DOES FOREIGN DIRECT INVESTMENT INCREASE BUSINESS R&D EXPENDITURES IN HOST COUNTRIES?

_____

Steinhauser D.
_____

Dušan Steinhauser / Bratislava University of Economics and Business, Faculty of Commerce, Department of International Trade, Dolnozemská cesta 1, Bratislava, Slovakia. Email: dusan.steinhauser@euba.sk.

Abstract

During the current multiple crises periods, economies are trying to find their way to development. One possibility is investment in research and development (R&D). However, emerging economies often have limited resources, so they rely on stimulating R&D through FDI inflows. The question remains about the effectiveness of this path. To investigate this question methodologically, a panel regression analysis with fixed effects was applied. The presented research was inspired by the empirical finding that a correlation between FDI inflow and business expenditure on research and development (BERD) has not been proven in EU countries. However, the new 11 EU members, have shown that FDI inflows influence BERD only in manufacturing sector. To confirm Dunning's investment development path (IDP) theory, the impact of net outflow foreign direct investment (NOFDI) on BERD was examined. We confirmed the specific IDP of new EU states and found a limited positive relationship between NOFDI and EU27 BERD in manufacturing, but gross value-added had a greater effect on BERD.

Implications for Central European audience: The Central European region, many of which were centrally planned economies in the past and underwent a transformation process, is the narrow focus of the article. Moreover, Central European countries are currently seeking a successful and effective development path, bolstered by research and development expenditures. Naturally, the article also provides a regional overlap perspective, as many other states can draw inspiration from the new member states and their respective development paths. Keep in mind that the Central European region's post-communist economies often serve as illustrations of Dunning's development path theory in action.

Introduction

Certain topics in economics are considered definitive and established, and they do not undergo continuous or recurrent verification. It frequently refers to politics and the decision sphere. These topics, such as the favourable influence of foreign direct investment (FDI) on

business expenditures on research and development (BERD) growth, are included in this topic list. There is literature that demonstrates both positive and negative effects of FDI inflows on R&D or innovation. The first group includes Berschek (1995), Telater et al. (2014), or Das and Chatterjee (2021). As for the second group, the negative effects of FDI on R&D can be found in the work of Lee (1996) or Kathuria (2008). However, there are also opinions that in the open environment of knowledge transfer that becomes available to firms, a substitution process for R&D activities occurs because it is illogical for firms to invest in innovation, science, and research if they can use available knowledge (Nieto & Quevedo, 2005).

And these questions are crucial for some types of countries that are determined to raise their economic level but lack internal sources of economic growth. In BERD, they divert resources to other uses, rely on external funds, and expect that the FDI inflow will automatically lead to an increase in BERD. In this case, however, it is necessary to monitor the type of economy, its historical origins, its involvement in global supply or value chains (GVCs), and the quality of the investments themselves. As a result, the presented study is not among the unequivocal supporters of the impact of FDI on BERD, but it certainly does not recommend underestimating it either. On the contrary, the presented study can provide very useful evidence that, in order to stimulate the BERD, it is necessary not only to attract new FDI from abroad but also to activate the country's internal resources to make R&D support a political priority for development. As a result, the article was placed within the theoretical framework of Dunning's investment development path (IDP). Despite focusing on specific EU member states, we maintain the belief that their development principles are applicable to all nations pursuing development initiatives.

However, this topic is important not only from a development point of view. FDI abroad is necessary for sustainable development because it is an indicator of the economy's competitiveness and maturity level. We also follow up on the findings of Villalvazo (2024), who claims that a rapid recession can occur in small economies in times of crisis, while more advanced economies have resources created abroad in the form of FDI outflow, which can correct these declines. And these questions are especially interesting at a time of multiple crises, from COVID-19 to the war in Ukraine.

The paper will be organised in the following manner: In the literature review section, we will provide a concise overview of significant articles regarding the effects of FDI on host economies, as well as the dissemination of knowledge and technology spillovers. Furthermore, we will delve into the subject of GVCs, a topic that directly aligns with our research focus. We shall analyse Dunning's IDP as a distinct process. The Materials and Methods chapter provides an overview of the methodological foundations, variables, and data sources used in the study. We have endeavoured to ensure that our analyses are straightforward. We source the data for our analyses from Eurostat, a reputable statistical authority. These variables are freely available, easily verifiable, and regularly updated.

The Results and Discussion chapter, split into four subsections, comes next. Initially, we will assess the FDI intake at BERD. Following that, we will examine the presence and reliability of Dunning's IDP. Then, we will evaluate the effect of the net outflow of FDI (NOFDI) on BERD. The acronym NOFDI represents the difference between FDI abroad and FDI invested within the domestic economy. It serves as the fundamental analytical variable for

understanding Dunning's IDP theory. Lastly, we offer an interim resumé and then interpret our gross value-added parameter estimations and their relationship to BERD.

1   Literature review

1.1 Dunning's investment development path

Boudier-Bensebaa (2008) states that there are several development theories. For example, M. Porter recognises four stages of development according to competitiveness (Porter, 1990); another alternative is the theory by Ozawa (1992). However, one of the most widely used is Dunning's (1981) IDP theory.

The rich literature (current bibliographic review offers a study by Sawitri and Brannan, 2023) manifests the numerous applications of this economic theory, which considers five development stages of economies and uses the variable NOFDI to determine the state. NOFDI represents the difference between the position of investments abroad and in the domestic economy, and tests the quadratic shape of the regression curve between NOFDI and gross domestic product per capita (GDP p.c.) (closer, e.g., Djokoto, 2021). The theory assumes that in the first stage of development, the economy does not generate investments abroad due to insufficient development and the lack of sources, but in the first stage, the economy slowly becomes a recipient of FDI. This FDI cautiously generates exports. In the second phase, the country becomes a massive destination for FDI from abroad. In the next phase, the economy becomes a marginal investor abroad. In the fourth phase, the country is a significant investor. While in the fifth phase, the most developed economies are concerned with satisfying the sophisticated demands of their population rather than foreign investments. The specific phases of the IDP can be briefly summarised in the following stages (Dunning & Lundan, 2008; Ferenčíková & Ferenčíková, 2012):

1. A country in the first phase of development is usually import-intensive. Export activities are based primarily on simpler production built on its competitive advantage, mainly of natural resources and labour-intensive sectors. The value of net outflow FDI decreases as the first foreign affiliates arrive in the country. However, in the case of FDI inflow, there is a danger of creating a so-called dual economy, in which domestic producers remain less productive than foreign investors.

2. The second phase, thanks to the growth of the domestic market, stimulates investments in activities with higher value-added. Dunnung and Lundan (2008) argue that in this phase, institutions are intensified, such as secondary education, public health, transport, or communication. In this phase, the country should stimulate its own investment activity before foreign FDI inflows, especially in large capital-intensive sectors such as the chemical industry or metalworking. Small sectors should develop knowledge-intensive goods such as electrical products and textile products.

3. In the third phase of growth, advanced economies emerge that are based on innovation. In terms of consumer behaviour, higher living standards determine the demand for quality and differentiated products. Tertiary education and communication institutions are intensified. FDI inflows can still be observed, but

these are intended to support sectors based on innovation and high quality, which represents a transition from capital-intensive industries.

4. The stage is characterised by the effort to increase efficiency while creating intra-industry specialisation rather than inter-industry. Companies are globalising. A very important role is played by research and development expenditures, which lead to innovations in the field of new products or production methods. The authors specifically mention computer and telecommunications technologies. The role of the government is to protect the economy from systemic failures.

5. In the final phase of growth, economies focus on meeting the advanced needs and demands of their populations. Interestingly, in this phase, net FDI outflows oscillate around zero.

Modified Dunning's IDP can be graphically seen in Figure 1. The modification consists of replacing GDP per capita with gross value added (GVA), which can also be used for sectoral analyses and is also suitable for the analysis of panel data with fixed effects. In these types of analyses, the estimated coefficients are interpreted as changes over time, thus making it possible to compare different countries with respect to their economic size or population.

Figure 1 | Dunning's investment development path modified by GVA
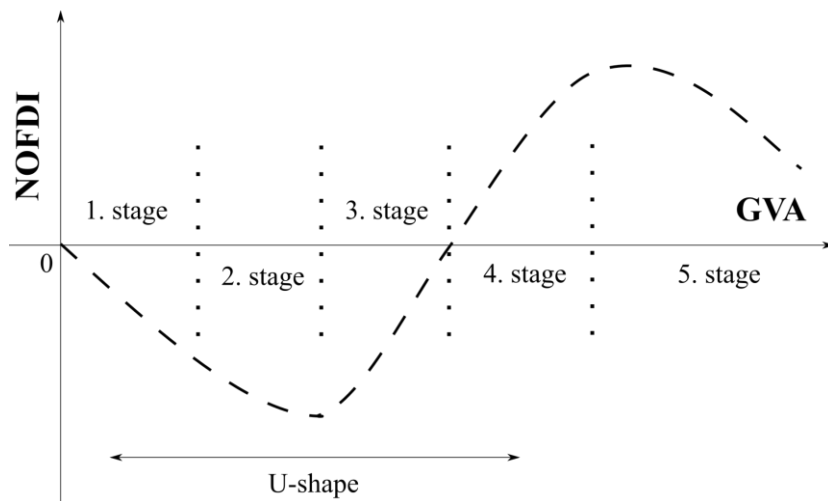
Source: own processing based on Narula and Dunning (2010); Djokoto (2021)

As for the empirical movement on the IDP, the second to third growth phases are characterised by development in qualitative and efficiency understanding through inter-industry specialisation, naturally within the GVC (e.g., Ferenčíková & Ferenčíková, 2012). These processes are practically implemented through outsourcing and offshoring. Based on the analysis of input-output tables, it is shown that these outsourcing and offshoring trends dominated until approximately 2010. Since then, the nearshoring tendency has prevailed, which characterises the increasing share of the entire manufacturing subsystem in developed countries (the manufacturing subsystem also represents related subcontracting ties from other industries; Lábaj & Majzlíková, 2022; 2023; Majzlíková, 2024). However, these revealed economic trends support earlier concerns about the deteriorating position within GVCs of

some economies in Central and Eastern Europe, which were highlighted by Kordalska and Olczyk (2022, 2023).

At this point, it is important to draw attention to deviations from the theoretical investment path. These divergences are observed, e.g., in Central and Eastern European countries, including 11 new and former post-socialist EU members (Narula & Guimon, 2010). The reasons are diverse, ranging from historical ties to the institutional environment, the state of GDP and FDI at the beginning of the transformation, and many others. We would like to discuss and develop these determinants further in the results of this study. However, other countries in the world with different socio-economic characteristics also exhibit deviations. Gorynia et al. (2020) also investigated the specifics of the IDP of five selected countries from the CEE region, and particularly the impact of integration on their investment flows. The authors found that integration in these countries was supported more by FDI inflows than by their outflows. Djokoto (2021) even suggests that the government should actively stimulate its companies' willingness to invest abroad, e.g., by developing a list of potential investment destinations. It's noteworthy that new member countries are specifically making efforts to diversify, particularly in export flows. The Slovak Republic serves as an example of this trend (The concept of foreign economic relations and economic diplomacy of the Slovak Republic for the period 2022–2030; Ministry of Economy and the Ministry of Foreign and European Affairs of the Slovak Republic, 2021).

According to Stoian (2013), countries in Central and Eastern Europe are also slowly starting to invest in other countries. To investigate this, she described the benefits of investing abroad in 20 so-called European emerging and post-communist economies. From an analytical point of view, she suggested adding institutional factors to the models of the IDP to make them more accurate. The author included the home country's economic development as measured by GDP per capita, the domestic technological development as measured by R&D per GDP, and the domestic inward FDI. Among the institutional factors of FDI outflow, the author included such variables as home country trade and foreign exchange, privatisation, and restructuring reforms.

Djokoto et al. (2024) focused on the relationship between FDI and domestic investments, particularly divestments. They recommend that the decision-making sphere in Central and Eastern Europe should strategically focus on the growth of net exports, which encourages foreign investors to stay in these economies and domestic companies to invest in R&D in order to increase domestic investment, de facto GDP, and growth. The reason is the danger of the crowding-out effect of disinvestment, not only of the inflow but also of the outflow of FDI. Finally, we can mention an early study by Bellak (2000), which revealed certain specificities of the IDP not only in CEE countries but also in small developed states such as Austria.

1.2 Impact of FDI on R&D, knowledge spillovers, and productivity growth

At the beginning of our short excursion, it is useful to define the difference between knowledge and technology spillovers (e.g., Kittová, 2016). Knowledge spillover represents a channel for the inflow of knowledge and expertise from abroad, for example, through

investments, but technology spillovers are necessary when applying the results of science and technology to economic processes, and it is actually about their commercialization. As stated by Kittová (2016), the role of the state is to facilitate and support this costly process.

Berschek (1995), who, based on a microeconomic analysis of German companies, proved the positive impact of investments, but also exports, on the innovation activity of companies due to increased competition. Telatar et al. (2014) proved that there is a complementary, one-way causality between FDI and R&D in the EU. The authors examined the EU15 and EU27 separately for the period 1996–2009. Das and Chatterjee (2021) even proved two-way causality between FDI inflows and R&D, as sustainable growth requires capital accumulation through FDI. Countries with higher R&D expenditures are destinations for FDI inflows, and vice versa, FDI generates higher R&D. Although Lee (1996) did not primarily investigate the impact of FDI on R&D, he used Heckman's two-stage estimation of the impact of technology imports on the R&D efforts of South Korean firms. However, the import of technologies often serves as a substitute for R&D efforts. Conversely, in a footnote, the author mentions that he also marginally tested the impact of FDI on R&D efforts, but achieved similar results to the mentioned technology imports. Kathuria (2008) applied the analysis to Indian conditions, which required companies to increase their competitiveness in 1992. They had the choice of buying a license for the RD subject or doing their own research. They discovered that initially, FDI inflows had a limited impact on R&D after 1992, but later, this impact became insignificant. Nieto and Quevedo (2005) also confirm these studies.

Uyar et al. (2022) analysed the relationship between R&D spending, economic development, and research productivity. The authors quantified research productivity using citable numbers from published works. The authors found that economically more advanced countries have the capacity to create larger R&D financial funds, and again, research outputs increase these funds. On the other hand, the authors rejected the impact of FDI, trade, or finance on research productivity.

Vujanović et al. (2022) dealt with the different approaches of companies in developed and developing (emerging) countries. Developed countries tend to generate new knowledge, while companies in developing countries apply it. The authors assessed these two competing approaches and found that in emerging economies, there is an imitation process, and those imitating firms benefit more from applying knowledge than from generating it. Ali et al. (2016) dealt with the impact of human capital, which, together with research and development and foreign knowledge spillovers, has a positive impact on national productivity. It is also very interesting to find that knowledge spillovers resulting from foreign investments and trade are complementary. Spithoven and Merlevede (2023) found that R&D has a greater impact on the growth of company productivity than FDI knowledge spillovers. They therefore recommend policymakers support the intra-regional innovation system.

1.3 Mechanisms of vertical and horizontal knowledge spillovers

Kokko (1992) or Blomström and Kokko (1998) claim that local companies are increasing the quality of their production within the supply chain (vertical FDI). In the case of horizontal FDI, foreign investors train their employees in the sector, create pressure for domestic firms to adopt new technologies, or force them to withdraw from the market.

At the microeconomic level, Orlic et al. (2018) examined the impact of multinational corporations on productivity in the manufacturing sector, as well as the impact of foreign

companies on their competitors in host countries. Based on the input-output approach, the authors were able to examine the effect of knowledge spillovers in vertical and horizontal FDI within five economies, which are also part of our sample. It concerns the Czech Republic, Estonia, Hungary, Slovakia, and Slovenia between the years 2002 and 2010. The authors confirmed the significant impact of customer-supplier ties between domestic and foreign companies (vertical FDI), as well as the positive presence of service companies. They also proved the positive influence of horizontal FDI, highlighting the mobility of employees who gained skills and knowledge from foreign investors. On the other hand, the demonstration effect and foreign competition have a negative impact. The study shows the differentiating tendencies between the former post-communist economies because the Czech Republic shows a higher absorptive capacity of companies, measured by a higher share of intangible assets, than in Slovakia or Estonia.

In terms of knowledge spillover channels, Bournakis and Tsionas (2022) assume that spillovers can occur because of technology transfer, better organizational and managerial practices, better distribution networks, or foreign competition. They also point out the negatives of increased competition from foreign firms operating in host economies, which comes with a higher risk of a crowding-out effect on domestic firms. The authors also confirmed more intensive knowledge spillovers in the vertical (inter-industry) than in the horizontal (intra-industry) FDI. These results follow the older but influential literature on knowledge spillovers in vertical or horizontal FDI and confirm their conclusions (Javorcik, 2004; Newman et al., 2015).

Vujanović et al. (2021) decided to analyse the crisis from 2006 to 2014 with possible application to the COVID-19 pandemic. They are focusing on the role of FDI spillovers in times of crisis. The authors discovered that the crisis exhausted companies' financial possibilities, slowed down, and even stopped spillover processes. Small firms were at the biggest disadvantage, so the authors propose to create government support programmes in times of crisis so that the favourable absorption mechanism in these firms does not stop.

1.4 The role of global supply chains in developing economies

The participation of economies in GVCs is determined by the search for the highest possible efficiency of production and economies of scale, while their assumptions can be seen in the classic works of Krugman (1980; 1981). GVCs have their advantages and disadvantages. Especially after the outbreak of the COVID-19 pandemic or the war in Ukraine, concerns about the physical interruption of supplies arose. However, consideration of the probable risks of participation in GVCs has stimulated a discussion about possible reconfigurations of these channels, e.g., reshoring or nearshoring. The reason is the growing threat of protectionism (Khorana et al., 2022).

Steinhauser (2023) started with similar considerations about the riskiness of GVCs. Moreover, he assumed that more intensively involved economies would generate lower exported value-added. However, the results were the opposite. Based on the gravity modelling, the author proved that with the increase in export concentration, the exported value-added grew.

The OECD (2020) used the so-called METRO model to simulate the impact of economic shocks on GVC economies and those that did not participate. They found that involved economies have more options to face economic shocks, and even their recovery is faster this way. Similarly, the author collective, Camarero et al. (2022) or Bighelli et al. (2023), proved the positive impact of GVCs on productivity and employment in Europe.

Examining the structure and level of involvement in these chains is also necessary. Kordalska and Olczyk (2022) discovered that there were also differentiation tendencies between the new EU member states. For instance, economies like Slovakia or Poland, which engage in production activities with lower value-added, face disadvantages, while the Czech Republic and the Baltic States participate in GVCs that involve activities with higher value-added, such as research and development centres and management activities. Another article by the authors points out that it is necessary to stimulate activities with a higher value-added in the new EU member states because the rising wage level can take away the previous price competitiveness of these economies (Kordalska & Olczyk, 2023).

2 Materials and methods

Our article's primary objective is to investigate the possible relationship between the inflow of FDI into EU countries, with a specific focus on 11 new and former post-communist economies, and the subsequent increase in BERD. Furthermore, since there was no other evidence to support this correlation, our secondary aim is to explore whether we could predict BERD based on an increase in NOFDI. To achieve this aim, we utilised various analyses of panel data with fixed effects, which we will subsequently refer to as models. The general econometric equation with fixed effects valid for all our specifications has the following form (Torres-Reyna, 2007; Lukáčiková, 2013):

$$Y_{it} = \alpha_i + \beta X_{it} + \delta_t + u_i + e_{it} \tag{1}$$

where α_i means unknown intercept for each country, δ_t is the unknow coefficient for the time regressors, u_i is within-entity error term and e_{it} is overall error term. The equation also includes time effects, but during the research, we discovered a more advantageous and consistent form, so we excluded them. We used econometric software GRETL (Cottrell & Lucchetti, 2021). The figures were processed using Inkscape. Our methodology is straightforward, easily replicable, and incorporates variables not explicitly included in our specifications that significantly impact the dependent variables. This is primarily due to the adoption of fixed effects (Hsiao, 2014). Our models verified the following main hypotheses:

- ***H1:** FDI have a beneficial impact on BERD.*
- ***H2:** NOFDI have a beneficial impact on BERD.*

We have indeed developed models in Appendices 6 and 7 that validate the theoretical assumptions of Dunning's IDP. However, we have not formulated specific hypotheses for these models as they are supplementary to our main objective. However, these analyses are advantageous in terms of their contribution to the understanding, practical implementation, and updating of theoretical foundations and existing literature. We anticipate a negative coefficient for the parameter estimate that represents economic performance. Additionally, we expect a positive coefficient estimate for its square, indicating a U-shaped curve. Data were collected from Eurostat (2024a-c). The variables are described in Appendix 1. We will

refrain from providing further commentary on descriptive statistics in the appendix (Appendix 2 describes 27 EU countries, and Appendix 3 only 11 new EU members), as it is widely understood in the scientific community.

3 Results and discussion

3.1 Does the inflow of investment really influence the growth of R&D expenditures?

Firstly, in this study, we try to confirm if the inflow of FDI into the host economy fosters the creation of new knowledge within it, as evidenced by an increase in BERD. Should we fail to validate this process, we would be interested in scrutinizing the mechanism through the lens of Dunning's theoretical framework, which outlines the development path of FDI. However, it is crucial to examine if this theoretical framework is evident as anticipated not only in the EU states as a whole but also in the 11 former post-communist states that are now new members of the EU.

First, the correlation between the dependent variable BERD in the overall economy, followed by the manufacturing sector, and the condition of FDI in the host economy and GVA (Appendix 4 with main models 1 and 3 and their robustness checks). Here, we use GVA as a control variable to gauge the economic performance of the countries under investigation. Due to the initial illogicality of our results, we decided to conduct robustness checks in models 2 and 4 to address our concerns about the detrimental impact of collinearity.

Based on the main models 1 and 3, we can confirm that FDI inflow does not lead to an increase in BERD among the EU27 countries. Either the coefficients of the variables' parameters were statistically insignificant, namely, p-values allowing us to reject the null statistical hypothesis about the insignificance of the estimation (correlation between FDI inflow total and BERD total), or model 3 calculated this coefficient with an unexpected, negative sign (-0.019 *). Naturally, we disregard such an estimation and consider it statistically inconsequential. Robustness checks (models 2 and 4) have confirmed our results. This is evident not only in the calculated parameters of robustness checks but also in the inside coefficient of determination (R-squares), which is then exceptionally low. In contrast, the control variable exhibited statistical significance (variables GVA total and in the manufacturing sector). The inclusion of GVA resulted in an increase in the BERD value, both for the whole economy and specifically within the manufacturing sector.

Second, it was analysed 11 new EU members (Appendix 5). New member states have gone through the transformation process and can be labelled as former post-communist economies. According to the literature review based on empirical findings based on Dunning's IDP, countries that have gone through the transformation process show a different development trajectory based on the literature review. These economies mostly remained in the second stage of development, i.e., they are significant destinations of FDI, which considerably generate exports. The transition to the next stage of development, in which the economy itself becomes an investor abroad, is hindered by factors such as institutional specificities, existing informal ties stemming from the previous planned economy, the initial higher state of gross domestic product, and almost zero FDI in the economy at the beginning

of the transformation process (Narula & Guimon, 2010). In our opinion, another factor that keeps former post-communist economies in the second phase is intensive involvement in GVCs. The transformation process was accompanied by the loss of the competitive advantage of these states because, after the breakdown of economic ties within the Council of Mutual Economic Assistance (COMECON), socialist production could not compete with capitalist countries. At the same time, post-communist countries did not have sufficient resources for research and development. In this way, they were dependent on the inflow of FDI from abroad, which, from the beginning, made full use of the cost factors of competitiveness. It is true that some countries have been able to increase their level of participation in GVCs, as proved by the works of Kordalska and Olczyk (2022, 2023). Last but not least, we would like to take into account the degree of urbanisation and population mobility in the new 11 EU member states. There exists a positive relationship between urbanisation and economic growth (Nguyen & Nguyen, 2018). Enhanced labour force mobility is anticipated as countries improve their allocative efficiency (Habrman et al., 2022). During the period of the planned economy, industry was not allocated purely on the basis of comparative advantages of location but on the basis of the administrative division of labour first among COMECON members and later on the basis of administrative decisions within these countries. This is one of the reasons why these countries have created regions that are today less economically developed and poorer, and that have lost job opportunities after the termination of uncompetitive industrial enterprises in these regions.

These determinants had a high probability of leading to our different panel regression results for the 11 new EU member states, former post-communist countries, compared to the EU as a whole. Although for all sectors of the economy, the impact of the inflow of FDI into the host economies on the growth of the BERD was also not proven. However, in the manufacturing sector, there is evidence that an increase in FDI inflows determines an increase in BERD (0.014 ***). The reason may be the fact that the new member states are primarily industrial economies that face significant competition from third countries, especially the so-called emerging economies (China, India, and others). As a result, it is critical that foreign mothers' subsidiaries stimulate BERD in order to maintain their competitive advantage in the manufacturing sector.

3.2 Are new member states on the path? Investment development path?

Given that our findings did not provide conclusive evidence of a significant influence of FDI inflows on BERD in the host economy, we proceeded to examine the fundamental theoretical assumptions of Dunning's IDP. We have developed two primary specifications for the general economy, referred to as model 5, and for the manufacturing sector, known as model 7. Additionally, we have conducted robustness tests for each of these specifications (both models and their robustness checks are shown in appendix, Appendix 6). Given our specific circumstances, it is necessary to consider that there exists a quadratic correlation between NOFDI, GVA (or any indicator of economic performance). In this instance, BERD is encompassed within the specifications as control variables. Nevertheless, it is vexing that the specifications containing the incorporated control variable have a substantial likelihood of collinearity. Hence, it was crucial to conduct robustness checks by excluding a control variable, while ensuring that the condition index (Belsley-Kuh-Welsch collinearity diagnostics) remained below 30 (Adkins et al., 2015). In order to verify the accurate U-shaped pattern of

the NOFDI regression curve, we anticipate a negative coefficient for GVA and a positive coefficient for sq_GVA (GVA2). The original theory calculates with the macroeconomic indicator of gross domestic product. Employing the GVA indicator, we adapted it to suit our specific needs. The use of GVA is beneficial as it captures the utilisation of production factors within the domestic economy, specifically the internal environment. We employed this indicator in opposition to FDI.

All models from 9 to 12, including their robustness checks, exhibit statistical significance. Thus, it can be confirmed that all member states have adhered to Dunning's theoretical IDP since 2013 (estimated parameter between GVA total and NOFDI total -0.684 ***, squared coefficient 0.000 ***, parameter between BERD total and NOFDI was insignificant; estimated parameter between GVA in manufacturing and NOFDI in manufacturing -1.607 **, squared coefficient 0.000 *, parameter between BERD total and NOFDI was insignificant; robustness checks without BERD specifications confirmed the shapes of the regression curves). These findings inspired us to examine the impact of NOFDI on BERD rather than focusing on FDI inflows. Nevertheless, the outcomes for 11 previous post-socialist nations substantiate the aforementioned characteristics. The anticipated outcomes are solely confined to model 13 (Appendix 7). However, these findings are undermined by the robustness check, as we were unable to refute the statistical hypothesis regarding the lack of significance of the variable parameter sq_GVA (GVA2).

3.3 So, does the net outflow of FDI have a beneficial impact?

So, we want to emphasise again that the current findings offer empirical support for the Dunning IDP theory across all EU nations. However, when focusing specifically on the 11 new member states with post-communist backgrounds, the evidence becomes unclear. However, our initial hypothesis regarding the influence of FDI inflows on BERDs remains unsubstantiated, prompting us to consider whether BERDs respond to the fluctuations in NOFDI. In order to address this issue, we have delineated two distinct sets of models (Appendix 8 to 9 with models from 17 to 20 and 21 to 24 in appendix; models 18, 20 and 22, 24 are robustness checks specifications without GVA variable). When analysing the effect of NOFDI on BERD in all EU member states using Model 17, we did not find any significant results (correlation between NOFDI total and BERD total was insignificant, estimated parameter between GVA total and BERD total 0.025 ***). This lack of significance is further supported by the robustness check conducted in Model 18. Only when the control variable GVA is considered (model 19; estimated parameter between GVA and BERD in manufacturing was 0.090 ***) does the manufacturing sector show a positive relationship between NOFDI and BERD (0.026 ***). This specification's robustness verification revealed a discrepancy (insignificant parameter estimation between NOFDI and BERD in manufacturing sector).

Regarding the 11 new member states, all estimates of the NOFDI parameter are statistically significant, even after conducting robustness checks. However, it is worth noting that the estimations have an unexpected negative sign. These data suggest that the new member states are not only still in the second phase of Dunning's IDP, but their status is deteriorating. Put simply, these economies continue to experience a substantial inflow of FDI, and there is no rise in abroad investments.

3.4 Evaluation of Hypotheses and Control Variable: Or What Role Internal Economic Factors Play in R&D Growth?

In the methodology, we established two hypotheses: The first (H1) was whether FDI inflow has a beneficial impact on BERD growth. We did not confirm this hypothesis with great explanatory power. However, this only applies to the EU as a whole. The H1 was confirmed in manufacturing sector of 11 new member states. This may be due to the industrial nature of their economies. In other words, we see no reason why we should not recommend the inflow of FDI into these economies. However, in order for this effect to cover all sectors, we recommend that governments should provide incentives to foreign investors from areas with higher value-added.

As for the second hypothesis (H2), here the situation is different. We have some evidence that an increase in NOFDI is positively associated with an increase in BERD in the manufacturing sector, but only in the EU27. We attribute this result to the unique IDP of 11 new members, who, according to the literature, remain in the second phase of development for a long time.

But the most significant estimations in almost all of our specifications (not including Appendix 6–7 with NOFDI as dependent variables) are the coefficients of the GVA parameters in relation to BERD growth. So far, we have only talked about these estimates in technical terms. In order to promote BERD, an economy must encourage internal economic activity. Simply engaging in international business does not guarantee an increase in BERD. Nevertheless, even these findings are not reasons to refuse foreign capital. Instead, the solution lies in establishing an internal framework that allows domestic entities to also contribute to the development of the BERD (Narula & Guimon, 2010). Currently, we can recall the findings of a significant publication by Javorcik (2004) and Newman et al. (2015) regarding beneficial channels of knowledge spillovers from vertical FDI, mostly occurring within supplier connections.

Despite the various risks associated with disruptions in GVCs (such as geopolitical threats and pandemics), it would likely be detrimental to sever the interdependence of economies within these chains. This is because such interdependence is a crucial process for enhancing economic efficiency. However, it is also fundamental to oversee the level of engagement in these networks to ensure that the new EU members shift away from simply producing activities and begin engaging in activities that offer greater value-added (Kordalska & Olczyk, 2023). To accomplish this, enhancing BERD in the economy is the exact approach to pursue. The Aspen Institute Central Europe (2019) conference emphasised the need to invest more in education, science, development, and research to enhance national competitiveness. Empirical studies such as Kittová et al. (2023) demonstrate that R&D expenditures have a positive impact on exported value-added, supporting this recommendation. Empirically, engaging in GVCs in a healthy and proactive manner yields numerous advantages, including enhanced productivity and improved resilience in the face of economic shocks (OECD, 2020; Camarero et al., 2022; Bighelli et al., 2023). The gravity model confirms that as the concentration index increases, which means more intensive GVCs participation, the exported value-added also increases (Steinhauser, 2023).

Furthermore, implementing measures to improve economies' sophistication can lead to higher export levels in terms of both quality and quantity. An illustration of this can be seen

in The concept of foreign economic relations and economic diplomacy of the Slovak Republic for the period 2022–2030, as outlined by the Ministry of Economy and the Ministry of Foreign and European Affairs of the Slovak Republic in 2021.

Conclusions

Our article's primary objective is to investigate the possible relationship between the inflow of FDI into EU countries, with a specific focus on 11 new and former post-communist economies, and the subsequent increase in BERD. Furthermore, since there was no other evidence to support this correlation, our secondary aim is to explore if we could predict BERD based on an increase in NOFDI (difference between investment abroad and in the reporting economy). However, to achieve this objective, it was imperative to validate the fundamental theoretical assumptions of Dunning's IDP, which posits a quadratic linkage between the economic level and NOFDI. To measure this economic level, we used the GVA indicator.

We have confirmed that all 27 member nations of the European Union exhibit the conventional Dunning development trajectory. However, this theoretical trajectory is not clear for the 11 new EU member states that have experience with post-communism, especially when considering the existing literature. The new member states have had a prolonged period in the second stage of development due to their distinct economic starting points, existing informal linkages, and the structure of their economies, as stated by Narula and Guimon (2010) and Boudier-Bensebaa (2008). One of the next determinants we consider is a high level of participation in GVCs. The transformation process resulted in the loss of the competitive advantages of these countries due to the dissolution of economic links within COMECON. As a result, socialist production was unable to compete with capitalist countries. This simultaneously serves as indisputable evidence of the inefficiencies and lack of competitiveness of the planned economy. At the same time, post-communist countries lacked adequate funding for research and development. Their reliance on foreign direct investment (FDI) was crucial since it effectively utilised the cost-related elements that contribute to competitiveness. Kordalska and Olczyk's (2022, 2023) demonstrates that certain nations have successfully increased their involvement in GVCs.

We performed panel regression analysis using fixed effects. The advantage of this approach is its ability to control for all unobserved variables, which, although not included in the model specifications, significantly influence the dependent variable (Hsiao, 2014). The utilisation of fixed-effects regression analysis significantly streamlined our research process. However, we included one control variable, GVA, in all specifications as previously specified. Nevertheless, the demonstrated impact of this variable on BERD enabled us to formulate more comprehensive conclusions and recommendations.

The coefficients of the GVA variables in all main panel models demonstrate a significant and positive relationship. This indicates that the main driver of BERD growth is the internal economic environment, rather than external factors such as the inflow of FDI or increased investment abroad. This remark refers to the theoretical basis of Dunning's IDP, which recommends stimulating and supporting domestic resources and investments from the second phase of growth, which, in our opinion, should be directed towards intensive support of overall or corporate spending on research, science, and innovation. However, it would be

unwise to entirely disregard international investment and abandon the endeavour to attract FDI. Instead, the focus should be on attracting FDI that brings greater value to GVCs. Of course, these results are based on a correlation, while the causal relationship can also be the opposite. However, we must leave this investigation as a recommendation and a stimulus for further research. However, there are studies that have proven the impact of BERD on value-added. As for exported value-added, the results are heterogeneous. Gravity modelling has not proven the impact of increased R&D spending on the growth of bilateral exported value added (Steinhauser, 2023). On the other hand, total exported value added grows with the increase in BERD (Kittová et al., 2023). Research and development spending also stimulates economic growth (Sikder et al., 2019).

We can confidently state, after a comprehensive analysis, that foreign investors consistently have the strongest motivation to leverage cost advantages in the economies of the host countries. However, the rise in GVA signifies the overall growth of the economic level in these economies. Conversely, highly developed economic entities functioning in a favourable climate facilitated by the EBRD can provide more complex products and services to their international partners or stimulate exports with greater economic value-added (e.g., Ministry of Economy and The Ministry of Foreign and European Affairs of the Slovak Republic, 2021; Kittová et al., 2023).

Our approach had limitations due to the relatively short time series in the panel analyses. On the other hand, these short time series alleviate problems with non-stationarity (Frensch et al., 2013). For further research, we recommend linking urbanisation and economic development in the new EU member states. It should also be mentioned that our methodology succeeds more with correlations and proven causalities. We also recommend this fact as a topic for further research. It would also be very interesting to adjust the methodology to include data from input-output tables and quantify the entire sectoral subsystem in this way, similar to Lábaj and Majzlíková (2022, 2023).

Acknowledgement

Conflict of interest: The authors hereby declare that this article was not submitted or published elsewhere. The authors do not have any conflicts of interest.

References

Adkins, L., Waters, M., & Hill, C. (2015). *Collinearity diagnostics in gretl*. Retrieved from https://learneconometrics.com/pdf/Collin/collin_gretl.pdf

Ali, M., Cantner, U., & Roy, I. (2016). Knowledge spillovers through FDI and trade: The moderating role of quality-adjusted human capital. *Journal of Evolutionary Economics*, 26(4), 837-868. https://doi.org/10.1007/s00191-016-0462-8.

Aspen Institute Central Europe. (2019). *Kam kráčíš, Česko? 2018 – panel Konkurenceschopnost* [Where are you going, Czech Republic? 2018 – Competitiveness Panel]. Retrieved from https://www.youtube.com/watch?v=wFmPAy0bwxY&list=PLk4X31s7N1fsoZUqgRHpMe2 R_1s_cCu7C&index=2

Bellak, C. (2000). *The investment development path of Austria* (Department of Economics Working Paper Series No. 75). Inst. für Volkswirtschaftstheorie und -politik, WU Vienna University of Economics and Business. https://doi.org/10.57938/0e2767c2-c9cb-4a3d-b531-41104da083d1.

Bertschek, I. (1995). Product and process innovation as a response to increasing imports and foreign direct investment. *The Journal of Industrial Economics*, 43(4). https://doi.org/10.2307/2950548.

Bighelli, T., di Mauro, F., Melitz, M. J., & Mertens, M. (2023). European firm concentration and aggregate productivity. *Journal of the European Economic Association*, 21(2), 455-483. https://doi.org/10.1093/jeea/jvac040

Blomström, M., & Kokko, A. (1998). Multinational corporations and spillovers. *Journal of Economic Surveys*, 12(3), 247-277. https://doi.org/10.1111/1467-6419.00056

Boudier-Bensebaa, F. (2008). FDI-assisted development in the light of the investment development path paradigm: Evidence from Central and Eastern European countries. *Transnational Corporations*, 17(1). 37-67. https://digitallibrary.un.org/record/634814?ln=en&v=pdf

Bournakis, I., & Tsionas, M. (2022). Productivity with endogenous FDI spillovers: A novel estimation approach. *International Journal of Production Economics*, *251: 108546*. https://doi.org/10.1016/j.ijpe.2022.108546

Camarero, M., López-Villavicencio, A., Tamarit, C., & European Commission, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs. (2022). *Globalisation and unemployment in the EU: New insights on the role of global value chains and workforce composition*. Publications Office of the European Union. https://doi.org/10.2873/147718

Cottrell, A., & Lucchetti, R. (2021). *Gretl user's guide*. Retrieved from http://gretl.sourceforge.net/gretl-help/gretl-guide.pdf

Das, R. C., & Chatterjee, T. (2021). Trade liberalization and R&D activity: Examining long-run and short-run linkages for individual and panel of leading countries and groups. *Economic Change and Restructuring*, *54*(4), 1091-1118. https://doi.org/10.1007/s10644-020-09294-5

Djokoto, J. G. (2021). The investment development path theory and small states. *Research in Globalization*, *3: 100048*. https://doi.org/10.1016/j.resglo.2021.100048

Djokoto, J. G., Hysa, E., & Mansi, E. (2024). Foreign divestment and domestic investment in Eastern European countries. *Post-Communist Economies*, *36*(1), 90-104. https://doi.org/10.1080/14631377.2023.2237211

Dunning, J. H. (1981). Explaining the international direct investment position of countries: Towards a dynamic or developmental approach. *Weltwirtschaftliches Archiv*, *117*(1), 30-64. https://doi.org/10.1007/BF02696577

Dunning, J. H., & Lundan, S. M. (2008). *Multinational enterprises and the global economy* (2nd ed.). Edward Elgar.

Eurostat. (2024a). *BERD by NACE Rev. 2 activity* [Data set]. https://doi.org/10.2908/RD_E_BERDINDR2

Eurostat. (2024b). *EU direct investment positions by country, ultimate and immediate counterpart and economic* [Data set]. https://doi.org/10.2908/BOP_FDI6_POS

Eurostat. (2024c). *Gross value added and income by A10 industry breakdowns* [Data set]. https://doi.org/10.2908/NAMA_10_A10

Ferenčíková, S., & Ferenčíková, S. (2012). Outward investment flows and the development path: The case of Slovakia. *Eastern European Economics*, *50*(2), 85-111. https://doi.org/10.2753/EEE0012-8775500205

Frensch, R., Hanousek, J., & Kočenda, E. (2013). Trade with final goods in European Union: A gravity model approach. *Politická ekonomie*, *61*(6), 715-734. https://doi.org/10.18267/j.polek.927

Gorynia, M., Nowak, J., Trąpczyński, P., & Wolniak, R. (2020). Integration and investment development paths of CEE countries. Does EU-membership make a difference? *Eurasian Geography and Economics*, *63*(1), 27-54. https://doi.org/10.1080/15387216.2020.1828124

Habrman, M., Habodászová, Ľ., & Šrámková, L. (2022). *Reformný kompas slovenskej ekonomiky* [The reform compass of the Slovak economy]. Institute of Financial Policy, Ministry of Finance of the Slovak Republic. https://www.mfsr.sk/files/archiv/25/Reformny-kompas.pdf

Hsiao, C. (2014). *Analysis of panel data* (3rd ed.). Cambridge University Press.

Javorcik, B. S. (2004). Does foreign direct investment increase the productivity of domestic firms? In search of spillovers through backward linkages. *American Economic Review*, *94*(3), 605-627. https://doi.org/10.1257/0002828041464605

Kathuria, V. (2008). The impact of FDI inflows on R&D investment by medium- and high-tech firms in India in the post-reform period. *Transnational Corporations*, *17*(2), 45-66. https://digitallibrary.un.org/record/643909/files/diaeia20082_en.pdf

Khorana, S., Escaith, H., Ali, S., Kumari, S., & Do, Q. (2022). The changing contours of global value chains post-COVID: Evidence from the Commonwealth. *Journal of Business Research*, *153*, 75-86. https://doi.org/10.1016/j.jbusres.2022.07.044

Kittová, Z. (2016). *Transfer technológií na Slovensku a v zahraničí* [Technology transfer in Slovakia and abroad]. *Revue sociálno-ekonomického rozvoja: vedecký recenzovaný on-line časopis*, *2*(2), 49-53. https://nhf.euba.sk/www_write/files/katedry/ksrp/2017/RSER_2__2016.pdf

Kittová, Z., Steinhauser, D., & Drieniková, K. (2023). Determinants of domestic value added in exports of the EU countries. *Acta Oeconomica: Periodical of the Hungarian Academy of Sciences*, *73*(2), 285-303. https://doi.org/10.1556/032.2023.00017

Kokko, A. (1992). *Foreign direct investment, host country characteristics, and spillovers*. The Economic Research Institute. Retrieved from https://ex.hhs.se/dissertations/222006-FULLTEXT01.pdf

Kordalska, A., & Olczyk, M. (2022). Upgrading low value-added activities in global value chains: A functional specialisation approach. *Economic Systems Research*, 35(2), 1-27. https://doi.org/10.1080/09535314.2022.2047011

Kordalska, A., & Olczyk, M. (2023). Determinants of functional specialisation in EU countries (Working Paper 228). The Vienna Institute for International Economic Studies Wiener Institut für Internationale Wirtschaftsvergleiche. Retrieved from https://wiiw.ac.at/determinants-of-functional-specialisation-in-eu-countries-dlp-6558.pdf

Krugman, P. (1980). Scale economies, product differentiation, and the pattern of trade. *The American Economic Review*, *70*(5), 950-959. https://www.jstor.org/stable/1805774

Krugman, P. (1981). Intraindustry specialization and the gains from trade. *Journal of Political Economy*, *89*(5), 959-973. https://www.jstor.org/stable/1830815

Lábaj, M., & Majzlíková, E. (2022). Drivers of deindustrialisation in internationally fragmented production structures. *Cambridge Journal of Economics*, *46*(1), 167-194. https://doi.org/10.1093/cje/beab046

Lábaj, M., & Majzlíková, E. (2023). How nearshoring reshapes global deindustrialization. *Economics Letters, 230*: *111239*. https://doi.org/10.1016/j.econlet.2023.111239

Lee, J. (1996). Technology imports and R&D efforts of Korean manufacturing firms. *Journal of Development Economics*, *50*(1), 197-210. https://doi.org/10.1016/0304-3878(96)00010-7

Lukáčiková, A. (2013). *GRETL vo výučbe panelových dát: GRETL in teaching of panel data*. In Využitie kvantitatívnych metód vo vedecko-výskumnej činnosti a v praxi X: zborník príspevkov zo seminára: 29. – 31. máj 2013, Čingov – Slovenský raj (pp. 1-6). http://www.fhi.sk/files/katedry/kove/ssov/Cingov/Cingov-2013.pdf

Majzlíková, E. (2024). *Redefining global markets*. Springer. https://doi.org/10.1007/978-3-031-56042-2

Ministry of Economy & The Ministry of Foreign and European Affairs of the Slovak Republic. (2021). *Koncepcia vonkajších ekonomických vzťahov a ekonomickej diplomacie Slovenskej republiky na obdobie 2022-2030* [Concept of external economic relations and economic diplomacy of the Slovak Republic for the period 2022–2030]. Retrieved from https://www.economy.gov.sk/uploads/files/LMovpfgU.pdf

Narula, R., & Dunning, J. H. (2010). Multinational enterprises, development and globalization: Some clarifications and a research agenda. *Oxford Development Studies*, *38*(3), 263-287. https://doi.org/10.1080/13600818.2010.505684

Narula, R., & Guimon, J. (2010). The investment development path in a globalised world: Implications for Eastern Europe. *Eastern Journal of European Studies*, 1(2), 5-19.

Newman, C., Rand, J., Talbot, T., & Tarp, F. (2015). Technology transfers, foreign investment and productivity spillovers. *European Economic Review*, *76*, 168-187. https://doi.org/10.1016/j.euroecorev.2015.02.005

Nguyen, H. M., & Nguyen, L. D. (2018). The relationship between urbanization and economic growth. *International Journal of Social Economics*, *45*(2), 316-339. https://doi.org/10.1108/IJSE-12-2016-0358

Nieto, M., & Quevedo, P. (2005). Absorptive capacity, technological opportunity, knowledge spillovers, and innovative effort. *Technovation*, *25*(10), 1141-1157. https://doi.org/10.1016/j.technovation.2004.05.001

OECD. (2020). *Shocks, risks and global value chains: Insights from the OECD METRO model*. Retrieved from https://www.oecd.org/trade/documents/shocks-risks-gvc-insights-oecd-metro-model.pdf

Orlic, E., Hashi, I., & Hisarciklilar, M. (2018). Cross sectoral FDI spillovers and their impact on manufacturing productivity. *International Business Review*, *27*(4), 777-796. https://doi.org/10.1016/j.ibusrev.2018.01.002

Ozawa, T. (1992). Foreign direct investment and economic development. *Transnacional Corporations*, *1*(1), 27-54.

Porter, M. E. (1990). *The competitive advantage of nations*. Harward Business Review.

Sawitri, K. A., & Brennan, L. (2023). The investment development path literature: a review and research agenda. *Management Review Quarterly*, 73(4), 1825-1872. https://doi.org/10.1007/s11301-022-00287-4

Sikder, A., Inekwe, J., & Bhattacharya, M. (2019). Economic output in the era of changing energy-mix for G20 countries: New evidence with trade openness and research and development investment. *Applied Energy*, 235, 930-938. https://doi.org/10.1016/j.apenergy.2018.10.092

Spithoven, A., & Merlevede, B. (2023). The productivity impact of R&D and FDI spillovers: characterising regional path development. *The Journal of Technology Transfer*, 48(2), 560-590. https://doi.org/10.1007/s10961-022-09918-0

Steinhauser, D. (2023). Where Does Value-Added Flow in Gross Exports, Mr. Newton? Global Supply Chains and New Regionalization's Effects in the Asia-Pacific. *Journal of Economic Integration*, 38(3), 335-359. https://doi.org/10.11130/jei.2023.38.3.335

Stoian, C. (2013). Extending Dunning's Investment Development Path: The role of home country institutional determinants in explaining outward foreign direct investment. *International Business Review*, 22(3), 615-637. https://doi.org/10.1016/j.ibusrev.2012.09.003

Telatar, O. M., Genc, M. C., Keser, H. Y., Ay, S., & Deger, M. K. (2014). The causality relationships between fdi and r&d in european union. *Journal of economic and social development*, 1(1), 106-114. https://hrcak.srce.hr/128534

Torres-Reyna, O. (2007). *Panel Data Analysis Fixed and Random Effects using Stata (v. 6.0)*. Retrieved from https://www.princeton.edu/~otorres/Panel101.pdf

Uyar, A., Kuzey, C., & Kilic Karamahmutoglu, M. (2022). Macroeconomic factors, R&D expenditure and research productivity in economics and finance. *Managerial Finance*, 48(5), 733-759. https://doi.org/10.1108/MF-12-2021-0602

Villalvazo, S. (2024). FDI flows and sudden stops in small open economies. *Journal of Macroeconomics*, *79: 103586*. https://doi.org/10.1016/j.jmacro.2024.103586

Vujanović, N., Radošević, S., Stojčić, N., Hisarciklilar, M., & Hashi, I. (2022). FDI spillover effects on innovation activities of knowledge using and knowledge creating firms: Evidence from an emerging economy. *Technovation*, 118: 102512. https://doi.org/10.1016/j.technovation.2022.102512

Vujanović, N., Stojčić, N., & Hashi, I. (2021). FDI spillovers and firm productivity during crisis: Empirical evidence from transition economies. *Economic Systems*, 45(2): 100865. https://doi.org/10.1016/j.ecosys.2021.100865

Appendix

Appendix 1 | Description of variables

Variable	Description
BERD_Total	Business R&D expenditures, total all NACE activities, expressed in million euros [rd_e_berdindr2]
BERD_C	Business R&D expenditures in the manufacturing sector, as measured by NACE Rev. 2 activity, expressed in million euros [rd_e_berdindr2]
FDI_inw_Total	FDI position of the reporting economy, total all NACE activities, expressed in million euros. Special-purpose vehicles were abstracted [bop_fdi6_pos]
FDI_inw_C	FDI position of the reporting economy in the manufacturing sector, expressed in million euros. Special-purpose vehicles were abstracted [bop_fdi6_pos]
NOFDI_Total	Net outflow FDI represents the difference between investments abroad and in the reporting economy, total all NACE activities.
NOFDI_C	Net outflow FDI represents the difference between investments abroad and in the reporting economy, manufacturing sector.
GVA_Total	Gross value-added, expressed in current million euros, total all NACE activities [nama_10_a10]
GVA_C	Gross value-added, expressed in current million euros, manufacturing sector [nama_10_a10]

Source: own processing based on Eurostat (2024a–c)

Appendix 2 | Descriptive statistics (using the observations 1:01 - 27:10) – EU27

Variable	Mean	Min.	Max	Std. Dev.	Skew.	Kurt.	n
BERD_Total	7,047.30	17.00	81,809.00	14,017.00	3.45	12.44	270
BERD_C	4,460.70	4.54	64,361.00	11,789.00	3.97	15.20	203
FDI_inw_Total	338,050.00	5,697.00	4,276,200.00	639,340.00	4.04	18.46	237
FDI_inw_C	67,370.00	-112.00	733,430.00	124,190.00	3.12	10.13	246
NOFDI_Total	45,494.00	-379,830.00	918,850.00	200,650.00	2.40	5.89	237
NOFDI_C	14,207.00	-315,740.00	685,470.00	107,030.00	2.32	13.68	241
GVA_Total	440,270.00	7,019.20	3,509,600.00	695,930.00	2.45	5.53	270
GVA_C	73,754.00	700.90	714,820.00	130,240.00	3.35	11.80	270

Source: own processing based on Eurostat (2024a–c)

Appendix 3 | Descriptive statistics (using the observations 1:01 - 11:10) – new EU11 member states

Variable	Mean	Min.	Max.	Std. Dev.	Skew.	Kurt	n
BERD_Total	899.07	27.00	6,285.60	1,176.70	2.29	5.51	110
BERD_C	413.19	16.50	2,059.10	495.48	1.58	1.66	98
FDI_inw_Total	70,796.00	8,897.00	274,190.00	70,007.00	1.20	0.18	104
FDI_inw_C	17,724.00	1,402.00	83,463.00	19,599.00	1.49	1.50	104
NOFDI_Total	-51,234.00	-224,030.00	-3,718.00	51,005.00	-1.60	2.00	104
NOFDI_C	-15,589.00	-75,522.00	-961.50	18,199.00	-1.55	1.66	102
GVA_Total	109,400.00	16,568.00	582,840.00	119,650.00	2.02	3.62	110
GVA_C	22,203.00	2,481.10	114,300.00	24,410.00	1.71	2.44	110

Note: 11 new EU member states: Bulgaria, Czechia, Estonia, Croatia, Latvia, Lithuania, Hungary, Poland, Romania, Slovenia, Slovakia
Source: own processing based on Eurostat (2024a–c)

Appendix 4 | Panel regression analysis – EU27

	1	2	3	4
Dep. var.	BERD_Total	BERD_Total	BERD_C	BERD_C
const	-3,931.210 **	6,287.84 ***	-2,571.720	4,256.06 ***
FDI_inw_Total	-0.000	0.000		
GVA_Total	0.025 ***			
FDI_inw_C			-0.019 *	0.007
GVA_C			0.107 ***	
n (t 2013 – 2022)	237	237	194	194
Robust (HAC)	Yes	Yes	Yes	Yes
Fixed-effects	Yes	Yes	Yes	Yes
Within R-sq	0.793	0.000	0.624	0.017
B-K-W collinearity	max. 15.677	-	max. 16.442	-

Note: Probability of parameter´s estimation: *** 99% probability; ** 95% probability; * 90% probability.
Source: own processing based on Eurostat (2024a–c)

Appendix 5 | Panel regression analysis – new EU11 member states

	5	6	7	8
Dep. var.	BERD_Total	BERD_Total	BERD_C	BERD_C
const	-947.034 *	-72.006	409.651 ***	-151.241
FDI_inw_Total	0.000	0.014		
GVA_Total	0.025 ***			
FDI_inw_C			0.014 ***	0.032 **
GVA_C			0.027 ***	
n (t 2013 – 2022)	104	104	96	96
Robust (HAC)	Yes	Yes	Yes	Yes
Fixed-effects	Yes	Yes	Yes	Yes
Within R-sq	0.819	0.267	0.846	0.697
B-K-W collinearity	max. 10.652	-	max. 17.669	-

Note: Probability of parameter´s estimation: *** 99% probability; ** 95% probability; * 90% probability.
Source: own processing based on Eurostat (2024a–c)

Appendix 6 | Panel regression analysis – EU27

	9	10	11	12
Dep. var.	NOFDI_Total	NOFDI_Total	NOFDI_C	NOFDI_C
const	184,220.000 ***	178,330.000 ***	69,539.400 *	130,804.00 ***
GVA_Total	-0.684 ***	-0.605 ***		
sq_GVA_Total	0.000 ***	0.000 ***		
BERD_Total	5.867			
GVA_C			-1.607 **	-2.320 ***
sq_GVA_C			0.000 *	0.000 ***
BERD_C			3.977	
n (t 2013 – 2022)	237	237	189	241
Robust (HAC)	Yes	Yes	Yes	Yes
Fixed-effects	Yes	Yes	Yes	Yes
Within R-sq	0.256	0.250	0.369	0.120
B-K-W collinearity	max. 37.366	max. 29.062	max. 30.256	max. 18.254

Note: Probability of parameter´s estimation: *** 99% probability; ** 95% probability; * 90% probability.
Source: own processing based on Eurostat (2024a–c)

Appendix 7 | Panel regression analysis – new EU11 member states

	13	14	15	16
Dep. var.	NOFDI_Total	NOFDI_Total	NOFDI_C	NOFDI_C
const	-7,346.67 **	-6,216.640	74.740	1,808.770
GVA_Total	-0.387 ***	-0.430 ***		
sq_GVA_Total	0.000 *	0.000		
BERD_Total	-7.856 ***			
GVA_C			-0.538 *	-0.884 **
sq_GVA_C			0.000	0.000
BERD_C			-21.246 *	
n (t 2013 – 2022)	104	104	94	102
Robust (HAC)	Yes	Yes	Yes	Yes
Fixed-effects	Yes	Yes	Yes	Yes
Within R-sq	0.936	0.920	0.720	0.610
B-K-W collinearity	max. 26.948	max. 22.797	max. 42.728	max. 27.482

Note: Probability of parameter´s estimation: *** 99% probability; ** 95% probability; * 90% probability.
Source: own processing based on Eurostat (2024a–c)

Appendix 8 | Panel regression analysis – EU27

	17	18	19	20
Dep. var.	BERD_Total	BERD_Total	BERD_C	BERD_C
const	-3,949.700 **	5,916.66 ***	-2,201.710	4,603.750 ***
NOFDI_Total	0.005	0.009		
GVA_Total	0.025 ***			
NOFDI_C			0.026 ***	0,020
GVA_C			0.090 ***	
n (t 2013 – 2022)	237	237	189	189
Robust (HAC)	Yes	Yes	Yes	Yes
Fixed-effects	Yes	Yes	Yes	Yes
Within R-sq	0.813	0.076	0.662	0.076
B-K-W collinearity	max. 15.136	-	max. 12.734	-

Note: Probability of parameter´s estimation: *** 99% probability; ** 95% probability; * 90% probability.
Source: own processing based on Eurostat (2024a–c)

Appendix 9 | Panel regression analysis – new EU11 member states

	21	22	23	24
Dep. var.	BERD_Total	BERD_Total	BERD_C	BERD_C
const	-1,118.29 **	-1,264.270 **	-399.004 ***	-128.741
NOFDI_Total	-0.017 **	-0,042 ***		
GVA_Total	0.017 *			
NOFDI_C			-0.015 ***	-0.034 **
GVA_C			0.027 ***	
n (t 2013 – 2022)	104	104	94	94
Robust (HAC)	Yes	Yes	Yes	Yes
Fixed-effects	Yes	Yes	Yes	Yes
Within R-sq	0.830	0.805	0.852	0.690
B-K-W collinearity	max. 38.124	-	max. 16.597	-

Note: Probability of parameter´s estimation: *** 99% probability; ** 95% probability; * 90% probability.
Source: own processing based on Eurostat (2024a–c)