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Sourcing Inputs from China for Central and Eastern European Countries' Exports

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This article highlights the role of sourcing inputs from China for Central and Eastern European (CEE) countries' exports and sheds light on the rising trade deficit between China and these countries. Research findings on gross and value-added trade panel data for 12 CEE countries suggest that a 10 per cent increase of imported capital inputs from China would cause an overall increase of 2.4 per cent in CEE exports. The effect is more pronounced for both intermediates and capital inputs imported from China, taking domestic value-added exports into consideration. By taking into account the possible endogeneity in baseline regression and the COVID-19 pandemic as an instrument of supply shock for imports from China, findings affirm that sourcing from China has promoted significantly CEE countries' gross exports as well as domestic value-added in exports. Moreover, the export boosting effect affects significantly the intensive margin. This article has rich policy implications for CEE countries to improve trade deficits with China.

INTRODUCTION

The cooperation framework between China and Central and Eastern European Countries (hereafter China–CEEC cooperation) commonly known as "17+1" (17 CEE countries plus China), was launched in 2012.[1] As a cross-regional cooperation platform

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[1] The "17+1" cooperation framework, originally known as "16+1", was established in 2012. With Greece joining in 2019 as a new member, "16+1" expanded to "17+1". These 17 countries are Albania, Bosnia and Herzegovina, Bulgaria, Croatia, the Czech Republic, Estonia, Greece, Hungary, Latvia, Lithuania, Montenegro, the Northern Republic of Macedonia, Poland, Serbia, Slovakia, Slovenia and Romania. Lithuania, Estonia and Latvia were in the group until 2021, with Lithuania leaving the group first, in that year, followed by Estonia and Latvia withdrawing from the cooperation in 2022.

established according to common aspirations of China and the CEE countries, China–CEEC cooperation has helped to boost bilateral policy coordination, trade, investment and people-to-people exchanges. Over the past few years, despite challenges such as the supply chain crisis, sluggish economic growth and disruptions to import and export trade due to the COVID-19 pandemic, China–CEEC cooperation has remained resilient and robust. In 2020, total trade between China and CEE 17 countries exceeded US$100 billion for the first time. In 2021, the figure hit US$124.02 billion, a year-on-year increase of 19.88 per cent.[2]

Given the steady growth in China–CEEC bilateral trade over the past decade, the share of China–CEEC trade in China–Europe trade had increased from 7.62 per cent in 2012 to 9.92 per cent in 2019, signifying that CEE countries have become significant trading partners for China.[3] However, since the establishment of the cooperation framework, the CEEC trade deficit with China has become a deep concern, even with a steady growth in bilateral trade. China's overall trade surplus with CEE countries (17 countries) increased from US$28.71 billion in 2012 to US$45.78 billion in 2019. Casting a shadow over China–CEEC cooperation, Lithuania left the "17+1" format on 22 May 2021 and Estonia and Latvia dropped out of the cooperation mechanism on 11 August 2022.

Trade imbalance and benefits from cooperation understandably incur complaints. However, what matters is not only the deficit per se, as the composition of deficit is also worth paying attention to. A scrutiny of the deficit reveals that different factor endowments and trade structures among CEE countries have contributed to the deficit. On the other hand, CEE countries import more products that are later used in production and investment rather than consumption. Therefore, sourcing from China may improve their trade competitiveness and in turn increase gains from exports. The imported intermediates and capital inputs together account for more than 65 per cent of bilateral trade (except for Croatia), suggesting an increasing vertical integration between CEE countries and China. That share is even higher than 80 per cent in some countries, such as the Czech Republic, Hungary, Romania, Serbia and Latvia.[4]

Have imports from China actually enhanced CEE countries' gains from trade? If so, did the outbreak of the COVID-19 pandemic change the effect? This article first investigates the impact of imported inputs from China on CEE countries' gross and value-added exports. Decomposing the effects into intensive margin and extensive margin, the authors attempt to determine which of these is the main channel of the gain. They learn that input imports from China increase CEE countries' exports and domestic value-added (DVA) in exports. They corroborated the robustness of the

[2] The authors calculated the total trade value according to the data from National Bureau of Statistics of China, *China Statistical Yearbook*, various years, at <https://www.stats.gov.cn/sj/ndsj/>.

[3] Liu Zuokui, "Da bianju xia de 'Zhongguo–Zhong Dong'ou guojia hezuo'" (China–CEEC Cooperation under Profound Changes Unseen in a Century), *Guoji wenti yanjiu* (*International Studies*) 33, no. 2 (2020): 65–78.

[4] Authors' calculation based on UN Comtrade database.

positive impact by using an alternative database and eliminating endogeneity with instrumental variables. The authors highlight that the export boosting effect is predominantly effective regarding the intensive margin, enhancing firms' competitiveness in destination markets.

This article contributes to the extant literature in the following three aspects. First, unlike existing literature on import sourcing and exports that focuses mainly on their impact on the exports of a particular country without differentiating the source country,[5] this article explores the impact of imports from a particular country, especially China, on destination country exports.

Second, this article also extends the literature on China–CEE trade relations by directly addressing the trade deficit issue between China and CEE countries. While earlier research has tended to assess the contributions of the China–CEE cooperation mechanism, the Belt and Road Initiative (BRI) or the China–Europe Railway Express to Sino–CEE trade,[6] research has barely examined and explained the deficit between CEE countries and China.[7] This article sheds light on the debate regarding the trade deficit and investigates whether imports from China have a statistically significant contribution to CEE countries' exports in order to improve China–CEE cooperation in the future. In particular when China's gross exports are decomposed into value added components and double-counted terms, the deficit is much smaller since China's domestic content in exports accounts for merely 65 to 70 per cent for processing exporters.[8]

Third, this article not only focuses on the overall effect of imported inputs from China on CEE countries' exports, but also distinguishes between intensive margin and extensive margin. In addition, the article further investigates the presence of a trade diversion effect during the COVID-19 pandemic. Such a study enhances the literature by integrating the role of the public health emergency which has been largely ignored in the earlier research on trade effects of "17+1" cooperation.

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[5] Maria Bas, "Input-trade Liberalization and Firm Export Decisions: Evidence from Argentina", *Journal of Development Economics* 97, no. 2 (2012): 481–93; Hiroyuki Kasahara and Beverly Lapham, "Productivity and the Decision to Import and Export: Theory and Evidence", *Journal of International Economics* 89, no. 2 (2013): 297–316; Feng Ling, Li Zhiyuan and Deborah L. Swenson, "The Connection between Imported Intermediate Inputs and Exports: Evidence from Chinese Firms", *Journal of International Economics* 101, no. 3 (2016): 86–101; Francisco Requena, Guadalupe Serrano and Raúl Mínguez, "The Enhancing Effect of Imports of Intermediate Inputs on Firms' Exports", *World Economy* (2023): 1–30.

[6] Yao Qinhua and Wang Song, "The China–Central and Eastern Europe 16+1 Cooperation Mechanism", in *The New Silk Road: European Perspectives: Security Challenges/Risks within the Initiative 16+1*, ed. Vladimir N. Cvetković (Belgrade: University of Belgrade-Faculty of Security Studies, 2018), pp. 209–25; Mao Haiou et al., "Does Belt and Road Initiative Hurt Node Countries? A Study from Export Perspective", *Emerging Markets Finance and Trade* 55, no. 7 (2019): 1472–85; Savo Stanojevic, Qiu Bin and Chen Jian, "A Study on Trade between China and Central and Eastern European Countries: Does the 16+1 Cooperation Lead to Significant Trade Creation?", *Eastern European Economics* 59, no. 4 (2021): 295–316.

[7] Tamas Matura, "China–CEE Trade, Investment and Politics", *Europe-Asia Studies* 71, no. 3 (2019): 388–407.

[8] Hiau Looi Kee and Tang Heiwai, "Domestic Value Added in Exports: Theory and Firm Evidence from China", *American Economic Review* 106, no. 6 (2016): 1402–36.

This article is organised as follows. The second section provides a literature review; the third introduces the research methodology; the fourth analyses the empirical results and the fifth section concludes.

LITERATURE REVIEW

There are two strands of the research literature. The first studies the effect of intermediate input imports on export performance. The second focuses on trade between China and CEE countries since the establishment of the "17+1" cooperation.

Literature on international trade provides evidence that intermediate input imports generate productivity gains for firms through learning, variety and quality effects.[9] By gaining access to a wider variety of and higher-quality inputs (at a lower pricing), firms are able to achieve higher total factor productivity and a reduction in marginal costs. Yu and Li find that imported inputs could improve the productivity of a firm that produces homogeneous goods, but they have little effect on those firms that produce differentiated goods.[10]

Economists have also examined the correlation between the availability of imported intermediate inputs and firms' export decisions.[11] It is believed that the technology embodied in imported intermediates has contributed to firms' product quality upgrading. Moreover, intermediates—due to their lower cost—result in marginal cost reduction which improves firms' international competitiveness and eases export participation.

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[9] Mary Amiti and Jozef Konings, "Trade Liberalization, Intermediate Inputs, and Productivity: Evidence from Indonesia", *American Economic Review* 97, no. 5 (2007): 1611–38; Pinelopi K. Goldberg et al., "Imported Intermediate Inputs and Domestic Product Growth: Evidence from India", *Quarterly Journal of Economics* 125, no. 4 (2010): 1727–67; Petia Topalova and Amit Khandelwal, "Trade Liberalization and Firm Productivity: The Case of India", *Review of Economics and Statistics* 93, no. 3 (2011): 995–1009; László Halpern, Miklós Koren and Adam Szeidl, "Imported Inputs and Productivity", *American Economic Review* 105, no. 12 (2015): 3660–703; Yu Miaojie and Li Jin, "Imports, Heterogeneous Industry and Improvement of Firm Productivity" (in Chinese), *Economic Research Journal* 50, no. 8 (2015): 85–97.

[10] Homogeneous industry refers to one that has a guide price in the product exchange or industry list, like petroleum and minerals. Heterogeneous industry refers to one that does not have a uniform guide price and the product can be classified into different subunits, such as sneakers, sandals, boots, etc. See Yu and Li, "Imports, Heterogeneous Industry and Improvement of Firm Productivity" (in Chinese).

[11] Maria Bas and Vanessa Strauss-Kahn, "Does Importing More Inputs Raise Exports? Firm-level Evidence from France", *Review of World Economics* 150, no. 2 (2014): 241–75; Jože P. Damijan, Jozef Konings and Sašo Polanec, "Import Churning and Export Performance of Multi-product Firms", *World Economy* 37, no. 11 (2014): 1483–506; Bas and Strauss-Kahn, "Input-trade Liberalization, Export Prices and Quality Upgrading", *Journal of International Economics* 95, no. 2 (2015): 250–62; Ana Cecília Fieler, Marcela Eslava and Daniel Yi Xu, "Trade, Quality Upgrading, and Input Linkages: Theory and Evidence from Colombia", *American Economic Review* 108, no. 1 (2018): 109–46; Juan A. Máñez, María E. Rochina-Barrachina and Juan A. Sanchis, "Foreign Sourcing and Exporting", *World Economy* 43, no. 5 (2020): 1151–87.

Since the launch of the China–CEEC cooperation mechanism, the trade deficit of the CEE countries with China has received particular attention. Some researchers argue that the deficit should not be viewed as a real problem, as the CEE countries' imports from China are mostly spare parts, accessories and other inputs to the CEEC industries that are later re-exported to Western European countries as final products.[12] Yao and Wang stress the importance of rail links between China and Europe to promote the growth of Sino–CEEC trade.[13] In addition, trade between CEE and China has shown relative resilience to the effects of the COVID-19 crisis.[14] By examining the impact of the BRI (Belt and Road Initiative) on exports of "node countries" to China, Mao et al. conclude that CEE countries have benefited more than other "node countries", suggesting the BRI's positive contribution to CEEC exports to China.[15] Stanojevic et al. have identified China's growing share in total exports and imports of the CEE countries, and that the "17+1" cooperation has promoted higher trade flows from CEE countries to China, rather than from China to CEE countries.[16]

In sum, economists generally agree that the availability of high-quality and low-cost intermediate inputs could boost exports by reducing marginal costs, enhancing productivity and competitiveness of firms in international markets. However, they have not attempted to examine the differentiated effects of imported inputs across different geographical origins. The 2008/9 global financial crisis and the COVID-19 pandemic forced firms to geographically diversify their source of suppliers of crucial components so as to ease future supply chain disruptions and to manage supply chain risks.

Following the launch of the China–CEEC cooperation framework in 2012, economic and trade cooperation has accounted for an important part of bilateral relations between the two sides. This article applies a multicountry data set to investigate whether the imported inputs from China promote CEE countries' exports and domestic value-added (DVA) in exports. It also attempts to distinguish the main channel of trade increase between extensive and intensive margins while controlling for position in global value chains (GVCs). This study therefore enriches not only past findings that examine the effects of input imports on exports but also the extant literature on China–CEE trade.

[12] Matura, "China–CEE Trade, Investment and Politics".
[13] Yao and Wang, "The China–Central and Eastern Europe 16+1 Cooperation Mechanism".
[14] Péter Goreczky, "Trade between CEE and China in the COVID Era: Macro Trends and Hungarian Experiences", in *Results and Challenges: Ten Years of China–CEEC Cooperation*, ed. Levente Horváth (Budapest: Eurasia Center John Von Neumann University, 2022), pp. 160–78.
[15] Mao et al., "Does Belt and Road Initiative Hurt Node Countries? A Study from Export Perspective".
[16] Stanojevic, Qiu and Chen, "A Study on Trade between China and Central and Eastern European Countries: Does the 16+1 Cooperation Lead to Significant Trade Creation?".

RESEARCH METHODOLOGY

Data and Stylised Facts

Gross trade data used in the analysis were obtained from the United Nations Commodity Trade Statistics Database (UN Comtrade), which includes annual and monthly trade statistics by product and trading partners for approximately 200 countries. The bilateral export and import flows are grouped into three product categories according to their broad economic purposes (i.e. classification by broad economic categories [BEC]): intermediates, consumption and capital goods. According to BEC classification, goods with code "111", "121", "21", "22", "31", "322", "42" and "53" are intermediate goods, and goods with code "41" and "521" are capital goods. The authors also used nominal gross domestic product (GDP) data from the World Development Indicators database (World Bank) and export added value from the 2021 edition of the OECD Trade in Value Added (TiVA) database which includes 12 CEE countries' domestic value-added in gross exports from 1995 to 2018. Due to limited availability of data, only 12 CEE countries[17] for the 2002–18[18] period were examined in this empirical analysis, and they are all European Union (EU) member countries (CEE-12). The CEE-12, however, accounted for over 90 per cent of China's trade with 17 CEE countries, and hence the CEE-12 could be seen as representative of China's trade with the region.

The authors used data from the World Input-Output Database (WIOD), which has a considerably broader industrial coverage than the Asian Development Bank Multiregional Input-Output (ADB-MRIO) database, to calculate GVC indices. Additionally, they used the ADM-MRIO database, which covers 35 industries and sample updates up to 2021, to perform robustness check estimations. Each country's GVC position is a weighted average of industry GVC position, which is calculated from the decomposition of GVC production length provided by UIBE (University of International Business and Economics) GVC indicators.[19] The UIBE GVC database is a non-profit database for academic research that provides value-added trade indicators and GVC-related indicators, such as indicators associated with production length, production position and cross-border frequency in GVCs or international production processes.

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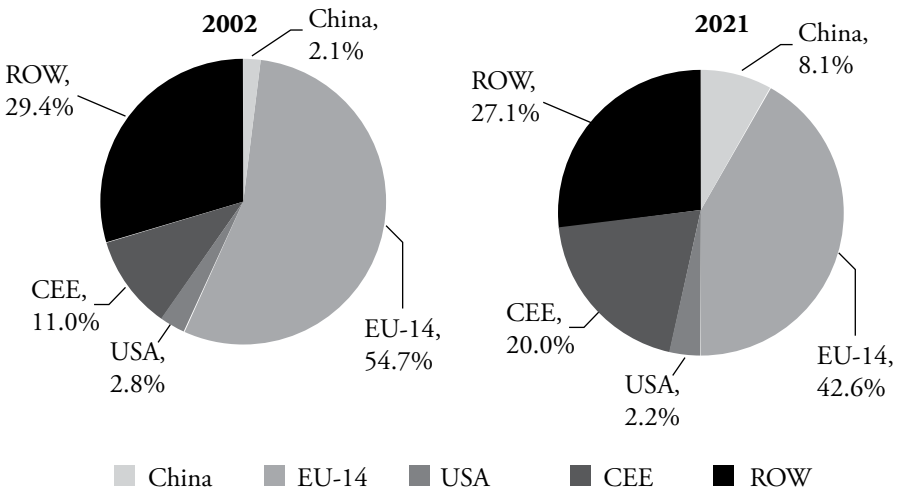
[17] These 12 countries are Greece (joined European Economic Community in 1981), Poland, Hungary, Czech Republic, Slovakia, Slovenia, Estonia, Latvia, Lithuania (joined EU in 2004), Romania, Bulgaria (joined EU since 2007) and Croatia (joined EU since 2013).

[18] Gross exports analysis was estimated during the 2002–18 period, while domestic value added (DVA) in exports was analysed during the 2005–16 period.

[19] Research Institute for Global Value Chains, University of International Business and Economics (RIGVC UIBE), "UIBE GVC Indicators", 14 October 2021, at <http://rigvc.uibe.edu.cn/english/D_E/database_database/index.htm> [15 October 2021].

As shown in Figure 1, CEE countries increased imports of intermediates from China between 2002 and 2021.[20] In 2021, imported intermediates from China reached US$59.6 billion, accounting for 8.1 per cent of total imported intermediates, a significant increase from 2.1 per cent in 2002. In addition, CEE, as a whole, trades more intermediates with each other; trade volume increased from US$16.4 billion in 2002 to US$147.4 billion in 2021, accounting for one-fifth of total imported intermediates. By contrast, the share from EU-14 member countries[21] and the United States fell to 42.6 per cent and 2.2 per cent of total imported intermediates, respectively.

Figure 1. Decomposition of Imported Intermediates for CEE-17 Economies, 2002 and 2021



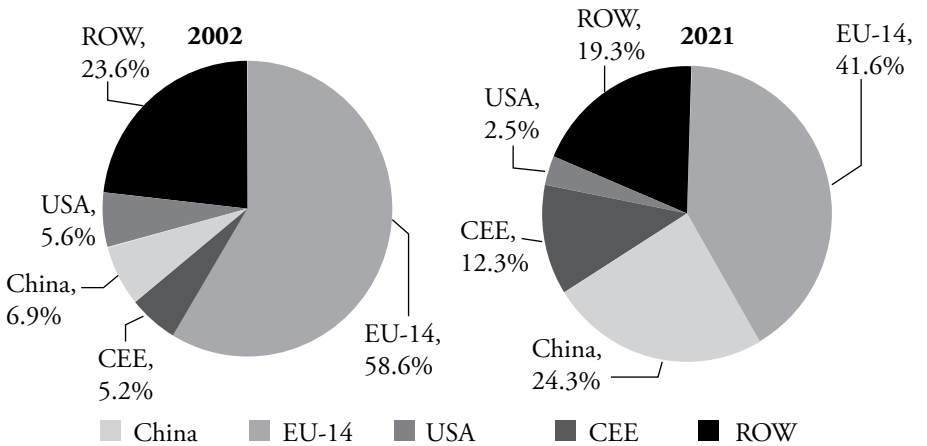
Notes: EU denotes European Union; ROW, rest of the world; CEE, Central and Eastern Europe[-an]. CEE-17 countries are Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Greece, Hungary, Latvia, Lithuania, Montenegro, the Northern Republic of Macedonia, Poland, Serbia, Slovakia, Slovenia and Romania. EU-14 countries are Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom.
Source: Authors' calculations based on the United Nations Commodity Trade Statistics Database (UN Comtrade data).

Figure 2 shows similar trends of a sharp increase in CEE countries' imports of capital goods from China. From 2002 to 2021, the imports rose so rapidly (about 16.7 per cent on average per year) that China became the largest capital goods sourcing country in 2021 for CEE countries, followed by Germany, accounting for 24.3 per cent and 18.6 per cent of CEE countries' total capital imports, respectively.[22] Conversely, the

[20] Since 2021 data for Albania were unavailable, both Figures 1 and 2 include only 16 CEE countries in 2021.
[21] These 14 countries are Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom.
[22] The authors computed Germany's share, which was not indicated individually in Figure 2.

share of imported capital goods from EU-14 and the United States declined to 41.6 per cent and 2.5 per cent from 58.6 per cent and 5.6 per cent at that time.

Figure 2. Decomposition of Imported Capital Goods for CEE-17, 2002 and 2021



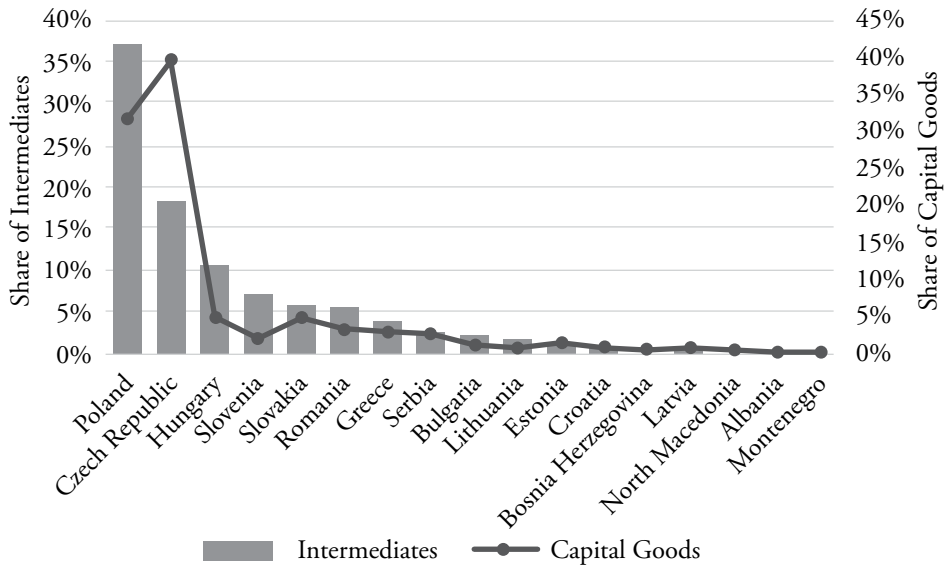
Notes: CEE denotes Central and Eastern Europe[-an]; EU, European Union; and ROW, rest of the world.
Source: Authors' calculations based on the UN Comtrade data.

Figure 3 shows that imported inputs of different countries vary substantially. In 2021, Poland imported the largest amount of intermediate products, worth US$22.2 billion, and the Czech Republic imported the largest amount of capital goods, worth US$19.5 billion, accounting for 37.2 per cent and 39.7 per cent of the total imported intermediates and capital goods of 17 CEE countries from China, respectively. Taking both intermediates and capital goods into consideration, imports were obviously highest into the V4 (Visegrád Four or the Visegrád Group) countries.[23] The top five importing countries—Poland, Czech Republic, Hungary, Slovakia and Slovenia—already accounted for over 80 per cent of total imports in 17 countries,[24] followed by Romania and Greece, with a share of 4.7 per cent and 3.6 per cent, respectively.

Before conducting regression analysis, the authors compared the relationship between CEE countries' exports and their imports of intermediate and capital inputs from China with that between CEE countries' exports and their imports from the rest of the world. Imported Chinese inputs are positively correlated with CEE countries' exports, as indicated by the fitted value line (see Figure 4). The positive correlation is particularly obvious for intermediate inputs, even after controlling for country-specific effects by expressing both exports and imports as a share of GDP. Despite the evidence of correlation, it is necessary to examine the mechanisms behind it. This empirical analysis therefore focuses mainly on the causality and effect of input imports from China for CEE exports.

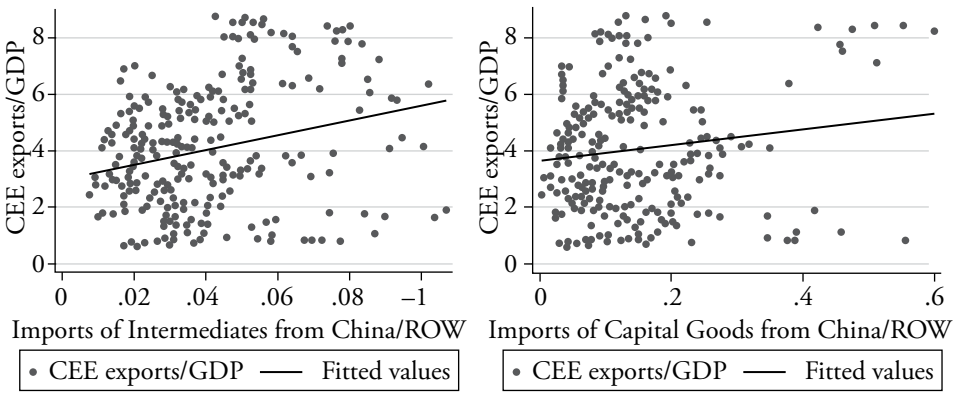
[23] The Visegrád Group or V4 is composed of the Czech Republic, Hungary, Poland and Slovakia.
[24] Data for Albania were based on 2020 due to unavailable data in 2021.

Figure 3. Share of Imported Inputs from China for Each CEE Country, 2021



Source: Authors' calculations based on the UN Comtrade data.

Figure 4. Scatter Plots of CEE Exports and Imported Inputs from China



Source: Authors' calculations based on the UN Comtrade data.

Empirical Model Specification and Variable Definitions

The authors formulate the basic regression model as follows:

$$\ln EX_{ct} = \alpha_0 + \alpha_1 \ln Z_{ct-1} + \alpha_2 \ln K_{ct-1} + \alpha_3 \ln Z_{ct-1} \times \ln K_{ct-1} + \alpha_4 GVC_{ct-1} + \alpha_5 X_{ct-1} + \eta_c + \eta_t + \varepsilon_{ct} \quad (1)$$

where $\ln EX_{ct}$ refers to country c's export value in year t; $\ln Z_{ct-1}$ and $\ln K_{ct-1}$ represent country c's lagged values of imported intermediates and capital inputs, respectively;

GVC_{ct-1} means country c's position in global value chains in the previous year; X_{ct-1} represents a set of control variables; η_c and η_t refer to country-specific and time-specific fixed effects; and ε_{ct} is the error term.

The authors' primary objective is to estimate the effects of imported inputs from China on CEE countries' exports through the coefficients α_1 and α_2. Further, the interaction of both imports ($\ln Z_{ct} \times \ln K_{ct}$) tests how capital goods imports affect the impact of intermediate imports on exports of CEE countries. The positive coefficient on the interaction (α_3) suggests complementarities in these two categories of imported inputs, i.e. large volumes of capital goods imports from China enhance the impact of imported intermediates on CEE exports. It is necessary to include a vector of control variables (X_{ct}) to isolate the impact of sourcing from China. These controls help to account for country-level factors, such as total imported inputs (both capital goods, $\ln K\_total_{ct}$ and intermediates, $\ln Z\_total_{ct}$) from the rest of the world to control for the effect of imported inputs from other trade partners, the country's position in GVCs and its GDP that shows the supply-side effect. To account for the unobserved country-level time-invariant factors that may have influenced each country's exports, η_c and η_t are included as country and year fixed effects. This is to control for the impact of country-specific characteristics and unobservable time-related factors on exports. A fixed effects model is a useful tool to control for, or partial out, the effects of time-invariant variables with time-invariant effects. However, endogeneity problems such as reverse causality may still be present. As a country exports more, its imported inputs increase accordingly. Therefore, lagged values of the explanatory variables are used to account for this problem.

GVC (Global value chain) position

To estimate a country's GVC position, the authors follow the method in Wang et al.'s[25] research using production length to examine sector i of country r's position in GVCs. The average production line position in a global value chain can be defined as the ratio of the two production lengths:

$$GVC\ position_{ir} = \frac{PL_v\_GVC_{ir}}{[PL_y\_GVC_{ir}]'} \tag{2}$$

where average forward production length $PL_v\_GVC_{ir}$ (to the end of the chain) is the ratio of GVC-related domestic value-added to induced gross output, while the average backward production length $[PL_y\_GVC_{ir}]'$ (to the starting point of the chain) is the ratio of GVC-related foreign value added to induced gross output. Equation (2) indicates that the production line position index is closely related to the measure of

[25] Wang Zhi et al., "Characterizing Global Value Chains: Production Length and Upstreamness", National Bureau of Economic Research (NBER) Working Paper 23261, March 2017, at <http://www.nber.org/papers/w23261> [15 April 2022].

production length—the larger the index value, the higher the relative "upstreamness" in global production for a particular country-sector pair.

Extensive and intensive margins

To investigate how imported Chinese inputs affect CEE countries' exports, the authors decompose gross trade into extensive margin (equation [3]) and intensive margin (equation [4]), following Hummels and Klenow's, and Shi's research.[26] The decomposition uses the Harmonized System (HS) 6-digit data and then the data are aggregated at country level.

$$EM_{jm} = \frac{\sum i \in I_{jm} M_{rmi}}{\sum i \in I_{rm} M_{rmi}} \tag{3}$$

In equation (3), j, r and m represent exporting country, reference country and importing country, respectively. Of great interest to this article are CEE countries' margins compared to the global average; hence the 12 CEE countries are taken as exporting countries, while the rest of the world takes the role of both importing and reference country. The variable I_{rm} is the product set of world's exports to country m, while I_{jm} is the product set of country j's exports to country m; and i is the HS 6-digit product code. The equation EM_{jm} denotes country r's exports to country m in I_{jm} relative to country r's exports to country m in all I_{rm} categories. Therefore, the extensive margin is a weighted value of country j's categories relative to country r's categories. And these categories are weighted by their importance in country r's exports to country m. A large extensive margin thus means a larger number of exported categories by country j.

$$IM_{jm} = \frac{\sum i \in I_{jm} M_{jmi}}{\sum i \in I_{jm} M_{rmi}} \tag{4}$$

In equation (4), IM_{jm} shows country j's exports relative to country r's exports in those categories in which country j exports to country m (I_{jm}). Therefore, country j's intensive margin is country j's share of exports in world total exports in the same categories. A large intensive margin means that country j is exporting relatively more of a given category compared to other countries, all else being equal.

The authors develop an empirical model that is estimated at both country and country-industry levels for both total exports and DVA in exports, but separately for intensive and extensive margins. The Hausman test is used to select between a fixed and random effects estimator. The Appendix presents the descriptive statistics of the variables in the basic regression model. As is evident in the Appendix, CEE countries vary greatly in exports, intermediate and capital inputs imports, and particularly the extensive margin.

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[26] David Hummels and Peter J. Klenow, "The Variety and Quality of a Nation's Exports", *American Economic Review* 95, no. 3 (2005): 704–23; Shi Bingzhan, "The Three Margins of China's Export Growth" (in Chinese), *China Economic Quarterly* 9, no. 4 (2010): 1311–29.

RESULTS AND DISCUSSION

The authors first investigate the effect of imported intermediates and capital goods from China on country-level gross exports, and then conduct tests on DVA in exports, intensive and extensive margins. Following an analysis of country-level data, the authors focus on industry-level data to accommodate for an industry's position in GVCs.

Baseline Results

Table 1 reports the estimates of baseline specification which assesses how CEE countries' exports respond to their intermediates and capital imports from China. Hausman test fixed effects estimator results are reported.[27] The F-test confirms for all specifications a good fit of included regressors jointly. Furthermore, the F-test that *all u_i=0* affirms the importance of the unobserved country-level heterogeneity in specified regression models, indicating that fixed effects estimator fits better than pooled ordinary least squares regression.

The results show that, in general, exports of CEE countries are positively linked to an increase in imported intermediate inputs from the rest of the world, while no significant impact is found for the imports of capital goods (Table 1, column [1]). When differentiating imports of inputs from China, imports of capital goods from China are found to stimulate exports, leading to around a one per cent increase in export value for every 20 per cent increase in imports of capital goods from China at an unchanged level of total imports of capital goods (Table 1, column [2]). Such is the robust export-enhancing effect of sourcing capital goods from China even when total imports are controlled (Table 1, column [3]), suggesting that an increase in the share of imports of capital goods from China is associated with an increase in the exports of CEE countries. As expected, exports are also positively related to a country's GDP, although the authors do not find a significant impact of GVC positions (Table 1, columns [4] to [6]).

TABLE 1
FIXED EFFECTS ESTIMATE OF GROSS EXPORTS FOR CEE-12, 2002–18

	(1)	(2)	(3)	(4)	(5)	(6)
	$\ln EX_t$	$\ln EX_t$	$\ln EX_t$	$\ln EX_t$	$\ln EX_t$	$\ln EX_t$
$\ln Z_{t-1}$		–0.005	–0.032	–0.040	–0.040	0.184
		[0.033]	[0.031]	[0.036]	[0.083]	[0.159]
$\ln K_{t-1}$		0.045***	0.047***	0.043**	0.042	0.242*
		[0.016]	[0.016]	[0.018]	[0.066]	[0.138]
$\ln Z_{t-1}$ x $\ln K_{t-1}$					0.000	–0.011
					[0.004]	[0.007]
$\ln Z_{total,t-1}$	0.441***		0.468***	0.484***	0.485***	–0.298
	[0.074]		[0.073]	[0.084]	[0.084]	[0.481]

[27] The Hausman test statistic for specification reported in column (1) of Table 1, for instance, is $chi^2(10) = 984.18$***.

TABLE 1 (*cont'd*)

	(1)	(2)	(3)	(4)	(5)	(6)
	$\ln EX_t$	$\ln EX_t$	$\ln EX_t$	$\ln EX_t$	$\ln EX_t$	$\ln EX_t$
$\ln K_{total,t-1}$	–0.018		–0.076	–0.076	–0.076	–0.909*
	[0.038]		[0.046]	[0.054]	[0.058]	[0.508]
$\ln Z_{total,t-1}$ x $\ln K_{total,t-1}$						0.036
						[0.022]
GVC_{t-1}				–0.264	–0.264	–0.164
				[0.385]	[0.391]	[0.393]
$\ln GDP_{t-1}$	0.116*	0.367***	0.149**	0.161*	0.162*	0.147
	[0.066]	[0.058]	[0.066]	[0.082]	[0.089]	[0.089]
Constant	10.850***	13.695***	10.403***	10.207***	10.217***	24.488***
	[1.278]	[1.247]	[1.263]	[1.715]	[1.927]	[8.853]
F test	F(18, 162) = 271.8***	F(18, 162) = 224.1***	F(20, 160) = 255.1***	F(18, 126) = 210.6***	F(19, 125) = 197.9***	F(20, 124) = 190.7***
F test that all u_i=0	F(11, 162) = 83.7***	F(11, 162) = 177.7***	F(11, 160) = 80.1***	F(11, 126) = 64.6***	F(11, 125) = 56.0***	F(11, 124) = 44.8***
Observations	192	192	192	156	156	156
No. of units	12	12	12	12	12	12
R-squared	0.968	0.961	0.970	0.968	0.968	0.969

Notes: Country and year fixed effects are included in all specifications. Robust standard errors are shown in parentheses; *** p<.01, ** p<.05, * p<.1.

Table 2 presents the empirical results for domestic value-added in exports. If this alone is considered, imports of capital goods from the rest of world, unexpectedly, are found to be negatively associated with exports, while intermediates imports continue to show a positive impact. Regressing sourcing of intermediates and capital goods from China separately does not yield a significant effect on domestic value-added in exports, in contrast to the role of sourcing from China for gross exports. The exception is in column (6) of Table 2, in which an interaction term of intermediates and capital goods is introduced; imports of both inputs from China (i.e. intermediates and capital goods) become positively related to exports, while their interaction is significantly negative. These results suggest that increased capital goods imports of a CEE country from China do indeed undermine the positive impact of increasing intermediates imports on domestic added value in exports and vice versa. This probably indicates a mismatch between imports of Chinese capital goods and intermediates.

TABLE 2
FIXED EFFECTS ESTIMATE OF DOMESTIC VALUE ADDED IN EXPORTS FOR CEE-12, 2005–16

	(1)	(2)	(3)	(4)	(5)	(6)
	$\ln DVAEX_t$	$\ln DVAEX_t$	$\ln DVAEX_t$	$\ln DVAEX_t$	$\ln DVAEX_t$	$\ln DVAEX_t$
$\ln Z_{t-1}$		0.014	–0.017	–0.026	0.117	0.413***
		[0.031]	[0.030]	[0.032]	[0.090]	[0.149]
$\ln K_{t-1}$		–0.021	–0.017	–0.015	0.118	0.397***
		[0.016]	[0.016]	[0.017]	[0.080]	[0.138]

(*cont'd overleaf*)

TABLE 2 (*cont'd*)

	(1)	(2)	(3)	(4)	(5)	(6)
	ln$DVAEX_t$	ln$DVAEX_t$	ln$DVAEX_t$	ln$DVAEX_t$	ln$DVAEX_t$	ln$DVAEX_t$
$\ln Z_{t-1}$ x $\ln K_{t-1}$					–0.007*	–0.021***
					[0.004]	[0.007]
$\ln Z_{total,t-1}$	0.416***		0.410***	0.433***	0.440***	–0.642
	[0.075]		[0.076]	[0.079]	[0.079]	[0.448]
$\ln K_{total,t-1}$	–0.088**		–0.049	–0.045	–0.024	–1.187**
	[0.035]		[0.045]	[0.047]	[0.049]	[0.477]
$\ln Z_{total,t-1}$ x $\ln K_{total,t-1}$						0.050**
						[0.020]
GVC_{t-1}				–0.211	–0.289	–0.209
				[0.322]	[0.322]	[0.316]
lnGDP_{t-1}		0.806***	0.600***	0.564***	0.521***	0.485***
		[0.061]	[0.075]	[0.082]	[0.085]	[0.084]
Constant	–13.37***	–10.09***	–12.95***	–12.36***	–14.57***	5.75
	[1.453]	[1.412]	[1.489]	[1.736]	[2.156]	[8.546]
F test	F(14, 118) = 143.4***	F(14, 118) = 113.9***	F(16, 116) = 125.5***	F(16, 104) = 113.2***	F(17, 103) = 108.7***	F(18, 102) = 108.0***
F test that all u_i=0	F(11, 118) = 35.0***	F(11, 118) = 39.0***	F(11, 116) = 28.0***	F(11, 104) = 25.4***	F(11, 103) = 21.2***	F(11, 102) = 16.7***
Observations	144	144	144	132	132	132
No. of units	12	12	12	12	12	12
R-squared	0.944	0.931	0.945	0.946	0.947	0.950

Notes: Country and year fixed effects are included in all specifications. Robust standard errors are in parentheses; *** p<.01, ** p<.05, * p<.1.

GVC Position and Imported Inputs: Industry Level

To test whether the correlation between sourcing from China and exports is sensitive to industrial characteristics, the authors conduct a regression analysis of the industry-specific GVC index and domestic value-added in exports (Table 3). The results support the country-level evidence of a significantly positive impact of sourcing intermediates and of a negative impact of importing capital goods from abroad on CEE countries' domestic value-added in exports. In terms of intensity of sourcing from China, the results indicate relatively robust evidence of an export-enhancing effect of sourcing intermediates from China, but a lack of robust evidence of a contribution of capital goods imports. However, the interaction term's significantly negative coefficient affirms the change of DVA in exports. A possible explanation could be that the positive effect on productivity of imported inputs depends largely on the importer's absorptive capacity—if the "absorption" cannot match the technology embodied in imported capital goods, then the effect is seen to depress the exports. Second, the negative effect could be attributed to the unbalanced import structure between intermediates and capital goods. CEE countries import more capital goods (20.4 per cent of bilateral trade on average) than intermediates (six per cent of bilateral trade on average) from China.

TABLE 3
FIXED EFFECTS ESTIMATE OF DOMESTIC VALUE-ADDED IN EXPORTS FOR CEE-12, 2002–16, INDUSTRY-LEVEL EVIDENCE

	(1)	(2)	(3)	(4)	(5)	(6)
	$\ln DVAEX_t$	$\ln DVAEX_t$	$\ln DVAEX_t$	$\ln DVAEX_t$	$\ln DVAEX_t$	$\ln DVAEX_t$
$\ln Z_{t-1}$		0.074***	0.049**	0.029	0.396***	0.526***
		[0.023]	[0.024]	[0.024]	[0.053]	[0.100]
$\ln K_{t-1}$		–0.007	0.016	0.012	0.320***	0.438***
		[0.011]	[0.012]	[0.011]	[0.042]	[0.087]
$\ln Z_{t-1}$ x $\ln K_{t-1}$					–0.018***	–0.024***
					[0.002]	[0.005]
$\ln Z_{total,t-1}$	0.936***		0.937***	0.998***	0.974***	0.519*
	[0.054]		[0.054]	[0.052]	[0.052]	[0.298]
$\ln K_{total,t-1}$	–0.235***		–0.289***	–0.300***	–0.185***	–0.672**
	[0.030]		[0.035]	[0.034]	[0.037]	[0.316]
$\ln Z_{total,t-1}$ x $\ln K_{total,t-1}$						0.021
						[0.014]
GVC_{t-1}				–0.819***	–0.795***	–0.786***
				[0.111]	[0.111]	[0.111]
$\ln GDP_{t-1}$		1.132***	0.827***	0.803***	0.650***	0.639***
		[0.044]	[0.056]	[0.054]	[0.057]	[0.058]
Constant	–32.657***	–25.448***	–33.143***	–32.367***	–37.009***	–28.634***
	[1.115]	[1.019]	[1.128]	[1.089]	[1.243]	[5.555]
F test	F(14, 7161)	F(14, 7161)	F(16, 7159)	F(17, 7121)	F(18, 7120)	F(19, 7119)
	= 643.2***	= 598.4***	= 563.8***	= 583.0***	= 558.4***	= 529.2***
F test that all u_i=0	F(655,7161)	F(655,7161)	F(655, 7159)	F(648, 7121)	F(648, 7120)	F(648, 7119)
	= 327.3***	= 315.5***	= 327.3***	= 182.2***	= 183.4***	= 183.4***
Observations	7,831	7,831	7,831	7,787	7,787	7,787
No. of units	656	656	656	649	649	649
R-squared	0.557	0.539	0.558	0.582	0.585	0.585

Notes: Country-industry and year fixed effects are included in all specifications. Robust standard errors are in parentheses; *** p<.01, ** p<.05, * p<.1.

Effects on Extensive and Intensive Margins

Previous studies have shown that the extensive margin of trade contributes more significantly to trade growth than the intensive margin.[28] Kancs[29] finds that the Balkan Free Trade Area triggers trade growth primarily through a growing variety of exported goods (the extensive margin of trade). In addition, reducing variable trade costs has a quantitatively larger impact on export growth than reducing fixed trade costs by the same percentage. Since China has a price advantage in products in world trade markets, it is reasonable to predict that imported inputs may boost exports, in particular the intensive margin, by reducing firms' variable costs.

[28] Jonathan Eaton, Samuel Kortum and Francis Kramarz, "An Anatomy of International Trade: Evidence from French Firms", *Econometrica* 79, no. 5 (2011): 1453–98.

[29] D'Artis Kancs, "Trade Growth in a Heterogeneous Firm Model: Evidence from South Eastern Europe", *World Economy* 30, no. 7 (2007): 1139–69.

While the preliminary results reveal a significant connection between imported Chinese inputs and CEE countries' exports, they do not explain how intermediates change exports. Thus, the following regressions decompose aggregate exports into two parts, namely extensive margin and intensive margin (Table 4). The regression model specification is adjusted by redefining the core variables which are expressed as the share of imports of intermediates and capital goods from China in total imports of the respective broad BEC category of goods. To control for the intensity of offshoring (i.e. importing inputs), the ratios of total imports of intermediates to GDP and of total imports of capital goods to GDP are calculated and used. Following that, whether imported intermediates from China benefit CEE exports through exporting more varieties of goods (the extensive margin), or through exporting larger quantities of each product (the intensive margin) is assessed. Results have suggested that a higher share of both imported capital goods and intermediates from China leads to a larger intensive margin, while a negative correlation between the share of imported capital goods and extensive margin is identified, but it dissipates after controlling for the input imports to GDP ratio. A possible explanation why an export-enhancing effect works with respect to the intensive margin could be that the relatively low price of imported inputs from China has improved the competitiveness of CEE countries, contributing to an increase in market share in global trade. Compared with imported inputs from the rest of the world, the price of similar inputs imported from China was, on average, 40 per cent to 60 per cent lower, based on pricing in 2018.[30]

TABLE 4
Fixed Effects Estimate of Intensive and Extensive Export Margins for CEE-12, 2002–18

	(1)	(2)	(3)	(4)	(5)	(6)
	Intensive margin	**Intensive margin**	**Intensive margin**	**Extensive margin**	**Extensive margin**	**Extensive margin**
$\frac{importZ_{China,t-1}}{importZ_{total,t-1}}$		0.00014***	0.00011**		0.00002	0.00284
		[0.000]	[0.000]		[0.003]	[0.004]
$\frac{importK_{China,t-1}}{importK_{total,t-1}}$		0.00006***	0.00004***		–0.00147**	–0.00056
		[0.000]	[0.000]		[0.001]	[0.001]
$\frac{importZ_{total,t-1}}{GDP_{t-1}}$	0.00137		0.00340**	0.13777		0.15780
	[0.002]		[0.002]	[0.094]		[0.117]
$\frac{importK_{total,t-1}}{GDP_{t-1}}$	0.00624*		–0.00523	–0.26784		–0.22455
	[0.003]		[0.004]	[0.196]		[0.296]
GVC_{t-1}			–0.00376*			–0.21459
			[0.002]			[0.172]
$\ln GDP_{t-1}$	0.00120***	0.00114***	0.00114***	–0.01483	–0.02805	–0.01708
	[0.000]	[0.000]	[0.000]	[0.020]	[0.020]	[0.028]
Constant	–0.027***	–0.025***	–0.022**	1.242**	1.585***	1.503**
	[0.009]	[0.008]	[0.010]	[0.498]	[0.486]	[0.726]

[30] Authors' calculations were based on UN Comtrade data; detailed information available upon request.

TABLE 4 (*cont'd*)

	(1)	(2)	(3)	(4)	(5)	(6)
	Intensive margin	**Intensive margin**	**Intensive margin**	**Extensive margin**	**Extensive margin**	**Extensive margin**
F test	F(18, 162) = 5.10***	F(18, 162) = 9.01***	F(11, 126) = 10.69***	F(18, 162) = 6.65***	F(18, 162) = 6.93***	F(18, 126) = 2.95***
F test that all u_i=0	F(11, 162) = 135.30***	F(11, 162) = 186.47***	F(11, 126) = 127.46***	F(11, 162) = 11.76***	F(11, 162) = 12.58***	F(11, 126) = 10.69***
Observations	192	192	156	192	192	156
No. of countries	12	12	12	12	12	12
R-squared	0.362	0.500	0.457	0.425	0.435	0.297

Notes: Country and year fixed effects are included in all specifications. Robust standard errors are in parentheses; *** p<.01, ** p<.05, * p<.1.

Further Discussion

Did trade diversion effects exist?

In the past three decades, production processes for most goods and services sectors (textiles and apparel, electronic goods, automobiles, transport, etc.) have become increasingly fragmented and dispersed across countries (regions). However, available empirical data have indicated that globalisation of production via international value chains had already peaked prior to the global financial and economic crises.[31] Since the early 2010s, trade and production networks have become more regionalised. The COVID-19 pandemic lent impetus to pending reshoring and nearshoring decisions by companies.[32]

Recent research has shown that participation in global value chains increased firms' vulnerability to the economic implications of the pandemic. Firms that both export and import (i.e. GVC firms) faced disruptions in their supplies from source countries, thus resulting in weaker export performance relative to other exporters. These supply-side disruptions had a significant downward impact on exports in the eurozone in 2020 and 2021.[33] Therefore, the pandemic raised concerns about the security of GVCs, especially in industries with high trade intensities, such as apparel and communication equipment, computers, electronics and semiconductors.

To account for the impact of the COVID-19 pandemic in Western EU countries and China on bilateral trade, the authors formulate the following model specification:

[31] UNCTAD, "World Investment Report 2020. International Production Beyond the Pandemic", 15 December 2020, p. 5, at <https://unctad.org/system/files/official-document/wir2020_en.pdf> [23 May 2023].

[32] Paolo Barbieri et al., "What Can We Learn about Reshoring after Covid-19?", *Operations Management Research* 13, no. 3 (2020): 131–6.

[33] Laura Lebastard and Roberta Serafini, "Global Value Chains and the Pandemic: The Impact of Supply Bottlenecks", European Central Bank Economic Bulletin Boxes, at <https://www.ecb.europa.eu/pub/economic-bulletin/focus/2023/html/ecb.ebbox202302_04~9cf7c60cef.en.html> [25 May 2023].

$$\text{Trade}_{ijt} = exp\left\{\delta_1 COVID_{it} + \delta_2 COVID_{jt} + \mu_{ij} + \mu_i + \mu_j + \mu_t\right\} \cdot \varepsilon_{ijt} \quad (5)$$

where Trade_{ijt} denotes export and import flows between countries i and j in time t, while *COVID* represents the number of infected people per one million population in the reporter (i) and partner (j) countries in time period t to capture the direct effect of both supply and demand shocks induced by the pandemic. Labour supply reduced by mortality and morbidity due to infection and the need to care for affected family members had led to supply shocks. Moreover, lockdown in countries with social distancing measures in place had a much larger economic effect than the direct effects from mortality and morbidity. Moreover, the COVID-19 pandemic had transformed consumer spending patterns. Since consumers sought to reduce their risk of exposure to the disease, the demand for products and services that involve close contact with others decreased. Also, supply shocks have been an additional reason for the decrease in demand. Therefore, the authors utilise COVID-19 cases to capture the instant effect of both supply and demand shocks. They then replace the number of COVID-19 cases (*COVID*) with the policy stringency index (policy stringency) in the empirical model [5], to better capture the effects of COVID-19. In addition, μ_{ij} denotes dyadic (reporter–partner) fixed effects, controlling for time-invariant country-pair characteristics impacting trade, such as distance measuring log value of the weighted distance between country i and country j. Variables μ_i and μ_j represent reporter and partner fixed effects, and μ_t denotes monthly fixed effects.

Equation (6) aims to capture the trade diversion effect from China to CEE countries:

$$\text{Trade}_{ijt} = exp\left\{\sigma_1 (COVID_{jt(j=China)} - COVID_{jt(j\neq China)}) + \mu_{ij} + \mu_i + \mu_j + \mu_t\right\} \cdot \varepsilon_{ijt} \quad (6)$$

where Trade_{ijt} denotes the ratio of Western European countries' imports from China against Western European countries' imports from CEE.[34] μ_{ij} denotes the weighted distance between country i and country j, and dummy variables indicate whether countries i and j share a common border, common language or common coloniser. The empirical models (5) and (6) are applied to monthly bilateral trade data of EU member states and China covering a six-year period from January 2017 to December 2022. Gross trade data used in the analysis are obtained from the Comext trade database. Data for the number of confirmed cases and the stringency index are taken from the Oxford COVID-19 government response tracker,[35] which collects systematic information on policy measures that governments have taken to tackle COVID-19.

[34] Because the United Kingdom left the EU on 31 January 2020, UK monthly trade data are no longer available from February 2020 onwards in the Comext trade database; hence, the EU countries include Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain and Sweden.

[35] Thomas Hale et al., "Oxford COVID-19 Government Response Tracker", March 2020–March 2023, Blavatnik School of Government, University of Oxford, at <https://www.bsg.ox.ac.uk/research/covid-19-government-response-tracker> [29 May 2023].

The different policy responses are tracked beginning 1 January 2020, covering more than 180 countries and are coded into 23 indicators, such as school closures, travel restrictions and vaccination policy, etc. These data serve informative purposes and thus do not represent the effectiveness or appropriateness of implemented measures.

The impact of domestic COVID-19 cases strengthened with a one-month lag compared with the current month. The exports decreased by more than one per cent if the number of domestic COVID-19 cases increased by 100 per million population in a previous month (Table 5, columns [1] and [2]); on the other hand, the COVID-19 incidence in an importing country did not have any significant effect on total exports, indicating that supply shocks have more significant effects than demand shocks do. By contrast, more stringent measures taken by the government of importing countries reduced imports from partner countries (Table 5, column [3]).

Some researchers are concerned that the Western European market may turn to searching for a nearer production hub to reduce supply risks after the COVID-19 pandemic and this may result in a trade diversion effect from China to CEE countries. While results in columns (5) and (6) have not corroborated such a deduction, a higher incidence of COVID-19 cases or more stringent measures in China had not led to more imports from CEE countries for Western EU countries. This could be attributed to the policy time lag effect and the China–Europe Railway Express effect. On the one hand, the European Commission, upon recognising the importance of building more resilient and sustainable supply chains, had taken steps to promote the development of European value chains (EVCs) in strategic industries, while firms would take time to relocate business operations.[36] On the other hand, the China–Europe Railway Express has played a vital role in transportation, facilitating bilateral trade between the EU and China, although the COVID-19 pandemic had restricted transportation at harbours and airports. As of end-2022, the railway express currently operates a network of 82 lines that connects over 200 cities in 24 European countries, covering virtually the entire Eurasia.[37] Nevertheless, during the first wave of the COVID-19 pandemic, overall trade among EU countries declined over 20 per cent and an increase in the incidence of COVID-19 cases in the destination country led to a further decrease in domestic exports of intermediate goods.[38]

Indeed, an increase in domestic COVID-19 cases tends to lead to a decrease in domestic exports between Western EU members and China. However, the research has not determined a trade diversion effect from China to CEE countries, although

[36] The steps taken include an Interregional Innovation Investments (I3) Instrument that aims to support the development of interregional innovation projects and some EU member state (Austria and France) government initiatives (announced in 2021 and 2022) to support active pharmaceutical ingredients (APIs) production in Europe.

[37] Data cited from "China–Europe Railway Express to Bring More Cooperation Opportunities for BRI Countries", Guangming News Agency, 28 April 2023, at <https://en.gmw.cn/2023-04/28/content_36531719.htm> [22 May 2023].

[38] Katja Zajc Kejžar, Alan Velić and Jože P. Damijan, "COVID-19, Trade Collapse and GVC Linkages: European Experience", *The World Economy* 45, no. 11 (2022): 3475–506.

the COVID-19 outbreak had re-emphasised the development of EVCs and reshoring. In other words, so far no supporting data exist that indicate a trade diversion effect. However, as more concrete and supportive policies are launched to directly promote the relocation of value chain activities to the EU, a trade diversion effect may exist in the future.

TABLE 5
IMPACT OF COVID-19 ON BILATERAL TRADE BETWEEN EU AND CHINA, AND ON TRADE DIVERSION EFFECT

	(1)	(2)	(3)	(4)	(5)	(6)
	Lntrade	Lntrade	Lntrade	Lntrade	Lntrade_r	Lntrade_r
$Covidcase_{it}$	0.007					
	(0.005)					
$Covidcase_{jt}$	–0.01**					
	(0.004)					
$Covidcase_{i,t-1}$		0.007				
		(0.005)				
$Covidcase_{j,t-1}$		–0.011**				
		(0.005)				
$Policy\ stringency_{it}$			–0.003*			
			(0.002)			
$Policy\ stringency_{jt}$			0.002			
			(0.001)			
$Policy\ stringency_{i,t-1}$				–0.002		
				(0.002)		
$Policy\ stringency_{j,t-1}$				0.002		
				(0.001)		
CovidCase_dif					–0.018	
					(0.025)	
Policy stringency_dif						0.001
						(0.001)
_cons	20.327***	20.33***	20.359***	20.341***	3.177***	3.165***
	(.009)	(.009)	(.07)	(.068)	(.008)	(.023)
Monthly fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Country-pair fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Reporter fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Partner fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,872	1,716	1,872	1,716	5,616	5,616
Adjusted R-squared	.977	.979	.978	.979	.936	.936

Notes: Robust Standard errors are in parentheses, adjusted for country-pair clusters;
*** p<.01, ** p<.05, * p<.1.

Reverse causality and lockdown in China as an instrument for supply shock

The main challenges for estimating the causal effect of imported inputs from China on the exports of CEE countries concern the issue of reverse causality. In baseline equation (1), Z_{ct-1} and K_{ct-1} are endogenous variables of interest, representing the quantity, respectively, of intermediate and capital goods from China in the previous year. Since the growth of imports of intermediate goods may be driven by the growth

of exports, the coefficients of interest could be biased. Therefore, utilising an instrumental variable (IV) is necessary to alleviate endogeneity. The requirements for a valid IV are relevance and exogeneity, i.e. the IV must be related to the endogenous variable imported inputs from China and should be exogenous to CEE exports.

COVID-19 severely impacted the global economy, with suspension of flights, border closures, import-export bans and factory shutdowns; unprecedented policy measures put in place affected the flow of goods across GVCs and caused a significant drop in exports of countries when waves of the pandemic hit. The lockdown due to COVID-19 disrupted production and trade in China, especially in 2020. However, compared to other regions, the slump in Chinese trade was much smaller. China experienced a strong recovery in trade, supported by robust global demand for goods and China's ability to reopen its domestic supply chains ahead of other countries.[39] Therefore, the unpredictable nature of COVID-19 could be a good instrument which is related to China exports.

$COVID19_t$, the number of COVID-19 cases in China as a measure of the supply shock to production, serves as this instrument. As the instrument varies only over time, it will be collinear with time fixed effects. Moreover, since geographical distance has a significant effect on bilateral trade, the authors can strengthen the fit of the first stage by accommodating this form of heterogeneity. With regard to the empirical strategy taken to reverse causality presented in Nunn and Qian's research,[40] the following estimates use $Lockdown_{ct}$, the interaction of $COVID19_t$ and $Distance_c$ (measured by the log value of the weighted distance between the capital city in China and country *i*), as the instrument for imported inputs from China. Thus, the first and second-stage equations become as shown:

$$\text{First stage: } \ln inputs_{ct} = \beta_0 + \beta_1 Lockdown_{ct} + \beta_2 Controls_{ct} + \eta_c + \omega_{ct} \quad (7)$$

$$\text{Second stage: } \ln EX_{ct} = \gamma_0 + \gamma_1 \ln inputs_{ct} + \gamma_2 Controls_{ct} + \eta_c + \varepsilon_{ct} \quad (8)$$

Table 6 presents the baseline IV two-stage least squares (2SLS) regression results. The first-stage results have shown that the COVID-19 lockdown is positively and significantly related to inputs imported from China, thus satisfying the relevance requirement for IV. Moreover, the Kleibergen-Paap LM value is significant at one per cent, rejecting the irrelevance assumption regarding IV and the endogenous variable. In addition, the Kleibergen-Paap F value is greater than the Stock-Yogo critical value at 10 per cent (16.38), denying the assumption that the equation is weakly identified. Therefore, the first-stage results reveal that the IV is valid and the second-stage results confirm the positive impact of sourcing from China for CEE countries.

[39] Rosie Dickinson and Gabija Zemaityte, "How Has the COVID-19 Pandemic Affected Global Trade?", World Economic Forum, 8 August 2021, at <https://www.weforum.org/agenda/2021/08/covid19-pandemic-trade-services-goods/> [5 June 2023].

[40] Nathan Nunn and Nancy Qian, "US Food Aid and Civil Conflict", *American Economic Review* 104, no. 6 (2014): 1630–66.

TABLE 6
INSTRUMENTAL VARIABLES (IV) REGRESSION RESULTS

	(1)	(2)	(3)
	First stage	Second stage	Second stage
Variables	ln*Input*	ln*EX*	ln*DVA*
Lockdown	0.005***		
	(0.001)		
$\ln(Z+K)_{t-1}$		0.525***	0.453***
		(0.061)	(0.069)
$\ln Z_{total,t-1}$	0.097	0.476***	0.169*
	(0.163)	(0.086)	(0.094)
$\ln K_{total,t-1}$	0.240	–0.284***	–0.126
	(0.147)	(0.081)	(0.077)
$\ln GDP_{t-1}$	0.162	–0.241	0.367**
	(0.331)	(0.176)	(0.164)
GVC_{t-1}	–6.368***	–1.787**	–4.051***
	(1.440)	(0.830)	(0.858)
Observations	168	168	168
R-squared		0.672	0.732
p-value	0.0000	0.0000	0.0000
Kleibergen-Paap rk LM	25.153		
Kleibergen-Paap rk Wald F	44.580		

Notes: Robust standard errors are in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Robustness check

Due to access limitations of the WIOD data, the baseline regressions cover only 12 years from 2005 to 2016 for DVA contents in exports analysis. Whether the role of sourcing from China for CEE countries has changed because of the COVID-19 pandemic is of interest to researchers. The authors conducted robustness check estimations that cover two years after the pandemic outbreak until 2021, using the ADB-MRIO database that includes MRIO tables for 62 economies and aggregated these estimations for the rest of the world. Both the intermediates and capital imports from China clearly exhibit a significant positive impact on DVA contents (Table 7, column [4]). The higher share of both imported capital and intermediate goods from China has boosted CEE countries' exports measured with reference to the intensive margin (Table 8, columns [1] and [2]). In particular, the ratio of imported intermediates from China to intermediates imported from the rest of the world has a significantly more positive impact than that of capital imports to capital goods imported from the rest of the world, indicating the more important role of intermediates from China for CEE countries. The results in Tables 7 and 8 confirm the conclusions drawn from Tables 2 and 4 about the importance of role sourcing from China.

TABLE 7
ROBUSTNESS CHECK FOR AGGREGATE EXPORTS AND DVA USING ADB DATA, 2007–21

	(1)	(2)	(3)	(4)
Variables	LnEX_t	LnEX_t	Ln$DVAEX_t$	Ln$DVAEX_t$
lnZ_{t-1}	0.0220	–0.0613	0.0635*	0.530***
	(0.0351)	(0.218)	(0.0358)	(0.199)
lnK_{t-1}	0.00929	–0.0652	–0.0102	0.499**
	(0.0188)	(0.242)	(0.0221)	(0.202)
lnZ_{t-1} x lnK_{t-1}		0.00297		–0.0245**
		(0.0112)		(0.00960)
ln$Z_{total,t-1}$		0.804		–0.262
		(0.611)		(0.526)
ln$K_{total,t-1}$		0.456		–0.380
		(0.660)		(0.559)
ln$Z_{total,t-1}$ x ln$K_{total,t-1}$		–0.0196		0.0154
		(0.0280)		(0.0237)
GVC_{t-1}		–0.883		–1.161*
		(0.544)		(0.678)
lnGDP_{t-1}	0.0720	–0.0577	0.597***	0.607***
	(0.0645)	(0.115)	(0.0894)	(0.112)
Constant	22.02***	9.169	7.968***	5.680
	(1.329)	(11.93)	(1.996)	(10.05)
Country fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Observations	168	168	168	168
R-squared	0.996	0.996	0.994	0.995

Notes: Robust Standard errors are in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

TABLE 8
ROBUSTNESS CHECK FOR BOTH INTENSIVE AND EXTENSIVE MARGINS USING ADB DATA, 2007–21

	(1)	(2)	(3)	(4)
Variables	Intensive margin	Intensive margin	Extensive margin	Extensive margin
$\frac{importZ_{China,t-1}}{importZ_{total,t-1}}$	0.0196**	0.0216**	–0.290	–0.307
	(0.00915)	(0.00930)	(0.345)	(0.356)
$\frac{importK_{China,t-1}}{importK_{total,t-1}}$	0.00301***	0.00309***	–0.122***	–0.127***
	(0.000711)	(0.000718)	(0.0322)	(0.0317)
$\frac{importZ_{total,t-1}}{GDP_{t-1}}$		0.00750***		–0.0810
		(0.00231)		(0.113)
$\frac{importK_{total,t-1}}{GDP_{t-1}}$		–0.0174***		0.336
		(0.00500)		(0.387)
GVC_{t-1}		–0.00710*		0.270
		(0.00412)		(0.258)
lnGDP_{t-1}	0.000577	0.00160***	–0.0855***	–0.102***
	(0.000378)	(0.000451)	(0.0224)	(0.0257)
Constant	–0.0119	–0.0322***	3.123***	3.286***
	(0.00943)	(0.0115)	(0.562)	(0.567)
Country FE	Yes	Yes	Yes	Yes

(*cont'd overleaf*)

TABLE 8 (*cont'd*)

	(1)	(2)	(3)	(4)
Variables	Intensive margin	Intensive margin	Extensive margin	Extensive margin
Year FE	Yes	Yes	Yes	Yes
Observations	168	168	168	168
R-squared	0.978	0.983	0.667	0.672

Notes: Robust Standard errors are in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

CONCLUSIONS

Utilising both country- and industry-level gross and value-added trade data, this article investigates how imported Chinese inputs contribute to CEE countries' exports. After controlling for inputs imported from the rest of the world, results have shown that imported inputs from China play an important role in CEE countries' domestic value-added exports and the positive impact has become even stronger after the COVID-19 pandemic outbreak. In addition, the industry-level analysis corroborates the conclusion, showing a slightly stronger effect on domestic added value compared with country-level data results. An in-depth analysis of the data reveals that the export-boosting effect of Chinese inputs is driven mainly by the intensive margin. This margin—an important component of the rising exports—could indicate that imported inputs from China contribute to CEE countries' competitive advantage in existing overseas markets. This is attributed primarily to China's rising export sophistication and quality of outputs, as well as lower export price in industries that have small scope for quality differentiation.[41]

This article provides new insights into the growth of the bilateral deficits between CEE countries and China, and the results demonstrate several policy implications. First, the key to alleviating CEE countries' trade deficits vis-à-vis China is to increase their exports to China instead of decreasing imports from China, given that CEE countries' imported inputs from China tend to contribute significantly to their expansion in exports and to their increase in domestic value added. Second, CEE countries should fully utilise various platforms to strengthen trade networks with China. The China–Europe Railway Express provides a secure, faster and low-cost transportation method to move goods from Europe to China. Freight fees by railway express are only 20 per cent of air freight rates and travel time is only one-quarter that of sea shipment.[42] Furthermore, the aforementioned factors are conducive to firms

[41] Wang Zhi and Wei Shang-Jin, "What Accounts for the Rising Sophistication of China's Exports?", in *China's Growing Role in World Trade*, ed. Robert C. Feenstra and Wei Shang-Jin (Chicago, IL: University of Chicago Press, 2010), pp. 63–104; Fan Haichao, Yao Amber Li and Stephen R. Yeaple, "Trade Liberalization, Quality, and Export Prices", *The Review of Economics and Statistics* 97, no. 5 (2015): 1033–51.

[42] GT staff reporters, "China–Europe Railway Express Stabilizes Global Industry Chains, Reaching 24 European Countries after 9 Years of Operation", *Global Times*, 18 August 2022, at <https://www.globaltimes.cn/page/202208/1273301.shtml> [15 June 2023].

to actively participate in expos (such as the China International Import Expo and China–CEEC Expo) to promote familiarity and popularity of CEE countries' products among Chinese consumers. Third, before making an investment decision in a foreign market, most firms tend to serve the market via exports and the probability that a firm begins to invest in a foreign country increases with its export experience in that country.[43] Therefore, rapid growth in exports to CEE countries tends to lead to an increase in greenfield investment in the related industry or field by Chinese firms, and this in turn creates more job opportunities. For example, Contemporary Amperex Technology Co. Limited (CATL) announced on 12 August 2022 its commitment to a 7.34 billion euro investment to build an EV battery plant in Debrecen, a city in eastern Hungary. This project would create 9,000 new jobs, according to Hungarian Minister of Foreign Affairs and Trade Peter Szijjarto.[44] Such investments, in turn, are likely also to promote the host country's exports.

The authors recognise the limitations of this article which has not covered other interesting aspects of China–CEEC trade, such as the quality effect on exports attributed to the technology contents in imported inputs, and in particular, the possible changes in China–CEEC trade relations post-COVID-19, as well as the recent trend of EVCs. Due to current unavailability of key data, the authors propose the aforementioned research agenda for future work.

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[43] Paola Conconia, André Sapira and Maurizio Zanardic, "The Internationalization Process of Firms: From Exports to FDI", *Journal of International Economics*, no. 99 (2016): 16–30.

[44] "China's Battery Producer CATL Officially Launches Hungarian Plant", Xinhua News Agency, 6 September 2022, at <https://english.news.cn/20220906/e887cefa5d9a4ec68c876029985c6970/c.html> [15 June 2023].

APPENDIX
Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
ln*EX*	204	24.15318	1.019431	21.54938	26.2909
ln*DVA*	144	10.14629	.8822076	8.391993	12.00417
EX M	204	.9168766	.0481247	.782368	.9909378
IN M	204	.0037525	.0033955	.0004393	.0141693
ln*Z*	204	20.37434	1.373649	16.45564	23.31943
ln*K*	204	20.02529	1.45654	14.98569	23.4343
$\ln Z_{total}$	204	23.78252	.9785916	21.33167	25.7658
$\ln K_{total}$	204	22.47538	.91786	20.4556	24.50134
GVC	156	1.012063	.0290558	.9437597	1.154074
ln*GDP*	204	25.059	.9800499	22.71416	27.0962