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Industrial Digital Interdependence and FDI Restrictiveness as Determinants of FDI for Eastern European Economies

SUMMARY

In the time of industrial supply chain redesign due to COVID-19 and geopolitical risks, Eastern European Economies (EEE) can benefit from their strategic location and interdependent and interconnected manufactured structure to attract foreign direct investment (FDI), particularly in the semiconductor industry. As EEE emerges in the global semiconductor supply chain, they must balance FDI attraction with enhanced national security restrictions. By analysing the patterns of FDI inflows for 20 EEE over 2003–2022, developing interdependence industrial indices, and assessing FDI restrictiveness, we find that the combination of higher trade interdependence in electronics industries, European integration, and more favourable FDI restrictiveness leads to higher FDI inflows to Eastern European Economies. The findings reveal that a higher level of semiconductor interdependence between Asian countries and EEE will positively correlate with an increase in FDI inflows to EEE. However, it has been verified that there is a weak negative correlation between the FDI in EEE and the OECD FDI restrictiveness index. Conversely, in prospects for strategic investment for the ICT, electric vehicle (EV) battery manufacturing, and automobile sectors in EEE, the concentration of FDI in the Western Balkans and other non-EU candidates may further increase, indicating the need to participate in the common FDI restrictions process to balance interests with core European values. At the same time, there is no evidence of a positive impact of increasing Chinese

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outbound FDI on FDI in EEE, indicating the Chinese preference for developed EU countries, while Germany serves as the main FDI origin in EEE.

Keywords: COVID-19, FDI Restrictiveness Index, Semiconductors, Export Control, FDI Screening Mechanism, Chinese Investment, Electric Vehicle (EV) JEL Classification: F15, F21, F23, O52.

Индустријска дигитална међузависност и рестриктивност као детерминанте страних директних инвестиција у источноевропским економијама

САЖЕТАК

У времену редизајнирања индустријског ланца снабдевања услед пандемије COVID-19 и геополитичких ризика, источноевропске економије могу имати користи од своје стратешке локације, међузависне и међусобно повезане производне структуре у привлачењу страних директних инвестиција (СДИ), посебно у индустрији полупроводника. Како се ове економије појављују у глобалном ланцу снабдевања полупроводницима, оне морају уравнотежити привлачење СДИ са појачаним националним безбедносним ограничењима. Анализом образаца прилива СДИ за двадесет источноевропских економија између 2003. и 2022. године, развојем међузависних индустријских индекса и проценом рестриктивности СДИ, налазимо да комбинација веће међузависности трговине у електронској индустрији, европских интеграција и повољније рестриктивности СДИ доводи до већих СДИ у овим економијама. Налази откривају да ће виши ниво међузависности полупроводника између азијских земаља и источноевропских економија позитивно корелирати са повећањем прилива СДИ у другим економијама. Међутим, потврђена је слаба негативна корелација између СДИ у источноевропским економијама и индекса рестриктивности СДИ OECD. Насупрот томе, изгледи за стратешка улагања у информационим технологијама, производњи батерија за електрична возила и аутомобилским секторима у источноевропским економијама, концентрацијом СДИ на Западном Балкану и другим кандидатима који нису чланице ЕУ могли би се даље повећати, указујући на потребу учешћа у заједничком процесу ограничења СДИ и уравнотежавања интереса са основним европским вредностима. Истовремено, нема доказа о позитивном утицају повећања кинеских инвестиција на СДИ у источноевропским економијама, што указује на кинеску преференцију према развијеним земљама ЕУ, док Немачка служи као главни извор СДИ у поменутим економијама.

Кључне речи: пандемија COVID-19, индекс рестриктивности страних директних инвестиција, полупроводници, контрола извоза, стране директне инвестиције, *Screening* механизам, кинеске инвестиције, електрична возила, ЈЕЛ класификација: Ф15, Ф21, Ф23, О52

Introduction

In the early post-COVID recovery phase of 2020-2021, Eastern European Economies (EEE) attracted significant foreign direct investment (FDI) inflows driven by their export-oriented manufacturing, particularly machinery and motor vehicles, and a less restrictive FDI regime. Indeed, in recent years, the average share of manufactured goods in EEE's total exports has steadily been growing, reaching 64% in 2022. Moreover, in Hungary, the Czech Republic, Slovenia, and Slovakia, this share is approximately 85%, which is higher than the EU average of 74%.[2]

However, today, geopolitical tensions and technological interdependence and interconnectivity are driving supply chain redesign, especially in the advancements in the Information and Communication Technology (ICT) industry and related semiconductor sector, which are core to electronics and EV battery production. This has led to a delicate balancing act for EEE as they navigate between national securities concerns, applying foreign investment screening mechanisms, and active participation in global supply chains. In 2022, the share of manufacturing in EEE's total exports has shown either stagnant growth or slower expansion compared to the share of services in the region's total exports. Specifically, Lithuania, Serbia, and Montenegro rank as leaders in terms of the percentage change in exports of knowledge-intensive services.[3]

During the pandemic, semiconductors became a critical commodity for trade, as they are essential components of industrial automation and data processing, as well as modern electronics and information technology; they are widely used in the automobile industry, computers, smartphones, tablets, and other consumer electronics. The European Economic Security Strategy of 2023 and the European Chips Act of 2023 underscore the importance of the semiconductor industry for economic growth in Europe.

The countries in the region of EEE are also focused on enhancing their ICT, electronic, and automobile sectors to ensure their national economic security and competitiveness. As part of this effort, we aim to gain a deeper understanding of how industrial development, primarily in the semiconductor and ICT sectors, along with macroeconomic factors and regulations governing FDI, can influence FDI inflows, especially during the post-COVID recovery phase.

Our primary concern is that the EEE region is underestimated in terms of its potential for digital transitions and as a significant resource for economic

[2] "World Development Indicators DataBank", World Bank, https://databank.worldbank.org/source/world-development-indicators#, 06/25/2023.

[3] Angelo Leogrande, "The Export of High Knowledge Intensity Services of European Countries", *MPRA Paper*, No. 112795, 2022, 1.

growth within Europe. The research idea stems from the unique position of EEE, which has access to the EU's Single Market, ICT infrastructure, and favoured FDI regulation. FDI can help build and develop semiconductor industries and IT hubs in the region to diversify supply chains for all countries in Europe, focusing on current interdependence and influential factors such as the degree of European integration and investment restrictions.

For the purposes of our study, which mostly focuses on the impact of industrial development on FDI, we focus on the trade in semiconductors, impose FDI regulation, and categorise countries into the Eastern Europe region based on the United Nations definition, including Kosovo and excluding the Russian Federation, Belarus, Armenia, and Azerbaijan.

We aim to fill this gap by conducting a comprehensive analysis that specifically focuses on the correlation between FDI inflows into Eastern European countries, trade interdependence with Asian nations, and FDI restrictions in the region. Additionally, we verify the relationship between Chinese investment in Europe and the trade dynamics between European and Asian economies.

Our research will encompass various aspects, including the examination of key trade patterns, bilateral investment flows, and economic convergence. We will also consider the role of government policies, trade agreements, and regional economic integration in influencing FDI patterns.

This study assesses the industrial digital interdependence and restrictiveness as determinants of FDI to 20 Eastern European Economies over 2003-2022. More precisely, we investigate the relationship between FDI inflows as a percentage of GDP and two critical factors: semiconductor interdependence between China, Taiwan, and EEE, as well as FDI restrictiveness imposed by the EU and other Eastern European countries. We pay particular attention to FDI in EEE that originates from the EU (Germany) as well as FDI from China in order to evaluate whether their effects are different from the effects of FDI from other places of origin. Additionally, we examine whether there are differences in the impacts of different periods of European integration, before and after becoming an EU member or candidate, as well as focusing on trade and FDI that go to different sectors of the economy, such as the electronics and information technology sectors.

The remainder of this paper is organised as follows: Section 2 reviews the literature on the effects of economic, political, and institutional factors on FDI and describes the methodology for measuring trade interdependence and FDI restrictions. Section 3 provides an overview of FDI trends reflected in the dynamics of trade semiconductors and FDI restrictions in Europe. Section 4 applies the empirical analysis and results of the FDI determinants in the region. Section 5 contains the findings and policy implications.

Review of FDI Determinants Studies and the Methodology of Trade Interdependence

While the literature provides a wide range of FDI determinants, such as economic size and growth, openness to trade, infrastructure development, and institutional quality, trade interdependence in the progressive industrial sectors, as well as investment regulatory barriers, are not practically examined.[4] Some studies have pointed out that FDI attractiveness and trade activity are heavily influenced by geopolitics and regional prospects but do not take into account the country's ability to connect with partners, particularly in cutting-edge industries such as semiconductors.[5] A focus on only the traditional factors of FDI and trade in Eastern European countries often misses some of the wider effects.

Eastern European countries remain collectively largely open to FDI and trade. Although European trade interdependence in the progressive industrial sectors and FDI restrictions might determine trade, investment, and European integration, quantitative estimates of such factors have been lacking. Based on the applied international trade and FDI literature, we measure interdependence in the electrical machinery and optical equipment sector by developing the Interdependence Index and measure restrictions by the OECD FDI Regulatory Restrictiveness Index (FDI Index).

Some authors performed an empirical model to assess the effect of restrictive policies on cross-border investment in the EU over 2011-2018 but did not explicitly consider the role that FDI restrictions and

[4] Alan Bevan, Saul Estrin, Klaus & Meyer Beva, "Foreign Investment Location and Institutional Development in Transition Economies", *International Business Review*, Vol. 13, No. 1, 2004, 43–64; Bruce A. Blonigen & Jeremy Piger, "Determinants of Foreign Direct Investment", *Canadian Journal of Economics*, Vol. 47, No. 3, 2014, 775–812; Elizabeth Asiedu, "On the Determinants of Foreign Direct Investment to Developing Countries: Is Africa Different?", *World Development*, Vol. 30, No. 1, 2002, 107–119; Elizabeth Asiedu, "Foreign Direct Investment in Africa: The Role of Natural Resources, Market Size, Government Policy, Institutions, and Political Instability", *The World Economy*, Vol. 29, No. 1, 2006, 63–77; Nguyen Phuc Canh, Nguyen Thanh Binh, Su Dinh Thanh & Christophe Schinckus, "Determinants of Foreign Direct Investment Inflows: The Role of Economic Policy Uncertainty", *International Economics*, Vol. 161, No. C, 2020, 159–172; Leena Ajit Kaushal, "Impact of Institutional and Regulatory Quality on FDI Inflow: Case of a Developing Indian Economy", *Cogent Economics & Finance*, Vol. 9, No. 1985201, 2021.

[5] Nor'Aznin Abu Bakar, Siti Hadijah Che Mat & Mukaramah Harun, "The Impact of Infrastructure on Foreign Direct Investment: The Case of Malaysia", *Procedia Social and Behavioral Sciences*, Vol. 65, 2012, 205–211; Nicholas Bailey, "Exploring the Relationship between Institutional Factors and FDI Attractiveness: A Meta-Analytic Review", *International Business Review*, Vol. 27, No. 1, 2018, 139–148; Amitendu Palit, "Trade and Economic Connectivity in an Age of Uncertainty: South Asia and Indo-Pacific", Konrad Adenauer Stiftung, https://www.kas.de/documents/288143/6741384/panorama_trade_Amitendu Palit_TradeandEconomicConnectivityinanAgeofUncertainty_SouthAsiaandIndo-Pacific.pdf/48620d6c-c9dc-8090-9393-e37e429e29e7?t=1564644887447, 06/27/2023, 113-121.

interdependence might simultaneously play.[6] In line with researchers, we estimate that even partial FDI restrictions can have a strong impact on FDI in Europe.[7] Some studies investigate the link between interdependence and aggregate trade flows; the relationship between trade interdependence in the electrical machinery and optical equipment sector and national FDI has not been covered.[8]

To determine whether the process of economic convergence with the European Union influences FDI inflows in EEE, some authors analysed five EU countries (Bulgaria, the Czech Republic, Poland, Romania, and Hungary) during the period from 2001 to 2010, all of which are now members of the EU. In our study, we investigate the relationship between FDI and economic convergence, considering trade interdependence in the electrical machinery and equipment sector and FDI regulations for all countries undergoing the process of becoming EU member states, including the Western Balkans, Ukraine, Moldova, and Georgia.

Some recent papers verify the relationship between trade position, inflation rate, and FDI in the EU and the Western Balkans or investigate the impact of European integration on capital flows to prospective EU member states.[9] However, we estimate the impact on FDI for a much wider range of countries and over a longer time period than in previous studies.

While scholars have explored the potential of value chain resilience between the EU and Asian countries and have analysed Chinese investment in Europe, far fewer have examined their interdependence in semiconductor trade and the impact of the EU's FDI screening on FDI.[10] Filling this research

[6] Wildmer Gregori & Michaela Nardo, "The Effect of Restrictive Measures on Cross-Border Investment in the European Union", *World Economy*, Vol. 44, 2021, 1914–1943.

[7] Fernando Mistura & Caroline Roule, "The Determinants of Foreign Direct Investment: Do Statutory Restrictions Matter?", OECD Working Papers on International Investment, https://www.oecd-ilibrary.org/docserver/641507ce-en.pdf?expires=1697549994&id=id&accname=guest&checksum=EFDD2CA20EFB5DE7145B0488DC28FF97, 06/28/2023, 4-57.

[8] C. T. Vidya, K. P. Prabheesh & Saahil Sirowa, "Is Trade Integration Leading to Regionalization? Evidence from Cross-Country Network Analysis", *Journal of Economic Integration*, Vol. 35, No. 1, 2020, 10–38; C.T. Vidya & Farhad Taghizadeh-Hesary, "Does Infrastructure Facilitate Trade Connectivity? Evidence from the ASEAN", *Asia Europe Journal, Springer*, Vol. 19, No. 1, 2021, 51–75.

[9] Dajana Ercegovac & Emilija Pucar, "The Nexus Between FDI and External Balance in Selected Emerging European Economies – A Panel Data Approach", *The Annals of the Faculty of Economics in Subotica*, Vol. 58, No. 47, 2022, 147–164; Ljuben Jirasavetakul & Johanna L. Y. Rahman, "Foreign Direct Investment in New Member States of the EU and Western Balkans: Taking Stock and Assessing Prospects", IMF Working Papers, No. 187, 2018, 1–37.

[10] Akhil Thadani & Greogry C. Allen, "Mapping the Semiconductor Supply Chain: The Critical Role of the Indo-Pacific Region", Center for Strategic and International Studies, https://www.csis.org/analysis/mapping-semiconductor-supply-chain-critical-role-indo-pacific-region, 06/28/2023.

gap can provide valuable insights and contribute to the existing body of knowledge. Research in this area can inform policymakers about the consequences of their decisions regarding trade and investment regulations. It can help them make more informed choices to support economic growth, innovation, and national security.

To analyse the complexity of trade interdependence in high-tech industries with global significance between EEE and its partners, we adopt the OECD practice and focus on semiconductor production within the middle segment of the supply chain.[11] We collected trade data for products HS 8541 and HS 8542 specifically for all Eastern European countries and major trade partners, including the EU, US, China, and Taiwan, spanning from 2003 to 2022.

The product categories 8541 and 8542 correspond to the electrical machinery and equipment sector in the classification of the Harmonised Commodity Description and Coding System (HS codes) by the World Customs Organisation. We also conducted an analysis of the trade patterns and dynamics of semiconductors, providing a comprehensive understanding of the interactions between these key partners.

The EEE Interdependence Index in the semiconductor industry focuses on the overall trade flows between EEE, Germany, and Asian countries. It calculates the ratio of imports from Germany or Asian countries to EEE to the total EEE imports and the ratio of exports from EEE to Germany or Asian countries to the total EEE exports (Formula 1). By analysing the EEE Interdependence Index, we can also assess the level of significance of the semiconductor industry in facilitating interdependence in the region.

$$\textit{EEE Interdependence Index} = \left(\frac{\textit{Imports of semiconductor goods from Germany (China or Taiwan)to EEE}}{\textit{Total EEE imports}} \right) / \left(\frac{\textit{Exports of semiconductor goods from EEE to Germany (China or Taiwan)}}{\textit{Total EEE exports}} \right) \quad (1)$$

The index value ranges from 0 to 1, where 0 represents no interdependence and 1 represents complete interdependence. A higher index value indicates a higher level of interdependence between EEE, the EU, and Asian countries in semiconductor trade. We suggest that as the

[11] "Measuring distortions in international markets: The semiconductor value chain", OECD Trade Policy Papers, No. 234, https://www.oecd-ilibrary.org/docserver/8fe4491d-en.pdf?expires=1697547407&id=id&accname=guest&checksum=881161462BFEAD39FE39C882F6591EBE, 06/29//2023, 1-111.

semiconductor industry becomes increasingly crucial in the global economy, deeper interdependence in this sector between EEE, the EU, China, and Taiwan will drive more investment and foster greater economic connectivity with EEE.

Conversely, growing scrutiny of foreign investment in Europe will negatively impact FDI inflows to the region. To verify if a more restrictive policy deters FDI in Europe, first we observe FDI restrictions for the sample countries measured by the OECD FDI Regulatory Restrictiveness Index (FDI Index). Then, we demonstrate the distribution of the FDI Index across European countries and compare how various levels of FDI restrictions relate to foreign investment flows.

Four types of measures are covered by the FDI Index: foreign equity restrictions, screening and prior approval requirements, rules for key personnel, and other restrictions on the operation.[12] It makes possible the use of the FDI Index to track regulation over time and provide a perspective on recent trends in FDI activity in European countries. Finally, we determine if countries where this measure is less restrictive systematically attract more FDI.

Dynamics of Trade Interdependence and FDI Restrictions

Global cross-border investment activities declined in 2022 after the strong recovery of FDI observed in 2021. With extensive global and regional connectivity links and trade interdependence, Europe is the largest destination of FDI stocks in the world, accounting for more than one-third (35%) of all inward investment positions over the period 2010-2022. However, European investment was no exception to the trend, falling in 2022.

Despite the decrease in FDI to the developed EU countries, FDI to EEE regularly increases, driven by the FDI growth in the Western Balkans and other EU candidates. Between 2003 and 2022, the world as a whole has been receiving FDI inflows of around 2.5% of global GDP, while foreign investment in EEE has averaged 6% of GDP. Most of these inflows into EEE, around 70% of the total, have come from the nearby EU15 countries. Moreover, the EU is the largest trade and FDI partner for the new EU candidates and applicants (Ukraine, Moldova, and Georgia), accounting for 52% of the total trade in Moldova, 39% in Ukraine, and 22% in Georgia in 2022.

Despite the US remaining the top EU foreign ultimate investment partner, in this paper we focus on the Asian partners among non-European

[12] Blanka Kalinova, Angel Palermi & Stephen Thomsen, "OECD's FDI Restrictiveness Index: 2010 Update", OECD Working Papers on International Investment, https://www.oecd-ilibrary.org/docserver/5km91p02zj7g-en.pdf?expires=1697549906&id=id&accname=guest&checksum=A798C04B283EBE20BCB585CEF004608A, 07/01/2023, 1-27.

FDI since the trade and FDI relations between Asian partners and European countries are undergoing the most pronounced changes.

The new phase of Europe-China trade and FDI connectivity over 2019-2021, in turn, has reduced Chinese FDI in the EU to its lowest value since 2010. However, China is still one of the largest investment sources for most European countries. In 2022, there was an increase in investment in the Eastern European automotive sector from Chinese battery giants, including CATL in Hungary. Between 2017 and 2021, the country received less than 1% of all Chinese investment in Europe. In 2022, by contrast, Chinese investment in Hungary was almost entirely driven by CATL's new gigafactory, with an announced total value of 7.6 billion EUR, making Hungary the electric vehicle (EV) battery hub for Europe.[13]

In addition, Chinese FDI covers all regions in Europe: EU countries, the Western Balkans, and Central European countries. Indeed, many Eastern European countries, such as Poland, the Czech Republic, Slovakia, Hungary, Romania, Bulgaria, Slovenia, Croatia, and others, are actively involved in the automobile and IT industries. The automobile industry in Europe relies on a complex global semiconductor supply chain where components are sourced from Asian countries. In recent times, the global semiconductor shortage has affected the automotive sector, leading to production delays and disruptions in EEE that illustrate the importance of interdependence in semiconductors for the automobile industry.

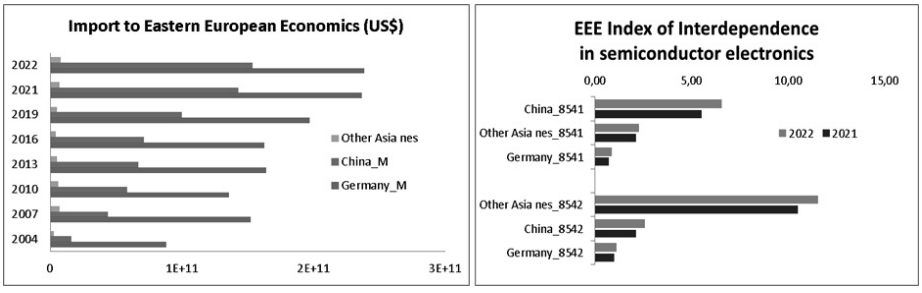
Besides this, the ICT industry in EEE is rapidly growing, with many countries, such as Poland, Romania, Serbia, Ukraine, and others, becoming hubs for software development, ICT services, and technology startups. Similar to the automotive industry, the ICT sector is highly dependent on semiconductors sourced from Asian suppliers, mainly Taiwan and China. Therefore, fostering interdependence in semiconductors can yield positive effects on FDI attraction in Eastern European countries by enticing high-tech companies, fostering innovation in the automobile and ICT sectors, enhancing national economic security, and bolstering the global competitiveness of EEE as a whole.

In terms of sectoral focus, there is a clear shift in Europe from infrastructure and finance FDI towards the automotive and ICT sectors with the required semiconductor devices. The importance of semiconductors in various industries, including automotive and ICT, has grown significantly, and interdependence in semiconductor trade has indeed become a significant determinant for FDI inflows to Europe.

[13] Agatha Kratz, Max J. Zenglein, Gregor Sebastian & Mark Witzke, "EV Battery Investments Cushion Drop to Decade Low - Chinese FDI in Europe: 2022 Update. Rhodium Group & Mercator Institute for China Studies", MERICS, https://merics.org/en/report/ev-battery-investments-cushion-drop-decade-low-chinese-fdi-europe-2022-update, 07/02/2023.

Zooming in on the trends among the main partners of EEE, China and Taiwan have demonstrated a more pronounced growth in semiconductor exports (Figure 1, left), since most of the world's fabs are located in the Indo-Pacific region.

Figure 1. EEE Import of Semiconductors (left)
and EEE Index of Interdependence (right)



Sources: International trade statistics of the United Nations (COMTRADE) and own calculations.

Notes: The trade data for Taiwan, Province of China, is categorised under "Other Asia, nes".

As seen from Figure 1 (left), despite Germany being the main trade partner for Eastern European countries, especially in the semiconductor sector, trade with China and Taiwan has increased more than threefold since 2004. While China focuses on the production of battery modules and less advanced chips, it also exhibits the highest degree of total interdependence and external orientation in the semiconductor industry with Europe. Moreover, the value of Chinese imports of semiconductors is growing at a faster rate compared to that of Germany or Taiwan. At the same time, Taiwan is becoming the world leader in advanced chip production, which drives its export growth. Subsequently, European countries increased their reliance on foreign suppliers from Asian countries, and the EEE's imports of semiconductor goods have grown by approximately 120% from 2016 to 2022.[14]

Indeed, as seen from Figure 1 (right), in the sector of diodes, transistors, and similar semiconductor devices (HS code 8541), China has a dominant position, while Taiwan has an advantage in exporting to the EU goods in the most advanced chips (HS code 8542).

Figure 1 (right) also illustrates the application of the EEE Index of Interdependence between the EEE, Germany (EU), and Asian countries in semiconductor devices. The Interdependence Index between EEE and Asian

[14] "UN Comtrade Database", https://comtrade.un.org/data, 07/02/2023.

countries in the semiconductor sector has a higher level than with Germany. This suggests that Germany (EU) demonstrates a greater degree of self-sufficiency and export competitiveness in the semiconductor industry.

The EEE Interdependence Index value in semiconductor devices (HS code 8541) exceeds 1, indicating a higher dependency on semiconductor imports from China, and a similar pattern is observed in the EU's dependency on advanced chips (HS code 8542) imports from Taiwan compared to its own semiconductor exports. This suggests that the EU relies more on foreign sources for semiconductor goods to meet its domestic demand. For Asian countries, this is evidence of their moving into the Eastern European market. Moreover, Asian countries will start producing semiconductors in Europe, providing an opportunity for Chinese EV makers. Investing in Eastern Europe would help them save on tariffs and production costs and also encourage EEE to participate in the global supply chain and increase their competitiveness.

Taken together, these factors suggest that countries with trade interdependence could provide FDI inflows to Eastern European countries. By examining the values of Interdependence Indices, it is possible to assess that deeper interdependence in this sector between Asian countries and EEE determines more investment and fosters economic integration.

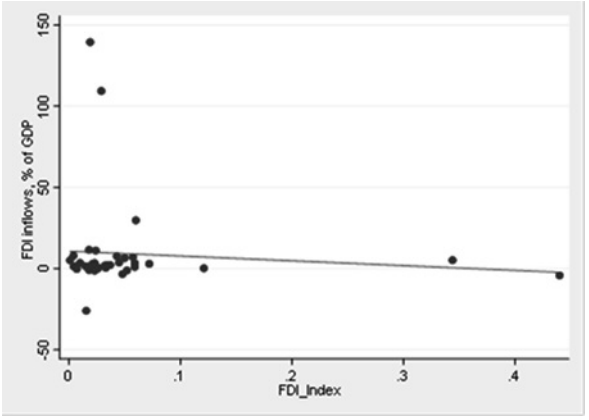
On the other hand, recent concerns among European countries regarding Chinese investment have led to the strengthening of FDI screening regulations and trade restrictions, which could impact FDI and trade in the region. The possible links between regulatory restrictions on foreign investment and FDI inflows across Europe through a descriptive analysis are explored in Figure 2. Based on the data from 2020, we have extrapolated the figures for 2022. The highest FDI Index score of 1 indicates that a country has a fully restrictive regime for FDI, and the lowest is 0, indicating that there are no regulatory impediments to FDI.

Although the patterns of FDI are broadly comparable for all European countries, the gap between EU members and EU candidates or applicants is high and quite marked. In total, about 97% of the countries in the database are open to FDI since the score of their FDI indices is between 0.0 and 0.05, compared to the average level of 0.06 in the OECD.[15] The indices also indicate that the Western Balkan countries have considerably open regulatory FDI frameworks. Specifically, in 2020, Kosovo had a minimal index level of 0.001, Montenegro had 0.024, while France had 0.045, Sweden had 0.059, and Austria had 0.106. Indeed, the growth rate of FDI in the EU was less than that in the Western Balkans and the new EU candidates over the period 2014-

[15] "FDI Regulatory Restrictiveness Index. OECD Statistics", OECD, https://stats.oecd.org/Index.aspx?datasetcode=FDIINDEX#, 07/03/2023.

2022.[16] It is probably one of the reasons why the growth of inward FDI in the Western Balkans exceeds the average in Europe.

Figure 2. FDI Inflows (% of GDP) and FDI Index in Europe for the year 2022



Source: Own elaborations on data: growth rates of FDI and FDI inflows as % of GDP calculated based on the World investment report (2023); FDI Regulatory Restrictiveness Index is from https://stats.oecd.org/Index.aspx?datasetcode =FDIINDEX#

Note: Restrictions are evaluated on a 0 (open) to 1 (closed) scale.

Figure 2 provides a complementary view of the trends of FDI regulatory restrictions embedded in changes in FDI inflows to European countries in recent years. This could be evidence of our suggestion of FDI attractiveness for the target countries: less restrictive countries tend to receive more FDI relative to the size of their economies. On the other hand, concerns about technological national security have led to increased FDI restrictiveness in European countries, especially as industrial interdependence and ICT have advanced.

Although the evidence in this sample seems limited, it suggests that changes in a country's FDI regulatory regime indeed influence changes in FDI flows to Eastern European countries. This is especially the case for the Western Balkans, where FDI accounts for a higher share of gross domestic product (GDP), indicating that the Western Balkans have considerably open regulatory FDI frameworks, especially when compared to the EU members and candidates. At the same time, not only the higher growth but also the stable FDI flows into the developed European countries may reflect the

[16] "World Investment Report 2023", United Nations Conference on Trade and Development (UNCTAD), https://unctad.org/publication/world-investment-report-2023, 07/05/2023.

strength of favourable FDI regimes and other locational factors, namely the larger market size within the Single Market of the EU.

More generally, non-European investors have a preference to invest in countries with more established regulatory frameworks and market environments, and EU investors are more likely to invest in a similar market and regulatory regime.

For example, Chinese FDI has traditionally been more significant in developed EU countries. Nevertheless, there are a growing number of prohibitions on investments in the EU originating from China. Notably, one-third of the screenings involved proposed acquisitions of semiconductor firms, a sector that both the Chinese and European governments consider highly strategic.[17] Consequently, Chinese companies may also choose to invest in less restrictive Balkan countries, either to gain access to the larger European Union market or for infrastructural reasons.

Empirical Analysis and Findings of FDI Determinants in Eastern European Economies

Data and Model specification

Our study primarily aims to investigate the impact of industrial development and FDI restrictiveness on FDI's post-COVID recovery in EEE. We specifically categorise countries within the Eastern Europe region based on the United Nations definition. We analysed 20 countries from the region over the period 2003-2022, including Kosovo, while excluding the Russian Federation, Belarus, Armenia, and Azerbaijan. The complete list is presented in Appendix A.

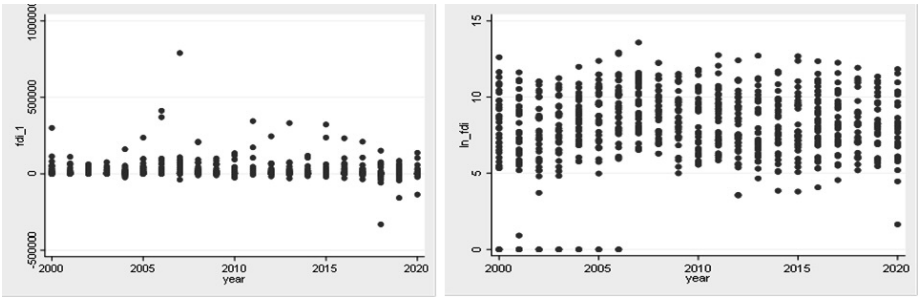
The study uses "FDI as % of GDP" as a dependent variable that represents FDI relative to the size of the country's economy (GDP). This allows for comparisons between countries of different sizes and economic strengths, providing a more standardised assessment. It is because larger economies tend to attract higher FDI inflows in absolute US dollars terms. By using "FDI as % of GDP," the analysis considers the significance of FDI in relation to the country's economic size. Additionally, "% of GDP" reduces the impact of currency fluctuations on FDI data, which can distort trends when using "FDI inflows in US$.

We take the dependent variable in a natural logarithmic form for two main reasons. The first is to respond to skewness towards large values of

[17] Agatha Kratz, Max J. Zenglein, Gregor Sebastian & Mark Witzke, "EV Battery Investments Cushion Drop to Decade Low - Chinese FDI in Europe: 2022 Update. Rhodium Group & Mercator Institute for China Studies".

FDI when one or a few points are much larger than the rest of the data. The second is to show percent change or multiplicative factors. Figure 3 shows how a log transformation can make patterns of FDI in EEE more visible. As seen, it is hard to distinguish a pattern of FDI in the left panel, whereas the strong relationship is shown clearly in the right panel.

Figure 3. Scatter Plots of FDI Inflows:
Level Data (left) and Log-Transformed Data (right)



Source: Own elaborations on data

As discussed in Section 2 of the analysis of FDI trends in Europe and the preceding literature review, this study employs a set of potential independent variables that might influence FDI flows in the sample countries. Namely, the paper focuses on the Interdependence Index, European integration, FDI restrictiveness, and the degree of ICT development. FDI restrictions are measured by the OECD FDI Regulatory Restrictiveness Index. The time horizon is 2003–2022 (T=20), the number of countries is 20 (N=20) and it changes according to the year (making an unbalanced panel) because some observations are missing.

Based on the literature, we suggest the following baseline model:

$$ln\_FDI_{it} = \beta_1 II_{it} + \beta_2 EU_{it} + \beta_3 ln\_CH_t + \beta_4 ln\_Gmn_t + \beta_5 FDI\_R\_Index_{it} + \beta_5 ln\_ICT_{it} + + u_{it} \quad (2)$$

where ln_FDI_{it} is a logarithm of FDI inflows (% of GDP) to country i at time t, *ln_ICT, ln_CH, ln_Gmn, EU, ln_II, FDI_R_Index* are the explanatory variables, and u_{it} is the composite error term consisting of fixed effects and the idiosyncratic error term. The variables of main interest, *In_II* and *FDI_R_Index,* are described in Section 2. Namely, the OECD FDI Regulatory Restrictiveness Index *(FDI_R_Index)* measures statutory restrictions on foreign direct investment in 22 economic sectors across countries and influences investors' choices for investment locations, clarifying the observed

correlation between positive FDI policy changes in one country and similar changes elsewhere. The degree of investment regulation openness plays a pivotal role in attracting investments.

As a consequence, European integration forms and treaties (such as the EU) that are associated with higher FDI restrictions might lead to a reduction in non-European FDI growth within the EU while potentially increasing FDI in the Balkan countries, Ukraine, Georgia, and Moldova.

Definitions, methods of calculation, and sources of the independent variables are presented in Table 1.

Table 1. Definition of the Independent Variables

Independent variables	Name	Description	Unit	Source
Interdependence Index	ln_ II	A measure of the level of interdependence in the semiconductor trade between Eastern European Economies (EEE) and Asian countries.	Index	Own calculation based on the COMTRADE database
European Integration	EU	A categorical variable indicating the degree of integration of the country within the European Union (EU membership).	0,1	European Commission website https:// ec.europa.eu/info/policies/ eu-enlargement _en
FDI Regulatory restrictiveness index	FDI Index	FDI Regulatory Restrictiveness Index, including foreign equity restrictions, screening and prior approval requirements, rules for key personnel, and other restrictions on the operation of foreign investors.	between 0 (open) to 1 (closed) scale	OECD database

Independent variables	Name	Description	Unit	Source
German FDI Outflows	ln_Gmn	The natural logarithm of German foreign direct investment (FDI) outflows	% of GDP	World Development Indicators
China's FDI Outflows	ln_CH	Chinese foreign direct investment, net outflows (in logarithmic form).	% of GDP	
Information and Communications Technology (ICT)	ln_ICT	A measure of the ICT development level in the country. The calculated sum of information and communication technology goods and services is exported (in logarithmic form).	% of total goods and service exports	World Bank Data

Source: Authors' elaboration.

For the robustness of our results in terms of alternative explanations, we include in the equation more control variables, namely interaction terms. So, an augmented equation (3) is:

$$ln\_FDI_{it} = \beta_1 II_{it} + \beta_2 EU_{it} + \beta_3 ln\_CH_t + \beta_4 FDI\_R\_Index_{it} + \beta_5 ln\_ICT_{it} + \beta_6 ln\_Gmn_t + \beta_7 FDI\_R\_Index * EU_{it} + \beta_8 ln\_CH * EU_{it} + u_{it} \quad (3)$$

where variables are the same as in equation 2, and additionally, to differentiate between various groups of countries, we estimate the data with interaction terms. Specifically, we consider the *FDI_R_Index*EU,* which represents the FDI Regulatory Restrictiveness Index for EU members, and *CH*EU*, which signifies Chinese FDI in the EU. It allows us to test if the relationship between FDI attractiveness (as measured by the FDI index) as well as non-European FDI (as measured by Chinese FDI outflows) and FDI in EEE is influenced by EEE's EU membership. We explore how the effect of FDI restrictiveness on EU members and Chinese outflows within the EU might differ compared to other countries in the sample. Based on the equations, we propose the following hypotheses:

Hypothesis 1:

It is hypothesised that a higher level of semiconductor interdependence between Asian countries and the EU will positively correlate with an increase in FDI inflows as a percentage of GDP in the region. As the semiconductor industry becomes more crucial to the global economy, deeper interdependence in this sector between China, Taiwan, and EEE is expected to attract more investment in the region and foster economic connectivity.

Hypothesis 2:

An improved regulatory environment (positive *FDI_R_Index* coefficient) leads to increased FDI in EEE. Concurrently, higher FDI restrictiveness in European countries reduces FDI for EU members in EEE with stricter regulations. This suggests that non-European partners are expected to be less likely to invest in countries with fewer regulatory FDI regimes, while EU investors are more inclined to invest in similar regulatory environments.

Hypothesis 3:

EEE countries with lower levels of ICT exports may be less attractive to foreign investors in technology-intensive sectors compared to EU countries with stricter FDI regulations and a guaranteed investment climate. Consequently, we expect that higher outbound FDI from China will be negatively correlated with FDI inflows to EEE, as it is more likely to be directed towards the developed EU countries, and higher FDI from Germany will be positively associated with higher FDI in EEE.

To test and support the hypotheses, we applied various empirical estimators and methods.

Empirical Methods and Results

Starting with the pooled OLS *(POLS)* model allows us to observe the relationships between variables in a straightforward manner. However, given the significant differences between countries in our sample, such as varying levels of economic development, trade patterns, and policy stability, there may be heterogeneity in the effects of FDI determinants in Eastern European countries, even after scaling variables with GDP. To address these issues and account for potential heteroskedasticity and autocorrelation, we implemented *xtpcse (PCSE)* (Heteroskedasticity and Autocorrelation Consistent Covariance Matrix) estimation in our analysis. This approach helps to improve the efficiency of estimates and provides more robust results when dealing with panel data that exhibit diverse economic conditions and FDI regulation across countries.

However, PCSE does not control for time-invariant, unobserved individual characteristics of Eastern European countries that may be correlated with our independent variables. To address this concern, we

proceeded to conduct a static panel data analysis. Based on the test results, we conclude that the fixed effects (*FE*) estimator is more efficient for our sample. We also extend the same methodology used for Equation 3 to include interaction variables. The empirical results are presented in Table 2.

Table 2. The Estimated Effects on FDI in EEE

Model	(1)	(2)	(3)	(4)	(5)	(6)
Estimator	POLS1	PCSE1	FE1	POLS2	PCSE2	FE2
Dependent variable	ln_FDI					
ln_II	0.1573 (0.0844)*	0.1573 (0.0826)**	-0.2116 (0.1302)	0.1548 (0.0834)*	0.1548 (0.0887)*	-0.3046 (0.1327)*
EU	-0.3594 (0.1368)**	-0.3594 (0.1194)**	-0.3779 (0.2049)+	-0.4636 (0.1285)**	-0.4636 (0.1522)**	-0.5183 (0.2162)*
ln_CH	-0.2906 (0.2345)	-0.2906 (0.1528)+	-0.1968 (0.1506)	-0.0771 (0.1947)	-0.0771 (0.2438)	0.1823 (0.1969)
ln_Gmn	0.1741 (0.1457)	0.1741 (0.0951)+	0.2245 (0.0910)*	0.1579 (0.0952)+	0.1579 (0.1416)	0.2136 (0.0902)*
ln_ICT	-0.1264 (0.0664)+	-0.1264 (0.0616)*	0.0522 (0.0746)	-0.1266 (0.0619)*	-0.1266 (0.0689)+	0.0899 (0.0749)
FDI_R_Index	0.0029 (0.0025)	0.0029 (0.0030)	0.0010 (0.0030)*	0.0026 (0.0030)	0.0026 (0.0025)	-0.0007 (0.0029)
FDI_R_Index*EU				0.9692 (0.6731)	-0.9692 (0.5506)	-0.5320 (0.7954) +
ln_CH*EU				-0.4146 (0.2550)	-0.4146 (0.3495)	-0.7377 (0.2459)**
_cons	1.4349 (0.2196)**	1.4349 (0.1657)**	1.3200 (0.1815)**	1.4926 (0.1672)**	1.4926 (0.2121)**	1.4284 (0.1838)**
N	400	400	400	400	400	400
r2	0.0499	0.0499	0.0345	0.0626	0.0626	0.0575

Source: Authors' elaboration.

Note: Standard errors in parentheses + p < 0.10, * p < .05, ** p < .01

As seen from Table 2, overall, both models show highly significant results. The R-squared coefficient, consistent with similar studies in this field, confirms the presence of unobserved country-specific factors, which encompass political, institutional, and legislative barriers.[18] These factors might potentially undermine the conducive conditions required for attracting inward FDI.

Our findings provide support for most of the hypotheses being tested. Namely, the Interdependence Index between Eastern European Economies and Asian countries indeed positively impacts FDI in the region (Hypothesis 1). This indicates that deeper interdependence in the semiconductor trade between EEE and Asian countries contributes to increased FDI inflows in Eastern European Economies. Consequently, with the recent US export controls on semiconductor devices and equipment, China may be even more inclined to invest in, rather than export, semiconductors to EEE.

Hypothesis 2 is only partially supported by the analysis. Namely, the positive coefficient of the FDI Regulatory Index (*FDI_R_Index*) in Model 3 indicates that, overall, an improvement in the regulatory environment fosters higher FDI inflows in EEE. This aligns with the concept that investor-friendly policies attract non-EU investors in the region (Hypothesis 2). At the same time, there is a weak negative correlation between the FDI in EU-member EEE countries and their OECD FDI restrictiveness index *(FDI_R_Index*EU)* in Model 6, which means the investors view EU membership as a sign of high regulatory restrictions for FDI, making them less inclined to invest in EEE countries that are EU members. The negative coefficient of the EU membership dummy variable *(EU)* further supports this suggestion, indicating that EU member countries in EEE might experience lower FDI inflows. On the other hand, EEE countries with lower levels of ICT exports may be less attractive to foreign investors in technology-intensive sectors compared to EU countries with stricter FDI regulations and a guaranteed investment climate.

A negative relationship between the developed technology sector ICT (ln_ICT) in EEE and FDI inflows to EEE supports Hypothesis 3. Consequently, there is a positive relationship between the level of FDI from Germany (*ln_Gmn*) and FDI inflows to EEE, while there is a negative relationship between outbound FDI from China *(ln_CH)* and FDI inflows to EEE, as it is more likely to be directed towards the developed EU countries. Indeed, the effect of outflow Chinese FDI *(ln_CH)* on FDI in Eastern European Economies (EEE) is negative, with a coefficient of -0.2906 (standard

[18] Andrzej Cieślik & Oleg Gurshev, "Determinants of inward FDI in Ukraine: Does political stability matter?", *International Journal of Management and Economics*, Vol. 56, No. 3, 2020, 243–254.

error: 0.2345). This could indicate that Chinese investments are directed elsewhere rather than into EEE.

Policymakers in EEE with less developed technology sectors and lower ICT exports may increasingly consider implementing FDI screening mechanisms. These mechanisms can help safeguard national interests, especially in sectors vital to national security.

Our empirical results support most of our hypotheses. The study's results provide strong evidence that the variables related to semiconductor trade interdependence, FDI restrictiveness, European integration, ICT development, and German and Chinese investment patterns play significant roles in influencing FDI inflows in the post-COVID recovery phase in Eastern European Economies.

Conclusions and Policy Implications

Trade disruptions resulting from the pandemic and geopolitical tensions have emerged as significant factors driving reshaping the FDI and global industrial supply chain landscape. The study examines the factors influencing FDI inflows to Eastern European Economies (EEE) from 2003 to 2022, providing valuable insights into the dynamics of FDI in the region.

In the initial post-COVID recovery phase of 2020-2021, EEE attracted substantial FDI inflows due to their export-oriented manufacturing, notably in machinery and vehicles, alongside a less restrictive FDI environment. Nevertheless, current geopolitical tensions and technological shifts, particularly in the ICT and semiconductor sectors crucial for electronics and EV battery production, are reshaping the FDI landscape and global supply chain in electronics. To compete with developed EU countries, Eastern European Economies (EEE) need to implement FDI screening mechanisms to enhance the investment climate and attract non-EU investors.

The EEE Interdependence Index value in the semiconductor sector indicates a higher dependency on semiconductor imports by EEE from China and Taiwan. This suggests that the EU relies more on foreign sources for semiconductor goods to meet its domestic demand. At the same time, when Asian countries start producing semiconductors in Europe, they will provide an opportunity for Chinese EV makers. Investing in Eastern Europe would help them save on tariffs and production costs, and it would enable EEE to participate in the global supply chain and enhance their competitiveness.

The empirical analysis showed that the Interdependence Index between EEE and Asian countries positively influences FDI inflows to the region. This indicates that stronger trade ties and connectivity in the semiconductor industry between EEE and Asian countries attract foreign investment to EEE. Therefore, fostering interdependence in semiconductors can yield positive effects on FDI attraction in Eastern European countries by enticing high-tech

companies from China and Taiwan, promoting innovation in the automobile, EV battery, and ICT sectors, enhancing national economic security, and bolstering the global competitiveness of EEE as a whole. Governments should explore trade agreements and partnerships to facilitate cross-border investment.

Changes in a country's FDI regulatory regime have an impact on FDI flows to Eastern European countries. This is especially the case for the Western Balkans with a less restrictive FDI regime, where FDI accounts for a higher share of gross domestic product (GDP), indicating that the Western Balkans have considerably open regulatory FDI frameworks, especially when compared to the EU members and candidates. At the same time, EEE countries with lower levels of ICT exports may be less attractive to foreign investors in technology-intensive sectors compared to EU countries with stricter FDI regulations and a guaranteed investment climate. Strengthening investment screening mechanisms across European countries may have positive implications for FDI flows in EEE.

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Appendix A

Table A1. Sample of Countries

Albania	Hungary	Republic of Moldova
Bosnia and Herzegovina	Kosovo	Romania
Bulgaria	Latvia	Serbia
Croatia	Lithuania	Slovakia
Czechia	Montenegro	Slovenia
Estonia	North Macedonia	Ukraine
Georgia	Poland	