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

Grațiela G. Noja
West University of Timișoara, Timișoara, Romania
East European Center for Research in Economics and Business
E-mail address: gratiela.noja@e-uvt.ro

Mirela S. Cristea
University of Craiova, Craiova, Romania
Center for Banking and Financial Research
E-mail address: mirelas.cristea@gmail.com

Atila Yüksel
Adnan Menderes University, Kusadasi Aydın, Turkey
E-mail address: atilayuksel@gmail.com

Received: 29 December 2017; Accepted: 8 April 2020.

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.

Key words: 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 Appendices.

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 (Appendices, Table 1), 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 Craft 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).

Craft (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.

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              | 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

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).

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, Portes and 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).

\[ y_i = \frac{x_i - \text{mean}}{sd}, \]

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 (wardslinkage) 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,
Equation system (2) encompasses the general outline setting of the SEM model.

\[
\begin{align*}
&b_{11}y_{2t} + \ldots + b_{1m}y_{mt} + c_{11}x_{1t} + \ldots + c_{1n}x_{nt} = \epsilon_{1t} \\
&b_{21}y_{2t} + \ldots + b_{2m}y_{mt} + c_{21}x_{1t} + \ldots + c_{2n}x_{nt} = \epsilon_{2t} \\
&\vdots \\
&b_{m1}y_{1t} + \ldots + b_{mn}y_{nt} + c_{m1}x_{1t} + \ldots + c_{mn}x_{nt} = \epsilon_{mt}
\end{align*}
\]

(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, \( i=1, \ldots, m; \)
\( j=1, \ldots, n \)” (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).

Source: Own process based on Charles Wyplosz (2016), p. 4, and Eurostat data
Figure 1 Intra-EU Trade Links with the UK: Exports to the UK (Import UK) (% of GDP of these Countries)

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).

Source: Own process based on Charles Wyplosz (2016), p. 4, and Eurostat data

Figure 2 Intra-EU Trade Links with the UK: Imports from the UK (Export UK), 2014-2015 (% of the UK’s GDP)
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 Netherlands (NL), Luxembourg (LU) and Cyprus (CY) (Figure 3). UK’s outward FDI projects were also mainly deployed in Netherlands (NL), Luxembourg (LU) and France (FR) (Figure 4).

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 (Appendices, Table 2). The main databases used for collecting the data are European Commission – Eurostat, World Bank – World Development Indicators, UNCTAD – United Nations Conference on Trade and Development (UNCTADstat).

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.

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 Appendices (Table 3).

![Figure 5](image-url)

**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 dendrograms (Figure 6 and Figure 8).
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) | Cluster Modelling – Ward | GDP per capita (avg. level) | GDP per capita (avg. level) | Clusters (C) | GDP per capita (avg. level) |
|--------------|--------------------------|-----------------------------|-----------------------------|--------------|----------------------------|
| 1995-2019    |                          |                             |                             | 2020-2025    |
| C1           | High                     | Medium to low               | High                         |
| C2           | Very high                | High                         |

Austria, Denmark, Finland, France, Germany, Italy, Spain, United Kingdom

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
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 benefitting 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 Appendices (Table 3).

**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)

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) | GDP growth (average level) | GDP growth (average level) | Clusters (C) |
|--------------|----------------------------|----------------------------|--------------|
| 1995-2019    |                            |                            | 2020-2025    |
| C1           | 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 |
|              |                            |                            |              |
| C2           | 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 |
|              |                            |                            |              |
| C3           | Medium to low (significant import increases) | Very low (negative growth rates for all considered indicators) | Estonia, Greece, Hungary |
|              |                            |                            |              |
| C4           | High (important increases both for trade and FDI) | Medium (important increases in FDI, but negative on trade) | Cyprus, Luxembourg |
|              |                            |                            |              |
| C5           | Very low (negative growth rates for all considered indicators) | Very high (high levels of positive growth rates both for trade and inward FDI) | Ireland |

**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 Appendices, Table 4) and GDP growth (Figure 10, and Appendices, Table 4) (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 (Figure 9 and Figure 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 (Appendices, Table 5).
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 Appendices (Table 11, Table 12). 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.

The results of the five econometric models (Appendices, Table 11 and Table 12) 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 (Appendices, Table 6); Wald tests for equations on each dependent variable, GDP per capita (Appendices, Table 7) and GDP growth (Appendices, Table 8); and, finally, analysed Cronbach’s alpha for individual items/each dependent variable (GDP per capita and GDP Growth) and total scale (Appendices, Table 9 and Table 10).

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 Appendices (Table 4).

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 (Jonath and 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, the 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, the 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, Cecilia Jurcut, and Claudiu Botoc 2014), with a focus on firm competitiveness (considering the work of Nicolae Bibu, Petru Steafea, 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).
Acknowledgments

The authors would like to thank the reviewers for their accurate and valuable observations that were essential in enhancing the research endeavour and preparing the final version of the manuscript.

References

Ali-Yrkkö, Jyrki, and Tero Kuusi. 2019. “Brexit and Indirect Impact Routes through Global Value Chains.” The Research Institute of the Finnish Economy (ETLA) Report 89, 1-21. http://hdl.handle.net/10419/201371 (accessed on March 31, 2020).

Balassa, Bela. 1978. “Exports and Economic Growth, Further Evidence,” Journal of Development Economics, 5(2): 181-189. https://doi.org/10.1016/0304-3878(78)90006-8.

Begg, Iain, and Fabian Mushövel. 2016. “The Economic Impact of Brexit: Jobs, Growth and the Public Finances.” London School of Economics and Political Science, LSE Library 67008.

Bibu, Nicolae, Petru Stefea, and Diana Sala. 2009. “External and Internal Environment influences on SME Competitiveness from the Western Area of Romania.” Megatrend Review, 6(2): 41-52.

Booth, Stephen, Christopher Howarth, Mats Persson, Raoul Ruparel, and Pawel Swidlicki. 2015. “What If..? The Consequences, Challenges and Opportunities facing Britain outside the EU.” Open Europe.

Busse, Matthias, and Jens Koniger. 2015. “Trade and Economic Growth: A Re-examination of the Empirical Evidence.” Economics Bulletin, 35(4): 2862-2876.

Cornish, Rosie. 2007. “Statistics: 3.1. Cluster Analysis.” Mathematics Learning Support Centre http://www.statstutor.ac.uk/resources/uploaded/clusteranalysis.pdf (accessed on September 04, 2017).

Crafts, Nicholas. 2016. “The Growth Effects of EU Membership for the UK: Review of the Evidence.” Competitive Advantage in the Global Economy (CAGE).

Dăncică, Daniela E. 2006. “Cluster Analysis in the Study of Life Quality on the Central and Eastern European Countries.” Zagreb International Review of Economics and Business, 9(1): 45-60.

Dhingra, Swati, Gianmarco I. P. Ottaviano, Thomas Sampson, and John Van Reenen. 2016. “The Consequences of Brexit for UK Trade and Living Standards.” London School of Economics and Political Science, LSE Library.
Dinca, Melinda, and Daniel Luches. 2018. “Work Integration of the Roma: Between Family and Labor Market.” *Sustainability*, 10(5): 1495. doi: 10.3390/su10051495.

European Commission. 2016. The Economic Outlook after the UK Referendum: A First Assessment for the Euro Area and the EU. Institutional Papers 032. https://ec.europa.eu/info/sites/info/files/file_import/ip032_en_2.pdf (accessed on September 12, 2017).

European Commission. 2017. Eurostat database. http://ec.europa.eu/eurostat (accessed on August 28, 2017).

Hirst, Paul, and Grahame Thompson. 2002. “The Future of Globalization.” *Cooperation and Conflict: Journal of the Nordic International Studies Association* 37(3): 247–265. https://doi.org/10.1177/0010836702037003671.

Irwin, Gregor. 2015. “BREXIT: the Impact on the UK and the EU.” Global Counsel.

Jafari, Yaghoob, and Wolfgang Britz. 2017. “Brexit – an Economy-wide Impact Assessment Looking into Trade, Immigration, and Foreign Direct Investment.” Paper presented at the 20th Annual Conference on Global Economic Analysis “Global Economic Analysis in the 21st Century: Challenges and Opportunities”, West Lafayette, Indiana, USA.

Jara, Alejandro, and Hubert Escaith. 2012. “Global Value Chains, International Trade Statistics and Policymaking in a Flattening World.” *World Economics*, 13(4): 5-18.

Kierzenkowski, Rafal, Nigel Pain, Elena Rusticelli, and Sanne Zwart. 2016. “The Economic Consequences of Brexit: A Taxing Decision.” OECD, Economic Policy Paper Series 16.

Krugman, Paul. 1979. “A Model of Innovation, Technology Transfer, and the World Distribution of Income.” *Journal of Political Economy*, 87(2): 253-266. https://doi.org/10.1086/260755.

Lee, Jong-Wha. 1993. “International Trade, Distortions, and Long-Run Economic Growth.” IMF Staff Papers, 40(2): 299-328. https://doi.org/10.2307/3867316.

OECD. 2005. “Handbook on Constructing Composite Indicators: Methodology and User Guide.” Statistics Working Paper. Paris: Organization for Economic Cooperation and Development. DOI: 10.1787/533411815016.

Pain, Nigel, and Garry Young. 2004. “The Macroeconomic Effect of UK Withdrawal from the EU.” *Economic Modelling*, 21(3): 387-408. https://doi.org/10.1016/S0264-9993(02)00068-8.

Pirtea, Marilen, Claudiu Botoc, and Cecilia Jurcut. 2014. “Risk and Return Analysis: Evidence from Emerging Markets.” *Transformations in Business & Economics*, 13(2B): 637-647.

Portes, Jonathan. 2016. “Immigration after Brexit.” *National Institute Economic Review*, 238(1): R13-R21. https://doi.org/10.1177/002795011623800111.
Portes, Jonathan, and Giuseppe Forte. 2017. “The Economic Impact of Brexit-Induced Reductions in Migration.” Oxford Review of Economic Policy, 33 (suppl 1): S31–S44. https://doi.org/10.1093/oxrep/grx008.

Romer, Paul M. 1990. “Endogenous Technical Change.” Journal of Political Economy, 98(5): 1002-1032. https://doi.org/10.1086/261725.

Simionescu, Mihaela. 2002. “The Impact of BREXIT on the Foreign Direct Investment in the United Kingdom.” Bulgarian Economic Papers, 7: 2-17.

Suciu, Marta C., Mirela Cristea, and Gratiela G. Noja. 2018. “Immigration Effects within the EU-Brexit Framework: An Empirical Analysis.” Economic Computation & Economic Cybernetics Studies & Research, 52(4): 113-130. DOI: 10.24818/18423264/52.4.18.08.

Tüzüntürk, Selim, Betül İnam, and Filiz Giray. 2018. “Analyzing the Relationship Between Foreign Direct Investment and Privatization in the European Union Founder Nations by Using Panel Data Approach.” Panoeconomicus, 65(5): 587-607. http://dx.doi.org/10.2298/PAN160106001T.

United Nations Conference on Trade and Development. 2017. UNCTADstat. http://unctadstat.unctad.org/EN/ (accessed on September 04, 2017).

Vandenbussche, Hylke, William Connell, and Wouter Simons. 2019. “Global Value Chains, Trade Shocks and Jobs: An Application to Brexit.” CESifo Working Paper 7473, 1-45. https://ssrn.com/abstract=3338827 (accessed on March 31, 2020).

World Bank. 2017. World Development Indicators. https://data.worldbank.org/indicator (accessed on October 17, 2017).

Wyplosz, Charles. 2016. “What to Do with the UK? EU Perspectives on Brexit.” CEPR Press.
## Appendices

### Table 1 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 | \( \frac{3}{4} \% \) 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    | 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,          | The OECD’s METRO model and the National Institute                             | Both near term (2020) and long run (2030), GDP would be smaller               |
Deregulation, for near term (2020) and longer term (2030). Global Econometric Model (NiGEM) macro model for the world economy 3%, respectively 5%. Capital, immigration and lower technical progress would influence the structural changes for the long term.

| Source | Effects for | 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 |
|--------|-------------|--------------|-----------------------------------------------------------------------------------|------------------------------------------|
| Simionescu (2016) | UK | | | |
| Jafari and Britz (2017) | 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) | 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 |

**Table 2** 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 3 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 |
|---------------------|---------------|----------------|----------------|----------------|----------------|-------|------|
| 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 2019-2019

| 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 - | 265.3422*** 0.6045 |

### GDP growth 2015-2019

| GDP_growth | 10 0.295 0.241 | 12 0.252 0.182 | 3 -0.047 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*** 0.8826 |
| 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 - | 1  5.787 1.280 | 1  338.1672*** 0.8925 |
| Source: Authors’ research |
|--------------------------|
| RD_exp                   |
| 10 -0.552 0.478 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 1.2 0.800 0.289 3 0.783 0.228 2 -1.050 1.787 1 0.694 0.087 16.2661*** 0.2853 |
### Table 4: 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*** (0.0300)     | 0.641*** (0.0909)   | -0.0426 (0.0221)       | 0.212 (0.139)          |
| **EDU**              | -0.0354 (0.0297)      | -0.229* (0.114)     | 0.0879** (0.0218)      | -0.141 (0.174)         |
| _cons                | -0.0919** (0.0284)    | 0.465*** (0.115)    | -0.0325 (0.0209)       | 0.232 (0.176)          |
| **HT_X**             |                       |                     |                        |                        |
| **RD_exp**           | 0.240*** (0.0372)     | 0.198** (0.0733)    |                        |                        |
| **EDU**              | -0.311*** (0.0368)    | 0.0857 (0.0917)     |                        |                        |
| _cons                | -0.0773* (0.0352)     | 0.112 (0.0929)      |                        |                        |
| **OD**               |                       |                     |                        |                        |
| **RD_exp**           | -0.0800** (0.0308)    | -0.0316 (0.0858)    | -0.0800** (0.0308)     | -0.0316 (0.0858)       |
| **EDU**              | -0.0104* (0.0305)     | -1.221*** (0.107)   | -0.0104* (0.0305)      | -1.221*** (0.107)      |
| _cons                | -0.0709* (0.0291)     | 0.945*** (0.109)    | -0.0709* (0.0291)      | 0.945*** (0.109)       |
| **GDP_cap**          |                       |                     |                        |                        |
| **Exports**          | 0.357*** (0.0367)     | 0.135** (0.0453)    |                        |                        |
| **HT_X**             | 0.00448 (0.0271)      | 0.621*** (0.0681)   |                        |                        |
| **OD**               | 0.410** (0.0384)      | 0.350*** (0.0368)   |                        |                        |
| **FDI_i**            | 0.229*** (0.0660)     | 0.0625 (0.0457)     |                        |                        |
| **FDI_o**            | 0.314*** (0.0478)     | 0.153*** (0.0434)   |                        |                        |
| **EARN**             | 0.0947*** (0.0266)    | 0.0132 (0.0558)     |                        |                        |
| _cons                | 2.750*** (0.0252)     | 2.728*** (0.0495)   |                        |                        |
| **FDI_i**            |                       |                     |                        |                        |
| **RD_exp**           | 0.124*** (0.0203)     | 0.533*** (0.155)    |                        |                        |
| **EDU**              | -0.00128 (0.00119)    | -0.0202 (0.0115)    |                        |                        |
| _cons                | -0.187* (0.0804)      | 1.186 (0.901)       |                        |                        |
| **FDI_o**            |                       |                     |                        |                        |
| **RD_exp**           | 0.0187 (0.0265)       | -0.0764 (0.144)     | 0.0187 (0.0265)        | -0.0764 (0.144)        |
| **EDU**              | -0.00645*** (0.00155) | -0.0402** (0.0107)  | -0.00645*** (0.00155)  | -0.0402** (0.0107)     |

*Denotes significance levels: *** p < 0.01, ** p < 0.05, * p < 0.1.
|        | _cons    | EARN     | RD_exp | 0.145*** | 0.327*** | 0.145*** | 0.327*** |
|--------|----------|----------|--------|----------|----------|----------|----------|
|        |          |          |        | (0.105)  | (0.0913) | (0.0420) | (0.0914) |
|        | _cons    | 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    | var(e.HT_X) |          | 0.554*** | 1.618*** |          |          |
|        |          | _cons    |          | (0.0296) |          |          |          |
| 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 |

**Source:** Authors’ research

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

**Table 5** Unit Root Tests of the Residuals from the GDP-Trade-FDI Impact Models

| LLC (Levin-Lin-Chu) | LLC (Levin-Lin-Chu) |
|---------------------|---------------------|
| p-value | 0.6765 |
| t-statistic | 0.4578 |
| ADF regressions: 1 lag |
| LR variance: Bartlett kernel, 10.00 lags average |
| p-value | 0.8792 |
| t-statistic | -6.5991 |
| Test critical values: |
| 1% | -1.810 |
| 5% | -1.730 |
| 10% | -1.680 |
| Im-Pesaran-Shin |
| ADF regressions: No lags included |
| AR parameter: Panel-specific |
| 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 |

**Source:** Authors’ research

**Table 6** Goodness-of-Fit Tests for the SEM

| Fit statistic | Description | GDP_capita | GDP_capita | GDP_growth | GDP_growth |
|---------------|-------------|------------|------------|------------|------------|

30
|                | 1995-2019 | 2020-2025 | 1995-2019 | 2020-2025 |
|----------------|-----------|-----------|-----------|-----------|
| Likelihood ratio |           |           |           |           |
| model vs. saturated | 1390.192  | 509.621   | 1108.532  | 795.369   |
| p > chi2 baseline vs. saturated | 2119.335  | 985.628   | 1249.841  | 1394.983  |

| Information criteria | AIC Akaike | BIC Bayesian |       |       |
|----------------------|------------|--------------|-------|-------|
| 1995-2019            | -15676.577 | -2171.676   | -15152.077 | -2290.600 |
| 2020-2025            | -15530.942 | -2071.709   | -15006.442 | -2190.633 |

| Baseline comparison CFI Tucker-Lewis |       |       |
|-------------------------------------|-------|-------|
| 1995-2019                          | 0.343 | 0.192 |
| 2020-2025                          | 0.103 | 0.432 |

| Size of residuals SRMR CD Coef of determ |       |       |
|------------------------------------------|-------|-------|
| 1995-2019                                | 0.145 | 0.366 |
| 2020-2025                                | 0.175 | 0.656 |

Table 7 Wald Tests for Equations, GDP per capita

| Variable | Chi2 GDP_capita 1995-2019 df p-value | Chi2 GDP_capita 2020-2025 df p-value |
|----------|--------------------------------------|--------------------------------------|
|          |                                      |                                      |
| 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 8 Wald Tests for Equations, GDP growth

| Variable | Chi2 GDP_growth 1995-2019 df p-value | Chi2 GDP_growth 2020-2025 df p-value |
|----------|--------------------------------------|--------------------------------------|
|          |                                      |                                      |
| 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_growt | 43.46 6 0.0000                     | 2061.3 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 9 Results for Cronbach’s alpha – GDP per capita

| Item       | Obs   | Sign | Interitem correlation | alpha | GDP_capita 1995-2019 | Sign | Interitem correlation | alpha | GDP_capita 2020-2025 |
|------------|-------|------|-----------------------|-------|-----------------------|------|-----------------------|-------|-----------------------|
| 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                |

Source: Authors’ research

### Table 10 Results for Cronbach’s alpha – GDP growth

| Item       | Obs   | Sign | Interitem correlation | alpha | GDP_growth 1995-2019 | Sign | Interitem correlation | alpha | GDP_growth 2020-2025 |
|------------|-------|------|-----------------------|-------|----------------------|------|-----------------------|-------|----------------------|
| 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** |       |      |                       | 0.5003 |                      |       |                       |

Source: Authors’ research

### Table 11 Macro-econometric Models – Various Estimation Procedures – GDP_capita 2020-2025

| Item       | (1)   | (2)   | (3)   | (4)   | (5)   |
|------------|-------|-------|-------|-------|-------|
| GDP_cap    | RE-ECM/GLS | GDP_cap | GDP_cap | GDP_cap | GDP_cap |
| Exports    | 0.268* | 0.334* | 0.0281 | 0.0413 | -0.9994*** |
| HT_X       | 0.601*** | 0.641*** | 0.730*** | 0.741*** | -0.8881*** |
| OD         | 0.106  | 0.0157 | 0.255*** | 0.255*** | 0.0272**  |

Source: Authors’ research
| Variable     | Coefficient 1 | Coefficient 2 | Coefficient 3 | Coefficient 4 | Standard Error |
|--------------|---------------|---------------|---------------|---------------|----------------|
| 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**       |                |                |                | 1.426**        |
|              | (0.0146)      |                |                |                | (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: chi2=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

Note: 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 12 Macro-econometric Models – Various Estimation Procedures – GDP_growth 2020-2025

| Variable     | (1)       | (2)       | (3)       | (4)       | (5)       |
|--------------|-----------|-----------|-----------|-----------|-----------|
| GDP_gr       | 0.282**   | 0.279***  | 0.303***  | 0.300***  | 0.0534*** |
| (0.0368)     | (0.0416)  | (0.00211) | (0.0143)  | (0.0607)  |
| M_gr         | -0.0395   | -0.0408   | -0.0467***| -0.0422***| -0.00419  |
| (0.0257)     | (0.0255)  | (0.000550)| (0.0121)  | (0.0298)  |
| OD           | -0.0234   | 0.0161    | -0.0805***| -0.0824***| 0.00237   |
| (0.0477)     | (0.0748)  | (0.00148) | (0.0146)  | (0.0675)  |
| FDI_i_gr     | 0.117     | 0.110     | 0.0836**  | 0.112**   | 0.0217    |
| (0.111)      | (0.127)   | (0.00953) | (0.0387)  | (0.0975)  |
| 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***  |           |
| _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       |
| R²           | 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

Note: 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