" (Jafari and Britz 2017, p. 15). Using cross-country evidence and illustrative scenarios, Jonathan Portes and Giuseppe Forte (2017) researched the impact of employment, wages, and growth to the UK's economy. They found that the decreases in migration flows "are likely to have a significant negative impact on the UK's GDP *per capita* (and total GDP), with marginal positive impacts on wages in the low-skill service sector" (Portes and Forte 2017, p. S31). On the contrary, Suciu, Cristea, and Noja (2018) found that, in the Brexit framework, immigration will induce positive effects on the labour market performance (employment) and economic growth, for ten EU countries most targeted by migrants.

As a result of our substantiated literature review, it would be appropriate to state that there are various studies accounting for the Brexit effects both on the UK (most studies), and the EU MS (fewer), long before the UK's vote for leaving the EU (June 2016) (e.g. Pain and Young 2004). The main aspects analysed by authors were trade, foreign direct investment, migration, and fiscal implications. We have identified a

single study that analysed the impact of Brexit on the UK and each of the EU MS, considering a set of ten factors for analysis (Irwin 2015). We must note that this study refers to the 2013-2015 period, without any simulations of further impacts.

The main finding of the previous studies, at least for the following years, is that Brexit will largely affect the UK, rather than the EU-27 MS. The effects would depend on the new relations established and terms negotiated by the UK with the EU-27. However, in the era of Globalisation 2.0., which fosters trade and investment agreements among countries (developed and developing ones), but also brings numerous uncertainties (such as catastrophic events due to climate change, prevalence of disease, epidemics, demographic pressures) (Hirst and Thompson 2002), there are several unknown variables that cannot yet be captured as proxies in the macro-econometric models, thus, the aggregated macroeconomic impact is difficult to quantify.

In addition to being a frontier study that highlights the Brexit effects on the UK, each EU-27 MS (cluster analysis) and overall the EU-28 (SEM models), our study broadens the understanding about the spillover effects induced by the free movement of goods and services (international trade) and capital (FDI), upon the economic activity (GDP *per capita* and GDP growth). Thus, firstly, we have accounted for previous data in trade and FDI relationships, and their potential for influencing welfare levels and economic growth within the EU-28 (1995-2016). Second, we have used this history to approximate further widespread spillover effects of international flows (extrapolated for 2017-2019 throughout the Brexit negotiations, and further for 2020-2025), assuming that existing trends will continue after the Brexit official deal, based on global value chains (Jyrki Ali-Yrkkö and Tero Kuusi 2019; Hylke Vandenbussche, William Connell, and Wouter Simons 2019).

2. Methodology and Data

To ensure a high level of data comparability across selection (between countries), we have *standardised the indicators* in the initial phase of our research, according to the Organisation for Economic Co-operation and Development's (OECD) methodology (OECD 2005), as described in Equation (1).

$$y_i = \frac{x_i - mean}{sd}, \tag{1}$$

where: "x_i represents the crude value of the indicator; and *sd* is the standard deviation".

Through the standardisation procedure, we have attained a reordering of indicators' integers that upturn the accuracy of the comparison between the countries considered in the panel data analysis. Therefore, the resulting compounded indicators are more reliable to examine the relationship and interdependencies between trade, FDI and the economic activity, as main vectors of the BREXIT spillovers. In addition, we have laid out the *linear extrapolation* for the values of the considered variables during 2017-2025 period.

Cluster forming and analysis is configured through the *Ward method* (*ward-slinkage*) specific for hierarchical clusters, by using the standardised values of the indicators, "not without limitations though, because the standardisation method tends to reduce the variability (distance) between clusters" (Rosie Cornish 2007, p. 2). This

method "makes a global analysis of statistical units using a high number of characteristics" (Daniela E. Dănăcică 2006, p. 46) and "attests that the distance between two clusters, A and B, is given by how much the sum of squares will increase when they are cumulated".

The Brexit impact overall the EU-28 was further analysed through specific macro-econometric models. We have mainly applied ***structural equation modelling (SEM)*** in order to assess and explore the links (direct, indirect, total) between international flows (trade and investments) and GDP *per capita*/GDP growth. SEM depicts "an advanced technique of multivariate data analysis, used to design, test and estimate causal relations between selected variables" (Suciu, Cristea, and Noja 2018, p. 119). Equation system (2) encompasses the general outline setting of the SEM model.

$$\begin{cases} b_{11}\, y_{2t} + ... + b_{1m}\, y_{mt} + c_{11}\, x_{1t} + ... + c_{1n}\, x_{nt} = \varepsilon_{1t} \\ b_{21}\, y_{2t} + ... + b_{2m}\, y_{mt} + c_{21}\, x_{1t} + ... + c_{2n}\, x_{nt} = \varepsilon_{2t} \\ ..... \quad .. \\ b_{m1}\, y_{1t} + ... + b_{mm}\, y_{mt} + c_{m1}\, x_{nt} + ... + c_{mn}\, x_{nt} = \varepsilon_{mt} \end{cases} \tag{2}$$

"where: t is the number of observed time period; b_{ij} represents the y_{ij} endogenous variable's parameters; c_{ij} are the x_{ij} exogenous variable's parameters, $i = 1,..., m; j = 1,..., n$" (Suciu, Cristea, and Noja 2018, p. 119).

Hence, we have considered the following ***variables,*** selected on the groundings of previous literature and in line with our research objectives:

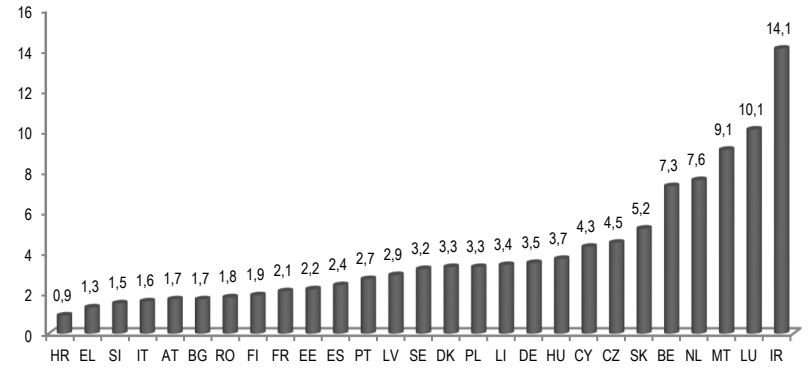
(i) *Economic activity and other specific indicators:* GDP *per capita* (GDP_cap) (Euro), GDP growth rate (GDP_growth) (%); annual net earnings of a two-earner married couple with two children (EARN) (Euro); educational level (both general and vocational) reflected through the educational attainment for upper secondary and post-secondary non-tertiary education (levels 3 and 4) and tertiary education (levels 5-8) and the participation rate in education and training (EDU); expenditures on research and development (applied research, and experimental development, both public and private) as a percentage of the GDP (RD_exp);

(ii) *International trade*: total exports (X); export growth rate (X_gr); exports of high tech goods and services (HT_X); exports of Information and Communications Technology goods and services (ICT_X); imports (M); imports growth rates (M_gr); the openness degree (OD);

(iii) *International investment: inflows* in absolute terms (FDI_i), and growth rate (FDI_i_gr) and *outflows* in absolute terms (FDI_o), and growth rate (FDI_o_gr).

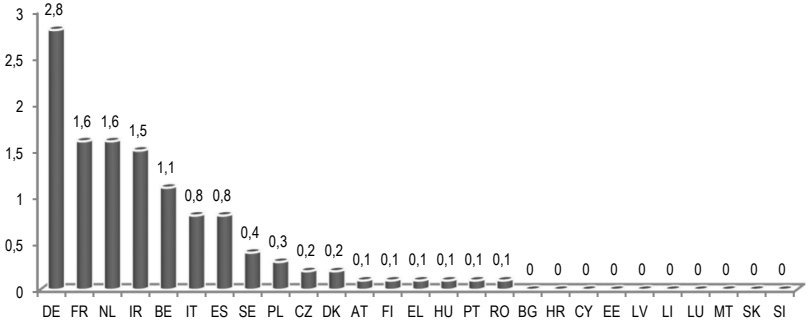
Considering *international trade*, the highest contribution of exports to the UK in exporter's GDP during 2014-2015 was accounted by Ireland (IE), Luxembourg (LU) and Malta (MT). Smaller extents are for Croatia (HR), Greece (EL) and Slovenia (SI) (Figure 1). UK's exports, as percentage of UK's GDP, were mostly directed towards Germany (DE), France (FR) and Netherlands (NL) (Figure 2).

International investment (FDI) in the UK (inward), measured as percentage of UK's GDP in 2014-2015 (before the Brexit referendum in 2016), came mostly from the Netherlands (NL), Luxembourg (LU) and Cyprus (CY) (Figure 3). *UK's outward FDI projects* were also mainly deployed in the Netherlands (NL), Luxembourg (LU) and France (FR) (Figure 4).



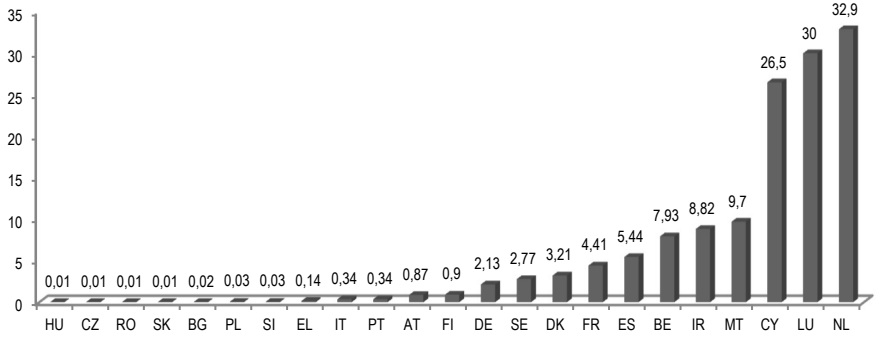
Source: Own process based on Charles Wyplosz (2016, p. 4) and European Commission (2017).

Figure 1 Intra-EU Trade Links with the UK: Exports to the UK (Import UK) (% of GDP of These Countries)



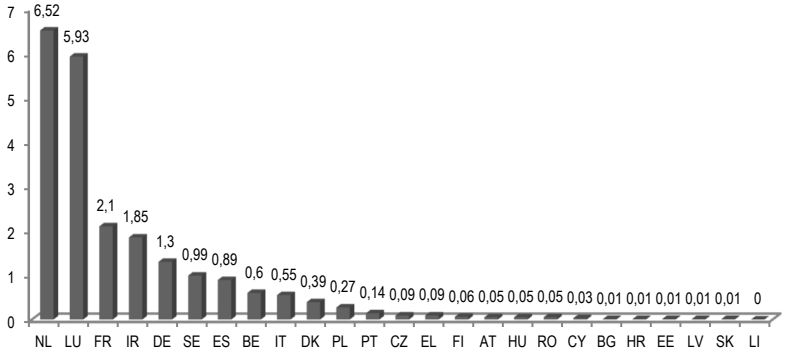
Source: Own process based on Wyplosz (2016, p. 4) and European Commission (2017).

Figure 2 Intra-EU Trade Links with the UK: Imports from the UK (Export UK), 2014-2015 (% of the UK's GDP)



Source: Own process based on Wyplosz (2016, p. 6) and European Commission (2017).

Figure 3 Foreign Direct Investment in the UK (Inward), 2014-2015 (% of the UK's GDP)



Source: Own process based on Wyplosz (2016, p. 6) and European Commission (2017).

Figure 4 Foreign Direct Investment from the UK (Outward), 2014-2015 (% of the UK's GDP)

The general panel (strongly balanced) configured within our empirical analysis comprises the current EU-28 MS, analysed during 1995-2019 and 2020-2025, with a total of 868 observations for each considered variable (Appendix, Table A2). The main databases used for collecting the data are European Commission (2017)[1], World Bank (2017)[2], UNCTAD – United Nations Conference on Trade and Development (UNCTADstat 2017)[3].

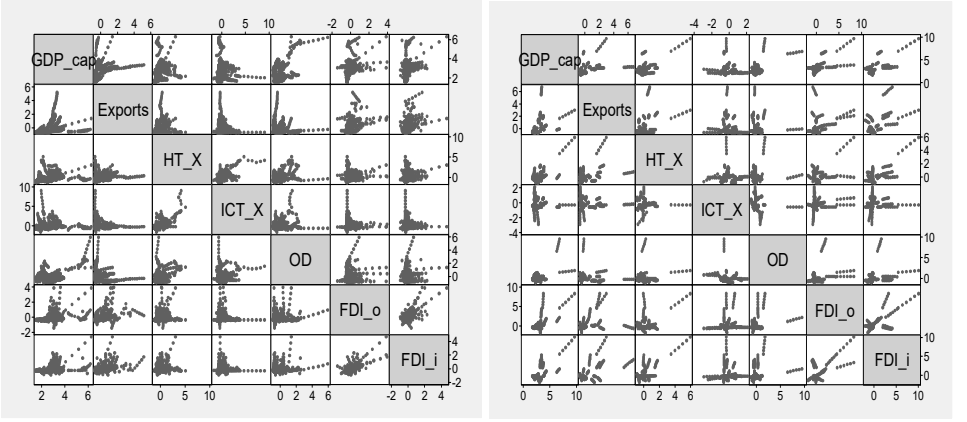
3. Results and Discussions

3.1 Trade and FDI Cluster Analysis Results for the Impact upon the Economic Activity

The cluster analysis was performed based on *two scenarios*, (i) one focusing on the performances achieved by the EU-28 MS *in terms of GDP per capita* under the impact of exports (total – X, high tech – HT_X, Information and Communications Technology – ICT_X), openness degree (OD) and FDI (both inward – FDI_i, and outward – FDI_o), while the (ii) second scenario takes into account the differences between the EU-28 MS related to *GDP growth rates* if we consider the variations in international flows (export growth rate – X_gr, import growth rate – M_gr, FDI inflows growth – FDI_i_gr, and FDI outflows growth – FDI_o_gr). In the second scenario we have also used two control variables related to education (EDU) and research and development expenditures (RD_exp). All the clustering procedures were applied on two separate time periods/sub-panels (before and after the Brexit), respectively during 1995-2019 and 2020-2025 periods.

[1] **European Commission.** 2017. Eurostat Database. http://ec.europa.eu/eurostat (accessed August 28, 2017).
[2] **World Bank.** 2017. World Development Indicators. https://data.worldbank.org/indicator (accessed October 17, 2017).
[3] **United Nations Conference on Trade and Development.** 2017. UNCTADstat. http://unctadstat.unctad.org/EN/ (accessed September 04, 2017).

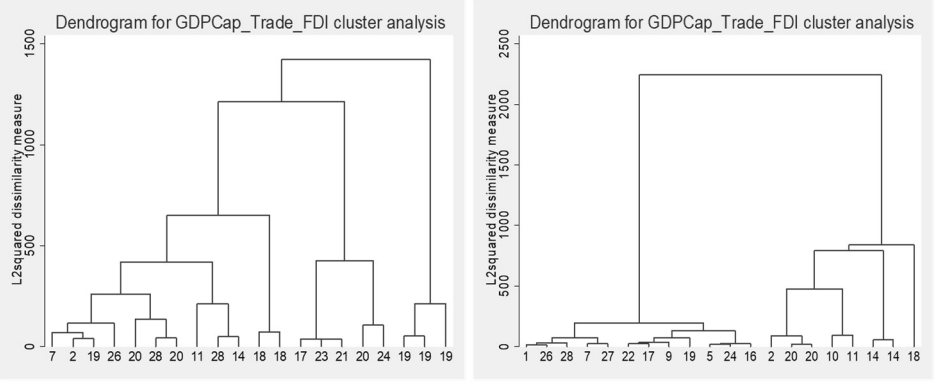
The results obtained after applying the Ward method specific for hierarchical clusters according to the credentials of our *first scenario* (impact of trade and FDI upon GDP *per capita* levels for EU-28 MS) are synthesised in Figure 5, Table 2 and detailed in the Appendix (Table A3).



Source: Authors' research.

Figure 5 Correlation Matrixes Associated with the Cluster Analysis for the Impact of Trade and FDI upon GDP per capita: 1995-2019 (Left) and 2020-2025 (Right)

In order to set the number of clusters we have used the Calinski-Harabasz criterion (cluster stop) and the method of graphical representation through dendrogams (Figure 6 and Figure 8).



Source: Authors' research.

Figure 6 Dendrograms Associated with the Cluster Analysis for the Impact of Trade and FDI upon GDP per capita: 1995-2019 (Left) and 2020-2025 (Right)

Five clusters of EU-28 MS have resulted from the analysis, and reveal the dominant position of Luxembourg with the highest GDP *per capita* levels on both time

periods considered, mainly due to an increased trade openness degree, as well as to large inward and outward FDI, especially after the Brexit (2020-2025).

Another important issue, revealed by the clustering results, is related to Ireland's position after the Brexit. Thus, by maintaining its trade and FDI relations with both EU-27 and the UK, Ireland could turn this outcome into a positive one. Compared to other studies (e.g. Irwin 2015) that place Ireland in a particular group of countries with a very high exposure to Brexit, due to geographic proximity, tight trade, investment and financial relations, close trade policy objectives, our results highlight a refocus of Ireland's economic policy that could lead to increased levels of total and high tech exports, as well as to large FDI during 2020-2025 period, with extremely important positive spillovers and increased GDP *per capita* levels.

Table 2 Clusters Associated with the Impact of Trade and FDI upon GDP per capita

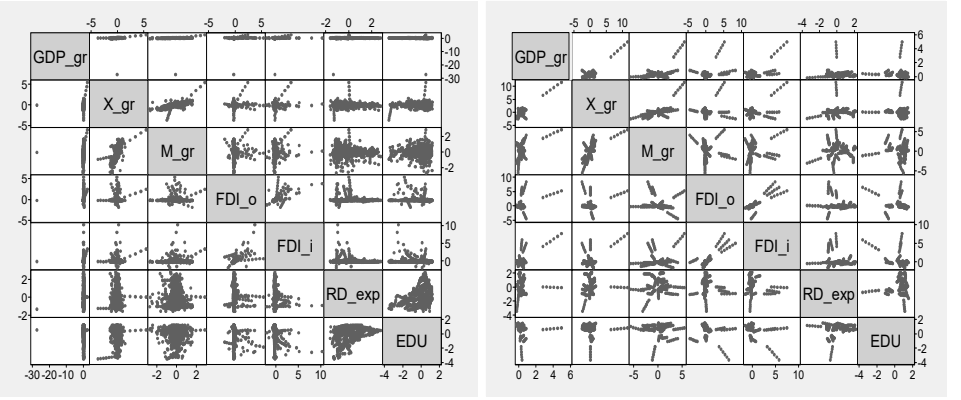
Clusters (C) 1995-2019		Cluster modelling - Ward method		Clusters (C) 2020-2025	
		GDP per capita (avg. level)	GDP per capita (avg. level)		
C1	Austria, Denmark, Finland, France, Germany, Italy, Spain, United Kingdom	High (mainly due to increased total and HT exports)	Medium to low (low performances for all considered indicators)	Austria, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Greece, Hungary, Italy, Latvia, Lithuania, Malta, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom	C1
C2	Luxembourg	Very high (mainly due to increased OD and FDI inwards)	High (mainly due to increased levels of FDI inwards and outwards)	Belgium, Netherlands	C2
C3	Belgium, Bulgaria, Croatia, Cyprus, Greece, Hungary, Lithuania, Portugal, Poland, Romania, Slovenia	Low (low performances for all considered indicators)	High (mainly due to large total and HT exports)	France, Germany	C3
C4	Czech Republic, Estonia, Latvia, Netherlands, Slovak Republic, Sweden	Medium (mainly due to high HT and ICT exports)	Very high (increased levels of total and HT exports, large FDI)	Ireland	C4
C5	Ireland, Malta	Medium to low (mainly due to high HT and ICT exports)	Very high (increased OD, large inwards and outwards FDI)	Luxembourg	C5

Source: Authors' research.

At the same time, the Netherlands and Belgium are placed in the second cluster (C2) in the scenario of GDP *per capita* impacts for the 2020-2025 period (Table 2), registering *high performances,* mainly due to increased levels of FDI inwards and outwards. Hence, these two countries could benefit from significant upwards in FDI after the Brexit compared to the 1995-2019 period, possibly due to an increased stability, new opportunities, and low levels of uncertainty as perceived by foreign investors, but also through the global value chains. Opposite, countries with high performances until 2020 (C1 cluster for the 1995-2019 scenario, namely Austria, Denmark, Finland, Italy, Spain, and the UK, except Germany and France) will register lower outcomes after the Brexit negotiations (C1 cluster with medium to low performances in the 2020-2025

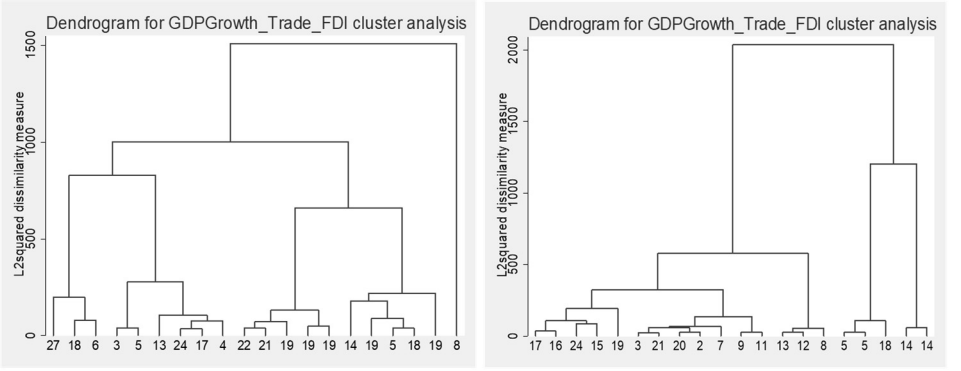
scenario, for all considered indicators). Germany and France will consolidate their outstanding trade position by benefiting from large total and high-tech exports, with significant positive effects on the GDP *per capita* (C3 cluster with high performances in the 2020-2025 scenario).

The results obtained after applying the Ward method specific for hierarchical clusters according to the credentials of our *second scenario* (impact of trade and FDI growth upon the GDP growth rate for EU-28 MS) are synthesised in Figure 7, Table 3, and detailed in the Appendix (Table A3).



Source: Authors' research.

Figure 7 Correlation Matrices for the Impact of Trade and FDI Growth upon the GDP Growth Rate: 1995-2019 (Left) and 2020-2025 (Right)



Source: Authors' research

Figure 8 Dendrograms for the Impact of Trade and FDI Growth upon the GDP Growth Rate: 1995-2019 (Left) and 2020-2025 (Right)

The indicators considered in relation with GDP growth rates are: export growth rate (X_gr), imports growth rates (M_gr), FDI inflows growth (FDI_i_gr), FDI outflows growth (FDI_o_gr), participation rate in education and training (EDU), and research and development expenditures (RD_exp).

In this particular case, Ireland holds a dominant position, benefiting from the Brexit through high levels of growth rates both for trade and inward FDI, in the above mentioned framework, with an associated positive impact upon GDP growth rates. At the same time, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Sweden refocus their economic policies and strategies on RD and education, so that by 2020-2025 these countries could benefit from significant increases in exports and inward FDI, thus improving their GDP growth rates.

At the same time, Croatia, Latvia, Lithuania, Romania, Slovak Republic and Slovenia registered negative growth rates for trade and FDI, but positive on education for 1995-2019, thus counterbalancing and leading to positive growth rates for trade and slightly negative on FDI with further medium performances in terms of GDP growth rate during 2020-2025 period.

Table 3 Clusters Associated with the Impact of Trade and FDI Growth upon the GDP Growth Rate

Clusters (C) 1995-2019		Cluster modelling - Ward method		Clusters (C) 2020-2025	
		GDP per capita (avg. level)	GDP per capita (avg. level)		
C1	Austria, Belgium, Denmark, Finland, France, Germany, Greece, Sweden	Low to medium (refocus on RD and education)	Medium (positive growth rates for trade, but negative on FDI)	Croatia, Italy, Latvia, Lithuania, Malta, Portugal, Romania, Slovak Republic, Slovenia, Spain	C1
C2	Bulgaria, Croatia, Cyprus, Greece, Hungary, Latvia, Lithuania, Romania, Slovak Republic, Slovenia, United Kingdom	Low (negative growth rates for trade and FDI, positive on education)	Medium (significant increases in exports and inward FDI)	Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Netherlands, Poland, Sweden, United Kingdom	C2
C3	Italy, Poland, Portugal, Spain	Medium to low (significant import increases)	Very low (negative growth rates for all considered indicators)	Estonia, Greece, Hungary	C3
C4	Cyprus, Ireland, Luxembourg, Malta	High (important increases both for trade and FDI)	Medium (important increases in FDI, but negative on trade)	Cyprus, Luxembourg	C4
C5	Estonia	Very low (negative growth rates for all considered indicators)	Very high (high levels of positive growth rates both for trade and inward FDI)	Ireland	C5

Source: Authors' research.

Our results show that the Brexit impact for the UK's economy tends to be more emphasised in terms of GDP growth rates and less regarding the GDP *per capita* levels, particularly on the short-run, due to many uncertainties surrounding this process. However, with a refocus on effective and efficient trade and investment policies and strategies and by maintaining tight relations with the EU, and with other foreign trade partners continuously, the overall outcome might be positive in the long term. Regarding the international flows deployed by the UK after the Brexit, a significant reduction with a further negative economic impact will be induced through FDI, these inflows being at very low levels during 2020-2025 period, mainly due to the uncertainties brought by the Brexit new arrangements established by the UK with its global partners.

3.2 Impacts of International Trade and FDI upon the Economic Activity in EU-28 Revealed by Structural Equations Modelling (SEM)

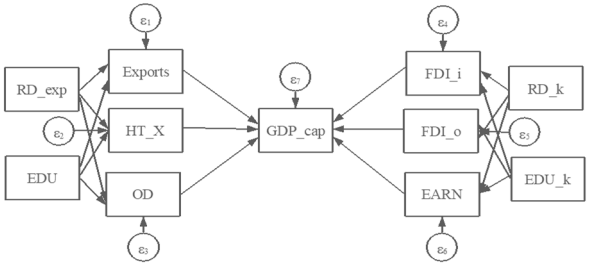
Further, based on structural equations modelling (SEM), we have developed two complex models (grounded on equation system 3) that aim to assess the impact of several exogenous variables - related to international trade, investments (FDI), and other specific indicators (annual net earnings, educational level and the participation rate in education and training, expenditures on research and development, as main control variables that account for the human capital dimension in economic growth models, and represent key coordinates of EU growth strategies), upon the endogenous variables - GDP *per capita* (Figure 9, and Appendix, Table A4) and GDP growth (Figure 10, and Appendix, Table A4) (the economic activity), in EU-28 during the 1995-2019 and 2020-2025 periods.

The two SEM models have been designed and processed based on the absolute and relative values of selected indicators, as well as on their standardised version, through the MLE (Maximum Likelihood Estimator) method of estimation. The exogenous variables (related to trade and investments) analysed for both SEM models (Figures 9 and 10) have been selected grounded on the previously stated literature and in line with our fundamental research objectives. RD expenditures (Rd_exp) and Education (EDU) have been introduced into both SEM models mainly as control variables, since the acknowledged EU economic strategies (Europe 2020 and Project Europe 2030) centre on a smart, sustainable and inclusive growth, with a keen focus on education.

SEM was applied in order to better capture the overall effects (direct, indirect and total) of international flows (trade and investments) upon the economic activity before and after the Brexit. We have also accounted for SEM modelling processed through the maximum likelihood procedure (MLE) because panel regression estimates through Ordinary Least Squares (OLS)/Generalised Least Squares (GLS) might not be substantial, since the unit-root tests provides discrepant results (Appendix, Table A5).

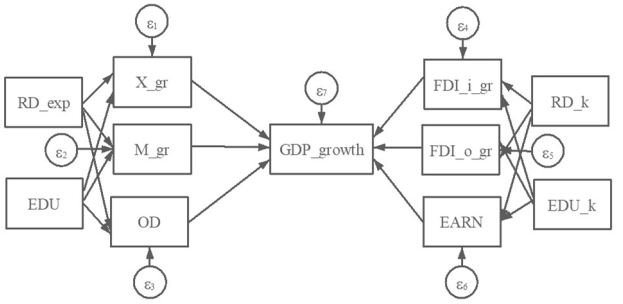
However, within this context, we have firstly configured and estimated the two general models through different estimation procedures (such as Generalised Least Squares for Random Effects – RE-ECM/GLS; Ordinary Least Squares for Fixed Effects – FE-LSDV/OLS; Panel Corrected Standard Errors – PCSE; Robust Regression – RREG with Cook's D, Huber and Biweight iterations; and System dynamic panel-data estimation based on Arellano-Bover/Blundell-Bond, GMM).

These preliminary results are synthesised and detailed in the Appendix (Tables A11 and A12). For the five considered models, a particular attention was devoted to robustness check and validation, as it is inserted at the end of each table. Since there was some evidence of heteroscedasticity, we have used robust and panel corrected standard errors (PCSE), and to account for endogeneity, we have applied robust regression (RREG) and Generalized Method of Moments (GMM) procedures, which gave consistent estimates. Moreover, the robust regression allowed us to ensure robustness, since in our case some findings might be entirely driven by larger economics (e.g. Germany and France). Thus, it firstly runs OLS, gets Cook's distance for each observation, and begins the iteration process with two different kinds of weight and, as a result, the most influential points are dropped.



Source: Own process.

Figure 9 SEM Developed to Assess the Impact of International Trade and Investment (FDI) upon GDP per capita in the EU-28, during 1995-2019 and 2020-2025 Periods



Source: Own process.

Figure 10 SEM Developed to Assess the Impact of International Trade and Investment (FDI) upon GDP Growth in the EU-28, during 1995-2019 and 2020-2025 Periods

The results of the five econometric models (Appendix, Tables A11 and A12) highlight a positive impact of international trade and investment upon both GDP *per capita* and GDP growth rates for the EU-28, but with a considerable attenuation during the Brexit negotiations and transition period (2017-2019), as well as shortly after the official Brexit (2020-2025).

In order to ensure accurate results of the SEM models, we have applied several specific procedures and tests, namely: compared Likelihood Ratios (LR) results (LR test for model *versus* saturated and baseline *versus* saturated) and information criteria (Akaike's, Bayesian) for each estimated model, made other baseline comparison through Comparative fit index and Tucker-Lewis index (Appendix, Table A6); Wald tests for equations on each dependent variable, GDP *per capita* (Appendix, Table A7) and GDP growth (Appendix, Table A8); and, finally, analysed Cronbach's alpha for individual items/each dependent variable (GDP *per capita* and GDP Growth) and total scale (Appendix, Tables A9 and A10).

Thus, we were able to select and store two models with consistent results for both time periods, 1995-2019 and 2020-2025, from a range of various estimations, with the results being detailed in the Appendix (Table A4).

The ***results of the 1st SEM model for GDP per capita*** impacts under the influence of international trade variables reveal favourable effects (as entailed by the

positive estimated coefficients and being statistically significant, of .357 in the case of *exports* and .410, if we consider the *openness degree (OD)*, for the 1995-2019 lapse of time), but that tend to diminish after the Brexit (also positive estimated coefficients, but with a slower pace of .135 associated with the *exports* variable and of .350, if we consider *the openness degree (OD)* for the 2020-2025 time period). A refocus on core innovation strategies in combination with incentives on international trade activities could provide positive ways to overcome potential difficulties encountered after the Brexit, also underlined by Kierzenkowski et al. (2016).

This idea is being supported by our empirical results that bring evidence to attest an extremely significant positive effect of *high tech exports* (HT_X) upon GDP *per capita* levels for the 2020-2015 period (an increase by 1% in HT exports could lead to a .621% increase in GDP *per capita*), compared to no statistically significant correlation in this respect during 1995-2019 period (.00448 estimated coefficient). Moreover, an increase in EU and UK's *RD expenditures* (RD_exp) induces significant positive spillovers upon GDP *per capita* (.384 during the 1995-2019 period) that seems to intensify after 2020 in the context of a core innovation strategy (.641 during the 2020-2025 period). On the other hand, an improvement in the *educational background and participation rates in education and training* (EDU) does not seem to account for positive economic effects, since our estimations reveal a negative sign for the associated estimated coefficients (-.229 during the 2020-2025 period). This controversial outcome could be linked to the challenges brought by new migration patterns of highly skilled workers, since labour mobility is a core issue on the Brexit agenda and has already induced swifts and downsizes of migratory flows within the EU, with further important effects upon the economic activity (Portes 2016).

When we have considered the FDI impacts upon the GDP *per capita*, as a consequence of reduced foreign capital entries due to Brexit major uncertainties, the positive FDI effects validated during the 1995-2019 period, through the estimated coefficients of .229 for *FDI inwards* (FDI_i), and .314 for *FDI outwards* (FDI_o), tend to convert to a smaller extent during the 2020-2025 period in the case of FDI outflows (.153), and almost imperceptible if we consider FDI inflows (.0625 statistically insignificant). Finally, an increase in *earnings* (EARN) has a low influence upon GDP *per capita* for the 1995-2019 period (.0947 coefficient), and no statistically significant correlation during the 2010-2025 period (.0132 estimated coefficient).

The results of ***the 2nd SEM model for GDP growth*** (Table 4) also reveal important credentials: (i) *first*, a significant increase in *exports growth rate* (X_gr) would have a decisive positive impact on economic growth both for EU-27 and the UK during 2020-2025 (.311, $p < .001$), if the trade relations with the EU-27 will remain in the same settings, due to the international value chains well-grounded between the UK and some of the EU countries (especially for Ireland, France, Netherlands, and Germany) (Ali-Yrkkö and Kuusi 2019; Vandenbussche, Connell, and Simons 2019); (ii) *second,* a slight growth in *FDI outwards* (FDI_o_gr) could also have positive effects on GDP growth rate (.151% increase during the 2020-2025 period); (iii) still, increasing the *imports growth rate* (M_gr), the *openness degree* (OD) and *earnings* (EARN) levels after the BREXIT would have adverse results reflected through a reduction in GDP growth rates (-.0490 coefficient for M_gr, -.111 in case of OD, respectively, -.187 for

EARN); (iv) *FDI inwards growth* (FDI_i_gr) has no statistically significant influence over GDP growth neither for the period until 2019, nor after that; (v) an increase in *RD expenditures* (RD_exp) has no statistically significant impact upon GDP growth (-.0426 during the 1995-2019 period and .212 for the 2020-2025 period); (vi) also, an improvement in *educational participation rates* (EDU) would not influence GDP growth rate after the Brexit, since our estimations reveal no statistically significant impact upon it (-.141 during the 2020-2025 period). Moreover, these variables are interconnected, "as economic growth and trade openness increase, FDI also increases" (Selim Tüzüntürk, Betül İnam, and Filiz Giray 2018, p. 602).

In either case, when we have estimated multiple regression models designed through a combination of trade and FDI indicators, as exogenous variables, and GDP *per capita*, respectively GDP growth, as dependent variables, through SEM-MLE, the estimated coefficients became much more statistically significant and revealed the importance of international trade and investments in jointly influencing the economic activity.

These impacts are mainly explained by the Globalisation 2.0 credentials ("global value chains"), which play a significant role in enhancing the international trade between countries (Vandenbussche, Connell, and Simons 2019), both developing and developed ones, and "transcends national borders to create a closely knit network of supply and use contractual arrangements" (Alejandro Jara and Hubert Escaith 2012, p. 16). Moreover, all the testing parameters procedures have allowed us to reject the null hypothesis that coefficients of the variables are jointly equal to zero, thus being an important measure of model correct specification, along with Wald and Fisher results and high values of the R-squared.

4. Concluding Remarks

Our research aims to assess the Brexit spillovers upon each of the EU-27 MS and the UK, as well as overall EU-28, through two fundamental freedoms as core pillars of regional economic integration, namely: free movement of goods and services, and capital. Even though migration is another topical subject largely debated by diverse strands of thought as regards the connection between the free movement of people and the Brexit decision, due to its complexity, we have considered it as a separate research (Suciu, Cristea, and Noja 2018). We have applied *cluster analysis* (to examine each of the EU-27 MS and the UK) and *Structural Equations Modelling (SEM)* (for all the EU-28 MS evaluation) on a strongly balanced panel.

The results obtained in our cluster analysis show that there are some EU MS (Ireland, Netherlands, Belgium) that could significantly benefit after the Brexit compared to the 1995-2019 period. Other MS will consolidate their dominant position either in terms of trade (Germany, France) or FDI (Belgium, Cyprus, Luxembourg), while others (mainly, the Central and Eastern European countries) will continue to struggle in developing their international activity and presence on the global markets, being strongly connected by new technologies, yet with low economic performances.

SEM results highlight the importance of international trade in enhancing the economic development, since a significant growth in total and high-tech exports could have positive effects both for EU-27 and the UK during the 2020-2025 period. In line

with these highlights, it is being revealed the importance of a coherent and effective trade policy after the Brexit that should continue to focus on trade liberalisation. This reduces transaction costs, which in turn can enhance economic growth rates (Matthias Busse and Jens Koniger 2015). Thus, such measures can stimulate international trade flows globally based on the new trade agreements negotiated with the main trade partners, especially with the remaining EU-27 MS (Ali-Yrkkö and Kuusi 2019). The international trade, FDI and growth theories point out extremely favourable outcomes resulted from participating in international activities, since it opens up the opportunities of global markets, makes the latest technology readily available to the businesses and increases competition, thus ensuring a more efficient allocation and use of available resources (Bela Balassa 1978; Paul Krugman 1979; Paul M. Romer 1990; Jong-Wha Lee 1993; Hirst and Thompson 2002).

Overall, the shock brought by the Brexit vote in June 2016 has wound up the EU-MS that are now searching for various ways to cope with the disintegration risk. Definitely, the Brexit impact will be significant, mostly negative in the short-run, especially for the UK, and some of the EU MS (mainly in terms of GDP growth rates). This outcome largely depends on the new agreements established by the UK with EU-27 and other global partners (Jara and Escaith 2012). With this respect, our results are in consensus with previous literature, and estimate a short-term negative shock to the UK and EU economies. The Brexit will also lead to a change in the EU's and UK's positions held regionally and globally, since the EU is losing an important and influent member, thus shifting the balance of power within the European Council.

The research performed within the paper is not without limitations, because the standardisation method applied to the indicators used in the cluster analysis tends to reduce the variability between clusters. Furthermore, the extrapolation procedure is subject to more uncertainty, thus influencing our results to some extent. Therefore, we intend to also consider the normalisation procedure, as well as to apply other clustering techniques, particularly the complete linkage (complete-link) method. Overall, the aggregated macroeconomic impact is difficult to quantify, due to numerous uncertainties that arise in the light of globalisation with unknown variables that cannot yet be captured as proxies in macro-econometric models (such as catastrophic events due to climate change, prevalence of disease, epidemics, demographic pressures) (as Hirst and Thompson 2002 underlined). A further focus will be placed on the Brexit effects on several organisations, particularly firms with the headquarters in emerging markets (considering the research of Marilen Pirtea, Claudiu Botoc, and Cecilia Jurcut 2014), with a focus on firm competitiveness (considering the work of Nicolae Bibu, Petru Stefea, and Diana Sala 2009). At the same time, we aim at deploying a distinct analysis on the Brexit effects through the free movement of people (international migration), particularly with respect to different ethnic groups (considering the works of Melinda Dinca and Daniel Luches 2018).

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Appendix

Table A1 Main Findings on the BREXIT Phenomenon (Literature Review)

Studies	Field of analysis	Effects analysed	Methods applied	Main results
Pain and Young (2004)	Effects for UK	FDI, Trade, Fiscal implications, Food prices	Simulations on the National Institute model of the UK economy (NiDEM), period 1967-1995	$2\frac{1}{4}$% lower outputs than no exit decision
Booth et al. (2015)	Effects for UK	Trades, Labour migration, Regulations	The computable general equilibrium (CGE) model	Different effects considering 4 scenarios
Irwin (2015)	Effects for UK and EU	10 channels: trade, FDI, liberalisation and regulation, industrial policy, immigration, financial services, trade policy, international influence, budget, uncertainty	Impact scale based on multiple metrics for each country from EU and for UK, for the period 2013-2015	Severe impacts for British economy. The EU Member States would be affected „in different ways and to different extents (Table 1, Literature Review Section)
Begg and Mushövel (2016)	Effects for UK and EU	The macroeconomic effects on the long and short term, job, public finances, migration	Debate at main contributions and conclusions of the economists	*Long term*: loss of GDP, from 10% to a gain of 4 points. *Short-term*: a negative impact for the EU economy, and UK.
Crafts (2016)	Effects for UK	GDP		Results depending on the terms negotiated
Dhingra et al. (2016)	Effects for UK	Trade Living standard (income)	"Quantitative trade model of the global economy", using different scenarios of what policies the UK adopts following Brexit.	A fall in income of between 1.3% and 2.6% per household per year
European Commission (2016)	Effects for UK, EU 27, EU 28, and Euro Area	Economic activity, financial markets, uncertainty, investments, trade, labour market, inflation, risks.	Simulations using the Commission's QUEST model using 2 scenarios: mild and severe	Deterioration of the growth outlook for the UK, but also for the rest of the EU in 2016 and 2017
Kierzenkowski et al. (2016)	Effects for UK	Confidence, Trade, FDI, Skills, Immigration, Deregulation, for near term (2020) and longer term (2030).	The OECD's METRO model and the National Institute Global Econometric Model (NiGEM) macro model for the world economy	Both near term (2020) and long-run (2030), GDP would be smaller 3%, respectively 5%. Capital, immigration and lower technical progress would influence the structural changes for the long term.
Simionescu (2016)	Effects for UK	FDI projects	Poisson models on panel data over 2012 to 2015 and for regions from the entire world	Decreasing the new working in FDI projects
Jafari and Britz (2017)	Effects for UK	Trade, labour and population (immigration), and FDI	Computable General Equilibrium model in manufacturing sectors	Decreasing in total output of the UK economy by about -3.36%
Portes and Forte (2017)	Effects for UK	Employment, wages, and growth	Illustrative scenarios using cross-country evidence	Negative effect on GDP *per inhabitant*, "marginal positive impacts on wages in the low-skill service sector".
Suciu, Cristea, and Noja (2018)	Effects for the first 10 most targeted EU countries by migrants	Migration, labour market and growth	Multifactorial econometric models and structural equation modelling	Positive impacts upon the labour market (employment) and economic growth for the ten EU considered countries

Source: Processed by the authors.

Table A2 Descriptive Statistics of the Variables

Variables	Obs.	Mean	Std. dev.	Min	Max
GDP_cap	868	32678.14	24031.13	3781.9	198526
GDP_growth	868	3.681527	42.0439	-1151	204.416
Exports	868	2.57e+11	3.77e+11	4.10e+09	2.80e+12
HT_X	868	14.71011	11.15082	1.206	81.155
ICT_X	868	8.665545	11.63203	-24.724	113.926
OD	868	119.089	89.45397	26.1203	965.477
FDI_o	868	29164.01	79379.59	-110292	688060
FDI_i	868	23383.69	76400.2	-127242	794623
FDI_o_gr	868	14.15518	59.1029	-249.386	502.245
FDI_i_gr	868	13.79917	47.05087	-78.8232	499.6
X_gr	868	6.949614	19.73526	-65.725	234.089
M_gr	868	6.696766	14.2618	-72.21	85.316
RD_exp	868	1.423676	.8930457	-1.633	3.914
EDU	868	69.89867	15.04544	15.7	92.6
EARN	868	42991.21	36857.87	-213871	311052

Source: Processed by the authors.

Table A3 Cluster Analysis Results (Trade and FDI Impact upon GDP per capita and GDP Growth), EU-27 and the UK

Indicators	Cluster 1 (C1)			Cluster 2 (C2)			Cluster 3 (C3)			Cluster 4 (C4)			Cluster 5 (C5)			F	R-sq
	N	Mean	sd	N	Mean	sd	N	Mean	sd	N	Mean	sd	N	Mean	sd		
GDP per capita 1995-2019																	
GDP_cap	8	3.186	0.438	1	5.420	0.539	11	1.996	0.317	6	2.120	0.340	2	2.388	0.390	699.0626***	0.8009
Exports	8	0.526	1.002	1	-0.451	0.093	11	-0.544	0.151	6	-0.463	0.198	2	-0.581	0.133	110.1073***	0.3879
HT_X	8	0.241	0.716	1	-0.394	0.303	11	-0.702	0.281	6	0.051	0.528	2	3.263	0.814	375.4708***	0.6836
ICT_X	8	-0.110	0.472	1	-0.371	0.344	11	-0.449	0.245	6	1.050	0.795	2	3.290	2.193	300.9730***	0.6340
OD	8	-0.302	0.505	1	2.470	1.327	11	-0.281	0.342	6	0.178	0.367	2	1.234	0.638	249.4203***	0.5894
FDI_o	8	0.167	0.731	1	0.131	0.386	11	-0.348	0.066	6	-0.332	0.072	2	-0.322	0.067	49.26892***	0.2209
FDI_i	8	0.120	0.645	1	-0.017	0.440	11	-0.273	0.063	6	-0.270	0.090	2	-0.179	0.138	34.67177***	0.1664
GDP per capita 2020-2025																	
GDP_cap	22	2.615	0.625	2	3.553	0.193	2	3.303	0.121	1	8.234	1.037	1	6.563	0.193	187.4686 ***	0.8214
Exports	22	-0.077	0.706	2	1.271	0.620	2	4.223	1.991	1	2.321	0.497	1	-0.164	0.049	84.9775***	0.6759
HT_X	22	-0.092	0.507	2	0.036	0.077	2	1.106	0.522	1	4.793	0.912	1	0.045	0.187	143.8479 ***	0.7793
ICT_X	22	-0.174	0.875	2	-0.020	0.589	2	-0.353	0.141	1	-0.311	0.013	1	-0.582	0.001	0..66395	0.0160
OD	22	-0.079	0.554	2	0.387	0.020	2	-0.391	0.131	1	1.638	0.137	1	7.978	1.102	341.1495***	0.8933
FDI_o	22	-0137	0.583	2	4.888	1.979	2	-0.484	0.293	1	6.438	1.378	1	1.634	0.375	212.7500***	0.8393
FDI_i	22	-0.459	0.472	2	3.326	1.019	2	3.055	0.689	1	7.823	1.699	1	1.245	0.306	415.4765***	0.9107
GDP growth 1995-2019																	
GDP_growth	8	0.139	0.053	11	0.160	0.108	4	0.164	0.083	4	0.459	0.606	1	-27.288	-	9196.811***	0.9815
X_gr	8	-0.093	0.245	11	-0.021	0.496	4	-0.119	0.689	4	0.521	1.601	1	-0.077	-	8.21532***	0.0451
M_gr	8	-0.116	0.337	11	-0.008	0.797	4	0.012	0.571	4	0.253	0.966	1	-0.094	-	2.68286*	0.0152
FDI_o_gr	8	-0.126	0.189	11	-0.220	0.118	4	-0.226	0.295	4	2.600	1.066	1	-0.238	-	663.9173***	0.7926
FDI_i_gr	8	-0.177	0.206	11	-0.214	0.185	4	-0.286	0.622	4	2.417	2.564	1	-0.200	-	130.4626***	0.4289
RD_exp	8	1.023	0.689	11	-0.682	0.441	4	-0.576	0.383	4	-0.403	0.493	1	-1.324	-	381.6088***	0.6871
EDU	8	0.165	0.518	11	0.279	0.566	4	-1.871	0.815	4	-0.762	1.090	1	0.525	-	265.5422***	0.6045
GDP growth 2020-2025																	
GDP_growth	10	0.295	0.241	12	0.252	0.182	3	-0047	0.070	2	0.521	0.211	1	3.890	0.792	338.3220***	0.8925
X_gr	10	0.009	0.865	12	0.185	0.681	3	-1.478	0.603	2	-0.934	1.095	1	8.979	1.893	188.9423***	0.8226
M_gr	10	1.215	1.060	12	-0.052	1.136	3	-3.100	1.079	2	-1.225	0.479	1	4.397	0.834	86.8941***	0.6808
FDI_o_gr	10	-0.564	1.003	12	0.021	0.528	3	-0.189	0.198	2	5.717	1.360	1	4.062	0.882	192.2961***	0.8251
FDI_i_gr	10	-0.241	0.416	12	-0.094	0.506	3	-0.608	0.275	2	4.139	0.970	1	5.787	1.280	338.1672***	0.8925
RD_exp	10	-0.552	0.478	12	1.125	0.626	3	-1.122	1.151	2	-0.798	0.200	1	-0.055	0.035	87.3619***	0.6819
EDU	10	0.459	0.922	12	0.800	0.289	3	0.783	0.228	2	-1.050	1.787	1	0.694	0.087	16.2661***	0.2853

Source: Authors' research.

Table A4 Estimation Results for SEM

	(GDP_cap) 1995-2019	(GDP_cap) 2020-2025	(GDP_growth) 1995-2019	(GDP_growth) 2020-2025
Exports (X)				
RD_exp	0.384***	0.641***	-0.0426	0.212
	(0.0300)	(0.0909)	(0.0221)	(0.139)
EDU	-0.0354	-0.229*	0.0879***	-0.141
	(0.0297)	(0.114)	(0.0218)	(0.174)
_cons	-0.0919**	0.465***	-0.0325	0.232
	(0.0284)	(0.115)	(0.0209)	(0.176)
HT_X				
RD_exp	0.240***	0.198**		
	(0.0372)	(0.0733)		
EDU	-0.311***	0.0857		
	(0.0368)	(0.0917)		
_cons	-0.0773*	0.112		
	(0.0352)	(0.0929)		
OD				
RD_exp	-0.0800**	-0.0316	-0.0800**	-0.0316
	(0.0308)	(0.0858)	(0.0308)	(0.0858)
EDU	-0.0104	-1.221***	-0.0104	-1.221***
	(0.0305)	(0.107)	(0.0305)	(0.107)
_cons	-0.0709*	0.945***	-0.0709*	0.945***
	(0.0291)	(0.109)	(0.0291)	(0.109)
GDP_cap				
Exports	0.357***	0.135**		
	(0.0367)	(0.0453)		
HT_X	0.00448	0.621***		
	(0.0271)	(0.0681)		
OD	0.410***	0.350***		
	(0.0384)	(0.0368)		
FDI_i	0.229***	0.0625		
	(0.0660)	(0.0457)		
FDI_o	0.314***	0.153***		
	(0.0478)	(0.0434)		
EARN	0.0947***	0.0132		
	(0.0266)	(0.0558)		
_cons	2.750***	2.728***		
	(0.0252)	(0.0495)		
FDI_i				
RD_exp	0.124***	0.533***		
	(0.0203)	(0.155)		
EDU	-0.00128	-0.0202		
	(0.00119)	(0.0115)		

_cons	-0.187*	1.186		
	(0.0804)	(0.901)		
FDI_o				
RD_exp	0.0187	-0.0764	0.0187	-0.0764
	(0.0265)	(0.144)	(0.0265)	(0.144)
EDU	-0.00645***	-0.0402***	-0.00645***	-0.0402***
	(0.00155)	(0.0107)	(0.00155)	(0.0107)
_cons	0.330**	3.593***	0.330**	3.593***
	(0.105)	(0.837)	(0.105)	(0.837)
EARN				
RD_exp	0.145***	0.327***	0.145***	0.327***
	(0.0420)	(0.0913)	(0.0420)	(0.0914)
EDU	-0.000292	0.0118	-0.000292	0.0118
	(0.00247)	(0.00679)	(0.00247)	(0.00679)
_cons	-0.222	-1.261*	-0.222	-1.261*
	(0.166)	(0.530)	(0.166)	(0.530)
var(e.Exports)				
_cons	0.554***	1.618***		
	(0.0296)	(0.177)		
var(e.HT_X)				
_cons	0.853***	1.051***		
	(0.0456)	(0.115)		
var(e.OD)				
_cons	0.585***	1.441***	0.585***	1.441***
	(0.0312)	(0.157)	(0.0312)	(0.157)
var(e.GDP_cap)				
_cons	0.420***	0.365***		
	(0.0224)	(0.0398)		
var(e.FDI_i)				
_cons	0.203***	3.757***		
	(0.0109)	(0.410)		
var(e.FDI_o_gr)				
_cons	0.344***	3.246***	0.344***	3.246***
	(0.0184)	(0.354)	(0.0184)	(0.354)
var(e.EARN)				
_cons	0.868***	1.303***	0.868***	1.303***
	(0.0464)	(0.142)	(0.0464)	(0.142)
M_gr				
RD_exp			-0.0814**	0.107
			(0.0256)	(0.132)
EDU			0.0344	-0.0876
			(0.0253)	(0.165)

_cons			-0.0334	0.185
			(0.0242)	(0.167)
GDP_growth				
X_gr			0.136	0.311***
			(0.0988)	(0.0146)
M_gr			0.0380	-0.0490***
			(0.0851)	(0.0124)
OD			0.00197	-0.111***
			(0.0585)	(0.0126)
FDI_i_gr			0.00279	0.0690
			(0.0689)	(0.0385)
FDI_o_gr			0.0938	0.151***
			(0.0862)	(0.0338)
EARN			-0.242***	-0.187***
			(0.0412)	(0.0246)
_cons			0.131***	0.325***
			(0.0389)	(0.0159)
FDI_i_gr				
RD_exp			-0.0486	-0.0602
			(0.0332)	(0.120)
EDU			-0.0101***	-0.0492***
			(0.00195)	(0.00889)
_cons			0.678***	4.244***
			(0.131)	(0.695)
var(e.X_gr)				
_cons			0.300***	3.781***
			(0.0160)	(0.413)
var(e.M_gr)				
_cons			0.403***	3.412***
			(0.0215)	(0.372)
var(e.GDP_growth)				
_cons			1.035***	0.0397***
			(0.0553)	(0.00434)
var(e.FDI_i_gr)				
_cons			0.540***	2.237***
			(0.0289)	(0.244)
N	**700**	**168**	**700**	**168**

Notes: Standard errors in parentheses. * $p < .05$, ** $p < .01$, *** $p < .001$.

Source: Authors' research.

Table A5 Unit Root Tests of the Residuals from the GDP-Trade-FDI Impact Models

Resid		
LLC (Levin-Lin-Chu)	*p*-value	0.6765
	t-statistic	0.4578
	ADF regressions: 1 lag	
	LR variance: Bartlett kernel, 10.00 lags average	
Im-Pesaran-Shin	*p*-value	0.8792
	t-statistic	-6.5991
	Test critical values: 1%	-1.810
	5%	-1.730
	10%	-1.680
	ADF regressions: no lags included AR parameter: panel-specific	
Harris-Tzavalis	*p*-value	0.0000
	statistic	0.0841
	z	-44.392
Fisher-type Based on augmented Dickey-Fuller tests	*p*-value	0.0000
	Inverse chi-squared (56)	163.296
	Modified inv. chi-squared	10.1386
Ho: (All) Panels contain unit roots Ha: Panels are stationary/At least one panel is stationary		

Source: Authors' research.

Table A6 Goodness-of-Fit Tests for the SEM

Fit statistic	**Description**	**GDP_capita 1995-2019**	**GDP_capita 2020-2025**	**GDP_growth 1995-2019**	**GDP_growth 2020-2025**
Likelihood ratio					
chi2_ms(31)	Model vs. saturated	1390.192	509.621	1108.532	795.369
p > chi2		0.000	0.000	0.000	0.000
chi2_bs(49)	Baseline vs. saturated	2119.335	985.628	1249.841	1394.983
p > chi2		0.000	0.000	0.000	0.000
Information criteria					
AIC	Akaike	-15676.577	-2171.676	-15152.077	-2290.600
BIC	Bayesian	-15530.942	-2071.709	-15006.442	-2190.633
Baseline comparison					
CFI	Comparative fit	0.343	0.489	0.103	0.432
TLI	Tucker-Lewis	-0.038	0.192	-0.418	0.102
Size of residuals					
SRMR	Std root mean sq	0.145	0.175	0.132	0.195
CD	Coef of determ	0.366	0.656	0.129	0.570

Source: Authors' research.

Table A7 Wald Tests for Equations, GDP per capita

Variable	Chi2	df	*p*-value	Chi2	df	*p*-value
	GDP_capita 1995-2019			GDP_capita 2020-2025		
Observed						
Exports	169.07	2	0.0000	50.29	2	0.0000
HT_X	90.41	2	0.0000	9.36	2	0.0093
OD	7.89	2	0.0194	135.06	2	0.0000
GDP_cap	500.20	6	0.0000	713.49	6	0.0000
FDI_i	37.18	2	0.0000	13.13	2	0.0014
FDI_o	61.05	2	0.0000	15.55	2	0.0004
EARN	12.58	2	0.0019	18.69	2	0.0001

H0: All coefficients excluding the intercepts are 0.
We can thus reject that null hypothesis for each equation.

Source: Authors' research.

Table A8 Wald Tests for Equations, GDP growth

Variable	Chi2	df	p-value	Chi2	df	p-value
	GDP_growth 1995-2019			GDP_growth 2020-2025		
Observed						
X_gr	17.04	2	0.0002	2.62	2	0.2695
M_gr	10.42	2	0.0055	0.81	2	0.6670
OD	7.89	2	0.0194	135.09	2	0.0000
GDP_growth	43.46	6	0.0000	2061.35	6	0.0000
FDI_i_gr	35.37	2	0.0000	32.93	2	0.0000
FDI_o_gr	17.40	2	0.0002	15.56	2	0.0004
EARN	12.58	2	0.0019	18.69	2	0.0001

H0: All coefficients excluding the intercepts are 0.
We can thus reject that null hypothesis for each equation, with a limitation on X_gr and M_gr for the forecasted period 2020-2025.

Source: Authors' research.

Table A9 Results for Cronbach's Alpha - GDP per capita

Test scale = mean (standardised items) average

Item	Obs.	GDP_growth 1995-2019			GDP_growth 2020-2025		
		Sign	Interitem correlation	alpha	Sign	Interitem correlation	alpha
GDP_cap	700/ 168	+	0.1579	0.6000	+	0.2261	0.7004
Exports	700/ 168	+	0.1775	0.6332	+	0.2777	0.7547
HT_X	700/ 168	+	0.2114	0.6820	+	0.2677	0.7452
OD	700/ 168	+	0.2286	0.7034	+	0.3051	0.7784
FDI_i	700/ 168	+	0.1642	0.6112	+	0.2376	0.7137
FDI_o	700/ 168	+	0.1642	0.6111	+	0.2523	0.7297
EARN	700/ 168	+	0.2176	0.6899	+	0.3242	0.7933
RD_exp	700/ 168	+	0.1809	0.6385	+	0.3199	0.7901
EDU	700/ 168	+	0.2489	0.7261	-	0.3311	0.7984
Test scale			0.1946	0.6850		0.2777	0.2777

Source: Authors' research.

Table A10 Results for Cronbach's Alpha - GDP Growth

Test scale = mean (standardised items) average							
Item	Obs.	GDP_growth 1995-2019			GDP_growth 2020-2025		
		Sign	Interitem correlation	alpha	Sign	Interitem correlation	alpha
GDP_growth	700/ 168	+	0.1264	0.5366	+	0.1890	0.6508
X_gr	700/ 168	+	0.0937	0.4527	+	0.2026	0.6703
M_gr	700/ 168	+	0.0930	0.4506	+	0.2507	0.7280
OD	700/ 168	+	0.0841	0.4236	+	0.2013	0.6685
FDI_i_gr	700/ 168	+	0.0670	0.3647	+	0.1597	0.6033
FDI_o_gr	700/ 168	+	0.0747	0.3923	+	0.1862	0.6468
EARN	700/ 168	+	0.1392	0.5639	+	0.2949	0.7699
RD_exp	700/ 168	-	0.1121	0.5024	-	0.2820	0.7585
EDU	700/ 168	-	0.1107	0.4990	-	0.2330	0.7084
Test scale			0.1001	0.5003		0.2221	0.7199

Source: Authors' research.

Table A11 Macro-Econometric Models - Various Estimation Procedures - GDP_capita 2020-2025

	(1) GDP_cap RE-ECM/GLS	(2) GDP_cap FE-LSDV/OLS	(3) GDP_cap PCSE	(4) GDP_cap RREG*	(5) GDP_cap GMM system**
Exports	0.268*	0.334*	0.0281	0.0413	-0.0994***
	(0.118)	(0.141)	(0.0161)	(0.0452)	(0.0120)
HT_X	0.601***	0.641***	0.730***	0.741***	-0.0881***
	(0.147)	(0.145)	(0.0206)	(0.0652)	(0.0113)
OD	0.106	0.0157	0.255***	0.255***	0.0272**
	(0.0700)	(0.0970)	(0.0206)	(0.0411)	(0.00946)
FDI_i	-0.0138	-0.0355	-0.0363***	-0.0427	-0.00494
	(0.0533)	(0.0537)	(0.00927)	(0.0486)	(0.00498)
FDI_o	0.166**	0.166**	0.201***	0.208***	-0.0365***
	(0.0521)	(0.0500)	(0.00480)	(0.0362)	(0.00444)
EARN	-0.291***	-0.320***	0.154**	0.193***	
	(0.0544)	(0.0529)	(0.0474)	(0.0414)	
RD_exp	-0.0576	-0.0691	0.0683**	0.0338	0.0208**
	(0.0518)	(0.0519)	(0.0226)	(0.0457)	(0.00639)
EDU	0.0255	-0.0472	-0.396***	-0.401***	0.0264*
	(0.115)	(0.122)	(0.0289)	(0.0768)	(0.0128)
L.GDP_cap					1.242***
					(0.0146)
_cons	2.789***	2.834***	2.957***	2.916***	-0.638***
	(0.173)	(0.0822)	(0.0195)	(0.0693)	(0.0401)
N	168	168	168	168	140
R^2		0.897	0.863	0.855	

Hausman test chi2 = -30.25
Breusch and Pagan Lagrangian multiplier test for random effects chibar20 = 317.96; p = .0000
Breusch-Pagan LM test of independence chi2(378) = 2267.998; p = .0000
Modified Wald test for groupwise heteroskedasticity in fixed effect regression model chi2 = 1.2e + 08; p = .0000
Wooldridge test for autocorrelation in panel data (H0: No first-order autocorrelation) F(1.27) = 1.811e+10; p = .0000
Sargan test of overidentifying restrictions chi2(295) = 219.265; p = .0000
Test parameters (coefficients of the variables are jointly equal to zero) chi2/F = 960.03; p = .0000

Notes: Standard errors in parentheses, *p < .05, **p < .01, ***p < .001. Cook's D, Huber and Biweight iterations. System dynamic panel-data estimation based on Arellano-Bover/Blundell-Bond.

Source: Authors' research.

Table A12 Macro-Econometric Models - Various Estimation Procedures - GDP_growth 2020-2025

	(1) GDP_gr RE-ECM/GLS	(2) GDP_gr FE-LSDV/OLS	(3) GDP_gr PCSE	(4) GDP_gr RREG*	(5) GDP_gr GMM system**
X_gr	0.282***	0.279***	0.303***	0.300***	0.0534***
	(0.0368)	(0.0416)	(0.00211)	(0.0143)	(0.00607)
M_gr	-0.0395	-0.0408	-0.0467***	-0.0422***	-0.00419
	(0.0257)	(0.0255)	(0.000550)	(0.0121)	(0.00298)
OD	-0.0234	0.0161	-0.0805***	-0.0824***	0.00237
	(0.0477)	(0.0748)	(0.00148)	(0.0146)	(0.00675)
FDI_i_gr	0.117	0.110	0.0836***	0.112**	0.0217*
	(0.111)	(0.127)	(0.00953)	(0.0387)	(0.00975)
FDI_o_gr	0.0944	0.0950	0.141***	0.115**	0.00444
	(0.0803)	(0.0929)	(0.00747)	(0.0352)	(0.00835)
EARN	-0.133***	-0.127***	-0.188***	-0.167***	-0.0142**
	(0.0322)	(0.0313)	(0.00581)	(0.0274)	(0.00500)
RD_exp	-0.00295	0.0147	-0.0151***	-0.0218	-0.0110*
	(0.0379)	(0.0467)	(0.00220)	(0.0160)	(0.00448)
EDU	0.225**	0.288**	0.0906***	0.0973***	0.00857
	(0.0715)	(0.102)	(0.00791)	(0.0239)	(0.00976)
L.GDP_growth					0.927***
					(0.0178)
_cons	0.179***	0.133	0.269***	0.259***	0.0355***
	(0.0483)	(0.0740)	(0.00443)	(0.0215)	(0.00610)
N	168	168	168	168	140
R^2		0.907	0.931	0.934	

Hausman test chi2 = 9.99; p = .2659
Breusch and Pagan Lagrangian multiplier test for random effects chibar2 = 351.71; p = .0000
Breusch-Pagan LM test of independence chi2(378) = 2268.00; p = .0000
Modified Wald test for groupwise heteroskedasticity in fixed effect regression model chi2 = 1.1e + 07; p = .0000
Wooldridge test for autocorrelation in panel data (H0: No first-order autocorrelation) F(1.27) = 2.162e + 11; p = .0000
Sargan test of overidentifying restrictions chi2(295) = .7329; p = .9938
Test parameters (coefficients of the variables are jointly equal to zero) chi2/F = 160.02; p = .0000

Notes: Standard errors in parentheses, *p < .05, **p < .01, ***p < .001. Cook's D, Huber and Biweight iterations. System Dynamic panel-data estimation based on Arellano-Bover/Blundell-Bond.

Source: Authors' research.