

Foreign trade relations of Hungary with China: A global value chain perspective

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ABSTRACT

Trade analysis for open economies is strategically important. Even though Hungarian trade relations are oriented towards the EU, the direct and indirect influence of Asia, mainly China, needs special attention. The paper focuses on direct bilateral relations between Hungary and China. The global value chain perspective enables the research to detect inter- and intra-industry dependencies and unfold and compare the industry focuses and dynamics of backward and forward linkages between 2000 and 2018. We used a mixed methodology, combining input-output analysis with company case studies based on a wide range of literature both from Chinese and East-Central European researchers. The findings support the significance of global value chain relations, highlight the restructuring of Hungarian trade relations with China over the past twenty years, and indicate the strong concentration of relations in terms of the number of companies.

KEYWORDS

global value chains, input-output analysis, China, Hungary, case study

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1. INTRODUCTION

Many countries, including Hungary, are far more open to the world economy than the average. Foreign trade performance strongly determines the production process, while, besides the big companies, it offers a new stage for the development of small and medium sized firms as well (Vakhal 2020). However, traditional trade analysis and measurement do not give an accurate picture since a wide range of industries are embedded in the international flows of intermediaries. Viewing foreign relations in terms of the global value chains (GVC) confers a different perspective (Gáspár 2020).

It is well known that Hungary's foreign trade links are highly concentrated in the EU, mainly with Germany. About one-fourth of the exports and imports and over 10% of the total global value chain linkages are related to Germany (KSH 2022; OECD 2021). In addition, the Central-European regional links are traditionally strong, and recently they have become tighter, mostly with the other Visegrad countries (Czechia, Poland and Slovakia), with a share of 4–4.5% of both imports and exports in each case (KSH 2022).

In the last decade, the dependence of the EU on Asian trade flows has strengthened, and the increasing role of China is visible. In 2022, China was the third largest partner for EU exports (9% of the total) and the most important country to import from (20.8%) (Eurostat 2023). In addition, even if their trade has shrunk, China has been flexible enough to change its export structure to target high-demand markets such as healthcare and medical equipment (Jindřichovská – Uğurlu 2021).

The role of China in Hungarian foreign trade has also strengthened. Like other emerging economies, China benefited from the extension of global value chains (Timmer et al. 2014). In the last twenty years, China has become one of the most global suppliers of manufacturing goods (Gereffi 2016). Koppány (2020) points out that the trade-influencing power of China on the Hungarian economy is outstanding, even if Hungary is a small country and its absolute share of Chinese exports is negligible. However, its direct shares, mainly in the electronic industry, and the indirect effects via the German supplies highlight that the dependence of Hungary on China is much higher than expected.

Despite the facts presented above, the literature still needs more studies on Hungarian-Asian global value chain relations. The motivation of this paper is twofold: first, even if there is extensive literature on Hungary's external links, the non-EU relations are less researched than the EU-relations; second, it is strategically important to detect how the Chinese relations influence or determine the Hungarian industrial network and performance. Additionally, the data we used allowed us to differentiate between GVCs led by foreign-owned multinational corporations operating in China and GVCs led by Chinese companies. Therefore, we can show how the Hungarian economy slowly changes its dependence from the first to the second one.

The main contribution of the paper is a detailed examination of the structure of the flows of semi-final and final goods between China and Hungary as well as how these structures changed over almost twenty years. The analysis is based on OECD input-output tables for several years. In terms of methodology, the analysis is restricted to tracing the direct global value chain flows, which far underutilizes the input-output analysis potential. However, we wish to highlight that the direct linkage analyses are regularly neglected, yet the low value added total flows might be considered in absolute terms and can have a greater influence on a country than expected. In addition, the research contextualises the 'pure figures' by discussing, through case studies, the



different companies, ownership structures, and production processes that exist behind the macroeconomic data.

The main research questions are as follows: To what extent did direct Sino-Hungarian intermediate trade rise between 2000 and 2018, relative to ‘traditional’ foreign trade? What industry focuses and dynamics can be detected in both backward and forward directions, and to what extent do they overlap? How can company level data supplement the results of the macro or sector level analyses?

The paper first gives an overview of the literature, focusing on the significance of GVC analysis, how Chinese publications discuss Central-European relations, and what aspects and results Hungarian and East-Central European research provide. The methodological framework is followed by complementary approaches such as input-output data analysis and company case studies. Finally, we discuss the results and draw conclusions.

2. LITERATURE REVIEW

Participation in GVCs can, on the one hand, increase trade between countries if there is intensive trading in parts, components, and final goods, and even related services; and, on the other hand, can have a substantial impact on the composition of trade in terms of goods categories (see e.g. [Van Assche – Gangnes 2019](#), or [Zhang et al. 2021](#)). It can also result in differences between gross and value added exports at the level of individual countries ([ECB 2013](#)). The impact of GVCs on trade between China and the Central and Eastern European (CEE) countries, including Hungary, has been studied in the literature at both ends, i.e., in China and the CEE countries.

Like other CEE countries, Hungary is highly integrated into GVCs ([Sass – Szalavetz 2014](#); [Cieřlik et al. 2021](#)). [Cieřlik et al. \(2016\)](#) showed that CEE economies differ in their level of participation in GVCs, but Germany’s role is uniformly decisive. The CEE countries are integrated into GVCs via Western European countries and have mainly backward participation. [Braun \(2020\)](#) documented that the Hungarian automotive, electronics, and machinery industries have significant cross-border exposure through their high integration in GVCs. Most of these strong interdependencies are linked to the German economy, but for some sectors, there is a strong dependence on China on the one hand and other European countries, such as Italy, Austria, and Denmark, on the other hand. [Vakhil \(2021\)](#) showed the leading role of Germany, the USA, and China in terms of direct and indirect value added flows to Hungary.

Numerous studies analyse the group of CEE countries, including Hungary, from the point of view of their GVC relations with China. [Ye \(2016\)](#) developed an export value added model to analyse China’s exports to CEE countries at the national and industry levels, showing the significant impact of participation in GVCs on bilateral trade. [Wang and Ji \(2018\)](#) found that China’s goods imported and exported from and to CEE countries contain mainly capital-intensive products, and Chinese goods have stronger competitive advantages in these goods compared to the CEE countries. [Xiao \(2020\)](#) showed a higher concentration of import and export in the CEE countries compared to China, with exports mainly dominated by vehicles and electronics, and imports of mineral products, with a mismatch between the leading export products and competitive advantage products for each country. [Wei and Zhang \(2020\)](#) analysed the bilateral import potential based on import data and found that although the distribution of



trade potential between China and CEE countries is uneven, China's market size, bilateral cooperation mechanisms, and the supply capacity of CEE countries are the reasons why there is still great room for tapping the bilateral trade import potential. [Bai et al. \(2020\)](#) examined bilateral trade relations in terms of goods exports and imports between China and CEE countries. The results showed that the bilateral goods trade grew rapidly, though its volume is still small and structural imbalances exist. Furthermore, China's role is determining, as it is at the core of the import-export network relationships and determines an industrial division of labour between itself and the CEE countries ([Cui-Li 2018](#)). As for the Visegrad countries' trade with China, [Cieřlik \(2019\)](#) indicated that they have particularly strong GVC linkages, especially in the automotive, electronics, and metalworking industries. In these industries, the Visegrad countries are in a worse position than China in terms of value added, and there is an increase in the reliance of the Visegrad countries on Chinese inputs.

Particularly for Hungary, [Éltető and Völgyi \(2013\)](#) indicated quite early that the role of GVCs may be of determining importance in the bilateral trade between the country and China. Other authors called attention to dynamic changes in bilateral trade after the 2008–2009 crisis due to the reorganisation of GVCs ([Szalavetz 2016](#)) and links between Chinese equity investment in Hungary and GVC participation ([Gerőcs 2022](#)). [Czakó and Vakhil \(2020\)](#) and [Koppány \(2020\)](#) disclosed a significant share of value added originating from China in Hungarian electronics exports. These results were reinforced by [Braun \(2020\)](#).

It is important to note that we cannot ignore changes in GVCs and the participation of the studied countries in them. These changes characterise China, especially after the 2008–2009 crisis. According to [Garcia and Nguyen \(2019\)](#), based on the analysis of data up until 2018, China has become more vertically integrated, and thus its dependence on Asian and global chains has gradually decreased. At the same time, Europe's value chains increasingly depend on China at the expense of their own regional integration. This means that China imports increasingly fewer intermediate goods from the EU, but it exports increasingly more intermediates to EU member states for their re-export. Thus, the EU depends more on Chinese inputs for exports, while China relies less on EU goods for its exports. Consequently, the EU's integration with China's value chain is becoming more asymmetric in China's favour.

3. METHODOLOGY

The research uses a mixed methodology for data collection and analysis. The documentary analysis collects and compares the main experiences of the literature. The quantitative input-output analysis follows the [Miller and Blair \(2009\)](#) foundations and reveals the main characteristics of Hungarian-Chinese direct global value chain relations. To include indirect relations in total (direct plus indirect) linkages, we exploited the decomposition scheme of [Wang et al. \(2017\)](#). It highlights that important direct linkages that deliver significant gross output with lower value added contributions can remain hidden in a more complex, trade in value added oriented GVC analysis. These linkages, however, can play a key role for both partners. This suggests that it is important to analyse direct relationships, which are the focus of this study.

The third pillar is a series of case studies that test and complement the figures we received in the input-output analysis and unfold the background of the data. The chosen studies represent several layers of foreign relations, namely the experiences of Chinese multinational corporations



in Hungary, big Hungarian companies in China, and foreign multinational corporations in both countries.

The figures and tables in the paper are based on the 2021 edition of the OECD Inter-Country Input-Output (ICIO) Tables. This database contains a world input-output table for each of the years between 1995 and 2018. These tables distinguish 69 countries and country groups and 45 industries. The total time series offers 300 billion cells that reflect the value of the intermediate and final transactions among each country and industry in current million USD and the value added they produce. Our research uses the tables from 2000, 2007, and 2018 as a comparison. The raw ICIO and result tables of the Wang et al. (2017) model were processed by a self-developed Excel programme and pivot tables.¹

Table 1 presents a schematic ICIO table where rest of the world (ROW) now means all countries other than Hungary and China (not the original ROW category in ICIO). As our analysis focuses on the direct backward and forward relations between Hungary and China, we have highlighted related blocks within matrices Z (containing interindustry transactions) and F (final use). The first subscripts indicate the sources, and the second ones denote the destinations of product flows. Dots mean all countries/industries. Vector f contains the total final product, x is the vector of output, and v' is the vector of value added by producer country-industries.

It is important to note that the ICIO tables distinguish CN1 and CN2 in terms of China (similar to Mexico). CN2 covers the input, performance, and output of the companies that belong to the so-called export processing zones (EPZs²), which represent a significant role in the Chinese economy. The CN2 industries sell only to countries outside of China; however, they can

Table 1. The blocks of the ICIO tables related to the China-Hungary trade analysis

		Intermediate Use					Final Use				Total
		HUN	CN1	CN2	ROW	Total Int Use	HUN	CHN	ROW	Total Final Use	
Intermediate Use	HUN		$Z_{HUN,CN1}$	$Z_{HUN,CN2}$		$z_{HUN,*}$		$F_{HUN,CHN}$		$f_{HUN,*}$	x_{HUN}
	CN1	$Z_{CN1,HUN}$					$F_{CN1,HUN}$				
	CN2	$Z_{CN2,HUN}$					$F_{CN2,HUN}$				
	ROW				Z				F	f	x
Taxes less Subsidies on Products											
Value Added					v'						
Total		x'_{HUN}					$f'_{*,HUN}$				

Source: authors.

¹We must express our gratitude to Pál Pusztai, who helped in programming the conversion VBA package.

²These zones have been defined by the ILO (2022) as ‘industrial zones with special incentives set up to attract foreign investors, in which imported materials undergo some degree of processing before being exported again’.



purchase inputs from the non-EP sectors (CN1) of China. CN1 contains the economic performance of those companies that sell both to local and export industries in terms of semi-final and final products. The input and output indicators of CN1 and CN2 considerably vary, which results in different value chain mechanisms. This is why the OECD database distinguishes CN1 and CN2, which we follow in the research to preserve information.

For the total linkage analysis, Wang et al. (2017) suggest a $V = \langle c \rangle L \langle f \rangle$ decompositions of the world's value added or final product (at a global level, they are the same), where $\langle c \rangle$ is the diagonal matrix of value added rates (chevrons denote diagonalization), L is the global Leontief-inverse, and V is the matrix of value added contents, which one can organise into a table presented in Table 2.

In Table 2, the rows show value added flows in a forward direction, and the columns express the backward flows. Block matrix $V_{HUN,CN1}$, for example, represents the value added of Hungarian industries embodied in CN1 final products, while in the opposite direction, $V_{CN1,HUN}$ contains the Chinese (CN1) value added components of Hungarian final products.

4. DATA ANALYSIS

Based on the components shown in Table 2, we start our analysis by investigating Hungary's total backward and forward value added linkages to China.³ Indicators of other important GVC trading partners have also been added to Fig. 1 to show China's changing relative position in Hungary's value added trade. In terms of partner countries, Hungarian global value chain links

Table 2. The blocks of Wang's decomposition scheme related to the China-Hungary trade analysis

		downstream/forward value chains				Total GVA	
		Final Product					
		HUN	CN1	CN2	ROW		
upstream/backward value chains	Gross Value Added	HUN		$V_{HUN,CN1}$	$V_{HUN,CN2}$		$v_{HUN,\bullet}$
		CN1	$V_{CN1,HUN}$				
		CN2	$V_{CN2,HUN}$				
		ROW				V	
Total Final Product		$v^{\bullet,HUN}$				Global GVA / Final Product	

Source: authors.

³Total backward linkages measure the ratio of all foreign supplies from any industries that contributed to the final products of Hungary. In the case of China, it can be calculated by taking the total of $V_{CN1,HUN}$ and the total of $V_{CN2,HUN}$ relative to the sum of all $v^{\bullet,HUN}$ elements. Total forward linkages express how much of the value added of any Hungarian industry appears as a final product in another country. For the Chinese forward relations, they are a total of $V_{HUN,CN1}$, and a total of $V_{HUN,CN2}$ per sum of $v_{HUN,\bullet}$.



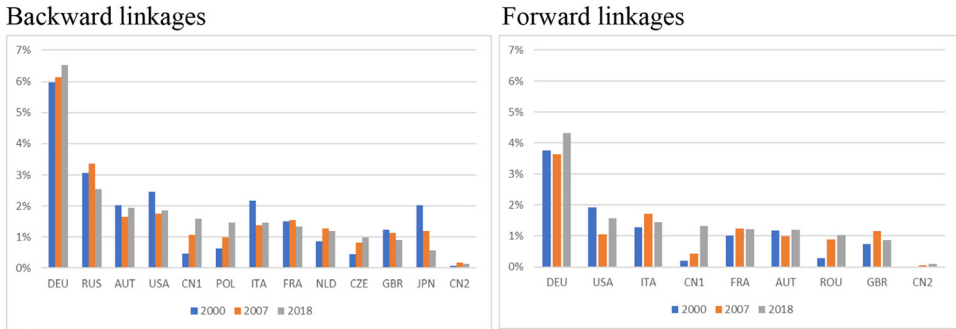


Fig. 1. The position of China in the total GVC linkages of Hungary (%)
 Source: compilation of the authors using OECD (2021).

are dominated by Germany to an increasing extent, and the rest are mostly networked in Europe. The figure reflect the asymmetric role of Russia: the second most important value chain partner, but only in the backward links (primary goods). This reflects the relatively high reliance of Hungary on imported energy and raw materials from Russia. In addition, regional and Central European relations have been increasing and taking up a larger share of backward relations, mainly with Poland and the Czech Republic.

Outside of the European continent, the USA, Japan, and China are Hungary’s primary partners. China (CN1) is an increasingly important partner for Hungary. In the past two decades, it has experienced the most dynamic increase. The strengthening of the links partly substituted for the share of Japan, which was among the most decisive partners in 2000; its share is partly due to the shift in strategy of Japanese companies in Hungary, towards establishing affiliates in the country rather than supplying from Japan.

As a comparison, we learned from the OECD database that the Chinese value chains are mostly linked to the USA and Japan, while CN2 is the major forward market for CN1. At the same time, there are reshoring tendencies in CN2 from overseas to the Asian region (CN1, Japan, Korea, Australia). The role of Hungary in the Chinese value chains is marginal, though measurable, and shows an increasing share over time.

As Fig. 1 reveals, the CN2 total linkages of Hungary in value added terms are minor compared to those of the CN1 total linkages. However, their value in gross output terms in the backward relation is quite close. This is due to the lower value-added contributions in China-Hungary trade relations. As a supplier, however, CN2 represents almost the same magnitude for Hungary as CN1. When considering the importance of a given direct supplier or buyer of a given country-industry or thinking about the risks and the consequences of losing them (i.e., a possible and very close disruption of the value chain), however, using gross value based direct linkages is more appropriate than value added content based total linkages.⁴

⁴Koppány (2020) applies Leontief and Ghosh’s inverse-based output-to-output elasticities to analyse China-Hungary total linkages. The most important components of the gross output-based total linkages are always the direct ones. Thus, the results of a total linkage analysis can be well approximated by a simpler direct linkage investigation. In our further research, however, we will extend our investigations to indirect relationships as well.



Figure 2 compares Hungary’s total direct forward and backward relations with China in terms of intermediate and final goods. The first investigation reveals an overall pattern: the flows of intermediate goods dominate the relations, mainly in the forward links. In addition, the backward linkages to China have a higher share than the forward ones, but mainly in final goods. Over the past two decades, Hungarian-Chinese relations experienced a dynamic accretion: first, the backward — mainly intermediate — links before the 2008 crisis, while second, the post-crisis period boosted the forward directions. In terms of partners, the Hungarian suppliers meet mostly CN1 companies, while the backward relations are dominated by CN2 firms. Before the crisis, their role grew substantially; however, CN1 relations have become more dynamic since then and have taken the lead.

In terms of industries (Table 3), the backward linkages of Hungary are highly concentrated in CN2, mostly linked to computer, electronic, and optical supplies (26). However, in CN1 relations, 2-3 industries represent one third, and 5 provide half of the total value. These are computer-electronic-optical products (26), electrical equipment (27), machinery (28), and textiles (13T15).

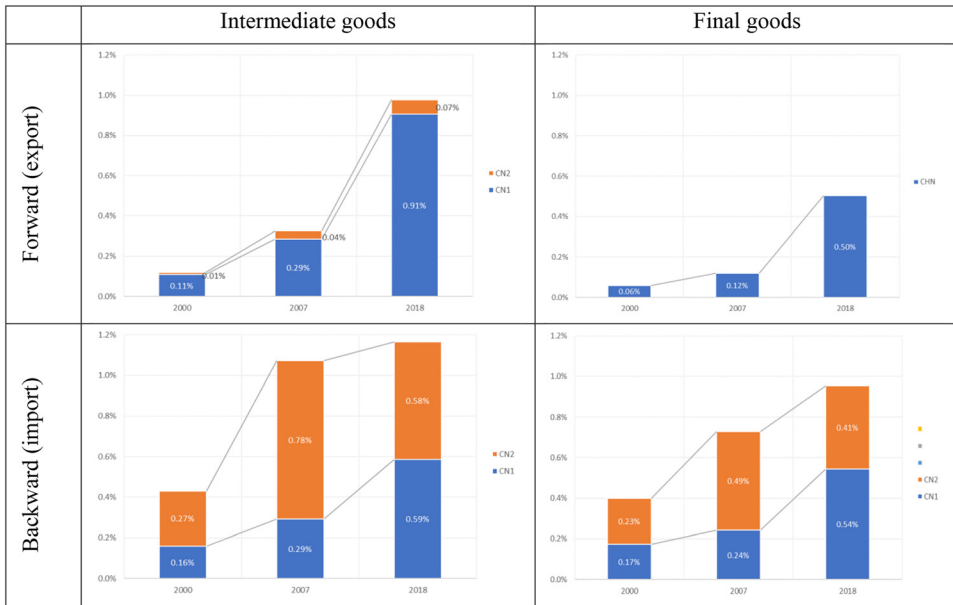


Fig. 2. Intermediate and final goods flow of Hungary in relation to China (as a % of the Hungarian total output/total use)⁵

Source: compilation of the authors using OECD (2021).

⁵The formulas behind the charts are $(i' Z_{HUN,CN1} i) / (i' x_{HUN})$ and $(i' Z_{HUN,CN2} i) / (i' x_{HUN})$ for upper-left, $(i' F_{HUN,CHN} i) / (i' x_{HUN})$ for upper-right, $(i' Z_{CN1,HUN} i) / (x'_{HUN} i)$ and $(i' Z_{CN2,HUN} i) / (x'_{HUN} i)$ for lower-left, and $(i' F_{CN1,HUN} i) / (f'_{\bullet,HUN} i)$ and $(i' F_{CN2,HUN} i) / (f'_{\bullet,HUN} i)$ for lower-right. Vector i is the identity or summation vector.



While in relation to CN2, the intermediate and final product supplies overlap by industries, the CN1 relations sharply vary: fabricated metal products (25),⁶ electrical equipment (27), electronic (26), and chemical (20T21) products characterise the semi-final linkages, while textiles and wearing apparel (13T15) dominate the final product imports, as well as machinery (28), trade, and repair services (45T47).

There has been a sharp shift in the industry structure over time, both between CN1 and CN2, as well as within each region, and the two are almost complementary in terms of total use. CN1, while enjoying the most dynamic rise in fabricated metallurgy (25), is replacing CN2 in machinery and electric equipment (28, 27). Conversely, CN1 lost a great share of the computer,

Table 3. Direct backward linkages of Hungary by Chinese industries in terms of intermediate, final, and total use of Hungary from China (%)⁷

		Hungarian use (intermediate, final and total)								
		Int Use			Final use			Total use		
		from CN1	2000	2018	CN1	2000	2018	CN1	2000	2018
Chinese supplying industries (CN1 and CN2)	25	3.35%	11.89%	13T15	12.42%	25.28%	13T15	12.23%	11.24%	
	27	9.62%	11.57%	28	8.04%	11.84%	28	5.76%	10.39%	
	26	14.56%	11.38%	45T47	11.12%	11.54%	26	13.86%	10.33%	
	20	8.27%	10.18%	26	12.57%	8.02%	45T47	12.60%	10.23%	
	28	4.53%	9.74%	27	2.62%	6.05%	27	7.16%	9.85%	
	45T47	13.39%	9.64%	31T33	4.26%	5.98%	25	2.53%	9.26%	
	49	4.41%	5.08%	49	10.21%	4.69%	20	5.97%	7.69%	
	13T15	12.12%	4.89%	25	1.02%	3.46%	49	6.45%	4.96%	
	23	1.20%	3.95%	29	2.32%	3.05%	31T33	2.40%	2.96%	
	22	2.19%	3.37%	51	2.16%	2.78%	23	0.82%	2.83%	
		from CN2	2000	2018	CN2	2000	2018	CN2	2000	2018
		26	72.53%	71.30%	26	78.61%	65.27%	26	69.75%	74.32%
		27	12.71%	16.08%	27	4.23%	10.93%	27	14.76%	10.21%
		28	1.79%	4.80%	28	4.10%	7.59%	13T15	1.94%	4.25%
		22	1.92%	2.00%	13T15	5.00%	5.16%	28	5.52%	2.47%
		25	0.94%	1.22%	30	1.32%	4.45%	31T33	1.33%	1.61%
	20	1.09%	1.18%	31T33	3.55%	3.41%	22	1.57%	1.41%	

Source: compilation of the authors using OECD (2021).

Notes: Dark blue = one third of total value; light blue = half of total value; light and dark green = increase over time; light and dark brown = decrease over time

⁶Though it demands further investigation, this figure most likely covers light metallurgy, especially aluminium products. Aluminium is an essential product for modern motor vehicles and electronic production. China provides 60% of the global aluminium supply.

⁷The table contains the breakdown of vectors $Z_{CN1,HUN}$, $F_{CN1,HUN}$, $Z_{CN1,HUN}$ + $F_{CN1,HUN}$, $Z_{CN2,HUN}$, $F_{CN2,HUN}$, and $Z_{CN2,HUN}$ + $F_{CN2,HUN}$ by Chinese supplying industries, respectively.



electronic, and optical products (26), whereas CN2 increased its participation. In terms of the textile industry (13T15), the semi-final background links have been shifted to final products, mainly in CN1. Even if CN1 takes most of the textile supplies, CN2's participation growth was dynamic between 2000 and 2018. It seems that Chinese-owned companies are gradually overtaking the participation of foreign-owned ones in GVCs in certain industries.

Table 4 reveals an even deeper relationship between the two countries by showing the inter-industry relations: the branches of production in Hungary that are supplied by Chinese linkages.

Table 4. Inter-industry relations of the direct backward linkages from China to Hungary (2018, million USD)⁸

		Hungarian semi-final use industries and final use											Total
		20	21	22	25	26	27	28	29	41T43	GFCF	HFCE	
Chinese supplying industries	13T15	0	0	8	0	1	1	2	11	4	0	199	298
	20	34	7	35	2	2	5	2	4	6	0	18	204
	23	0	0	1	1	1	1	1	7	37	0	3	75
	25	2	1	9	36	5	8	20	56	35	20	9	246
	26	0	0	1	1	138	4	2	29	2	48	18	274
	27	2	0	2	5	41	32	25	56	23	21	29	262
	28	1	1	2	3	3	4	27	105	6	97	1	276
	29	0	0	0	0	0	0	0	40	0	15	10	70
	45T47	3	1	5	3	60	7	7	37	9	33	59	272
	49	2	0	3	2	24	3	4	15	6	14	16	132
Total		50	16	80	62	289	76	98	387	145	297	465	2,654

CN2

		Hungarian semi-final use industries and final use										Total
		22	26	27	28	29	31T33	41T43	45T47	GFCF	HFCE	
Chinese supplying industries	13T15	1	0	0	0	2	1	1	1	0	31	47
	20	4	0	1	0	1	0	1	1	0	2	23
	22	7	2	2	1	8	1	4	2	2	2	38
	25	1	1	1	2	6	1	4	1	2	1	25
	26	9	854	26	14	179	39	10	42	297	110	1,691
	27	2	57	44	34	77	4	31	6	29	39	358
	28	1	1	2	13	51	1	3	2	47	0	134
	29	0	0	0	0	10	0	0	1	4	3	18
	30	0	0	0	1	0	1	0	0	25	3	38
	31T33	0	0	0	0	0	1	0	1	3	16	32
Total		25	915	76	66	334	49	55	56	406	212	2,424

Source: compilation of the authors using OECD (2021).

⁸Tables show selected rows and columns of matrices $Z_{CN1,HUN} \parallel F_{CN1,HUN}$ and $Z_{CN2,HUN} \parallel F_{CN2,HUN}$. \parallel denotes the concatenation of the matrices.



In the CN1 backward relation, the most outstanding values are the textile imports for Hungarian household final consumption, the computer, electronic, and optical Chinese contributions to the same industry in Hungary, and the machinery input to the motor vehicle industry. The most concentrated is the machinery supply, where most semi-final products are used by only a few Hungarian industries, primarily those that produce the same machinery and the motor vehicle products. Most Hungarian industries are supported by electronic equipment and semi-final products from China. In Hungary, the motor vehicle industry uses the highest amount of semi-final products from different Chinese industries.

The CN2 value links show a slightly different pattern. Here the highest value flows between the machinery and product processes between the two countries. Most Hungarian industries are supplied by the computer, electronic, and optical industries and electrical equipment production. The industry that uses most CN2 supplies is motor vehicle production, as well as many other Chinese industries that provide a great value of final products for gross fixed capital formation.

The maps in Fig. 3 trace the weight of the main Chinese supplying industries in 2018 and their dynamics since 2000. Among industries, three specific groups can be identified. In CN1, fabricated metal products (25) and non-metallic minerals (23) have the most outstanding dynamics over time, and fabricated metal has a high share, too. Machinery and electronic equipment also had a significant increase, higher than average, while they also played a determining role. The motor vehicle industry (29) indicates higher dynamics than the average but has a relatively smaller role in value, together with transportation and storage, which makes it less agile than most of the industries as backward links to Hungary.

CN2 also shows considerable differences in terms of its industry links to Hungary. One extreme is the computer, electronic, and optical industries, which have had an average amount of change over time but whose importance in value is outstanding. Machinery (28) and electronic equipment (27) are other extremities with relatively high significance in the CN2 production structure towards Hungary and very high dynamics. The textile industry is the third extremity, with a smaller contribution and a relatively low increase in the CN2-Hungary relationship.

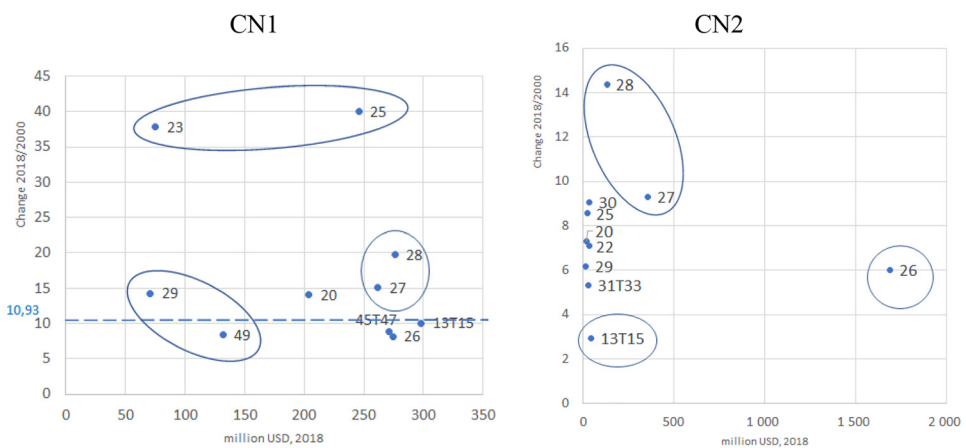


Fig. 3. Value and dynamics of Hungary's backward linkages to Chinese industries

Source: compilation of the authors using OECD (2021).



If we consider the industry structure of the forward linkages of the Hungarian economy to China (Table 5), both for CN1 and CN2 as well as in intermediate and final use, the motor vehicle industry (29) and the computer, electronic, and optical industry (26) have been dominating. However, while motor vehicle components dominate the supplies to CN1, almost 44% of the CN2 linkages come from the computer, electronic, and optical industries.

The forward global chains experienced considerable changes between 2000 and 2018. First and foremost, the supply of motor vehicles and motor vehicle components has significantly

Table 5. Direct forward linkages to China by Hungarian industries in terms of total Chinese intermediate and final use from Hungary (%)⁹

		Chinese intermediate and final use					
		Int Use			Final Use		
		Code	2000	2018	Code	2000	2018
			CN1			CHN	
Hungarian supplying industries	29	8.00%	29.61%	29	6.37%	44.81%	
	26	21.90%	14.50%	26	11.72%	9.98%	
	27	6.76%	8.94%	45T47	6.26%	5.39%	
	45T47	3.66%	5.54%	27	4.16%	5.34%	
	28	1.17%	5.11%	28	0.95%	5.25%	
	22	0.86%	4.20%	49	9.62%	3.03%	
	69T75	2.72%	3.77%	21	0.52%	2.60%	
	49	4.03%	3.76%	25	0.78%	2.48%	
	25	3.96%	3.48%	69T75	3.74%	1.88%	
	21	0.24%	2.52%	62T63	0.36%	1.80%	
	77T82	2.16%	2.23%	13T15	2.00%	1.62%	
	24	27.06%	2.20%	55T56	15.09%	1.59%	
				10T12	9.39%	1.58%	
				CN2			
		26	52.34%	43.95%			
		29	1.49%	14.74%			
		27	12.85%	12.60%			
		28	0.57%	5.80%			
		45T47	3.83%	4.81%			
		22	1.47%	3.75%			
		25	2.17%	2.29%			
		49	1.64%	1.88%			
		69T75	1.57%	1.62%			
		24	13.12%	1.36%			

Source: compilation of the authors using OECD (2021).

⁹The table contains the breakdown of vectors $Z_{HUN,CN1}$ i , $F_{HUN,CHN}$ i , and $Z_{HUN,CN2}$ i by Hungarian supplying industries, respectively.



increased for both CN1 and CN2 intermediates and CHN as final products, partly at the expense of computer and electronic products. Machinery has also gained shares as a semi-final or final product. Among the supplies for final use, fabricated metal and pharmaceutical products show a dynamic increase. As for intermediate products, it was mainly basic metals which lost their share — and leading role in CN1 — with the shift in the industrial structure. In terms of the final product, accommodation and food services as well as food products, beverages, and tobacco shrank over time.

The deeper analysis of the inter-industry relations (Tables 6 and 7) reflects that the intra-industry flows between the Hungarian and Chinese (CN1) motor vehicle and computer, electronic, and optical industries are the most significant. However, the performance of these industries is not limited to the inter-industry linkages; they — as well as electrical equipment and various services — also provide the widest range of Chinese industries. In addition, most Hungarian producers are also linked directly to the motor vehicle, computer, and electronic industries in China, while construction is a significant destination industry. It is also worth mentioning that even if the links are considerably concentrated, there are notable intra-industry flows in a wide spectrum of industries. In the CN2 relation, the computer and electronic intra-industry link dominates the forward participation. In addition, while the motor vehicle industry supplies are the most differentiated among the CN2 buyers, the computer and electronic industry collects the most Hungarian industry outputs in value.

When comparing the total weights and the dynamics of the industries (Fig. 4), we can identify different patterns in terms of the two China destinations. Towards CN1, the motor vehicle industry (29) is most significant, though its dynamic is relatively low among the most extreme industries. Paper and printing (17, 18), pharmaceutical products (21) and non-metallic minerals (23) do not perform well, but their growth is the most outstanding — in this case, mainly due to the low base figures in 2000. The computer, electronic, and optical products (26) are distinguished by their higher significance than average in value with a lower-than-average increase over time, while machinery (28), rubber, and plastic products (22) were more dynamic, though with a not outstanding share in value. In contrast, machinery and motor vehicle intermediates were the most dynamic in the CN2 direction, while the computer and electronic industries had the highest share. The non-metallic minerals, like in the case of CN1, have also experienced a phenomenal increase.

5. COMPANY CASE STUDIES

The statistical analysis showed considerable shifts in Sino-Hungarian foreign trade, and the impact of the participation of the two countries in GVCs is obvious from this point of view. In order to show that all three types of companies — Chinese-owned, Hungarian-owned, and third-country-owned — have an important impact on the changes in bilateral trade, we have selected a few companies to show their cases in detail. The company selection was limited by the availability of data. The balance sheets and supplementary material, all publicly available for certain firms, present data on the main country sources of inputs and country destinations of output. In certain cases, detailed data are published on trade with affiliated companies. We selected four such companies for whom information was available.



Table 6. Inter-industry relations with direct forward linkages from Hungary to CN1 (2018, million USD)¹⁰

		Chinese semi-final use industries and final use																			Total	
		10T12	13T15	17T18	21	22	23	24	25	26	27	28	29	35	41T43	45T47	49	69T75	77T82	86T88		
Hungarian supplying industries	10T12	7	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	25	
	13T15	0	15	0	0	0	0	0	0	0	0	0	5	0	0	1	1	0	1	0	33	
	16	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	10	
	17T18	2	1	13	0	0	1	0	0	1	1	1	0	0	0	0	0	0	2	2	0	32
	20	0	2	1	0	4	1	1	0	1	1	1	0	0	3	0	0	0	0	0	32	
	21	1	0	0	26	0	0	0	0	1	0	1	0	0	2	0	0	1	0	28	71	
	22	4	4	2	0	21	2	1	2	7	9	8	15	1	12	3	3	1	2	0	118	
	23	0	0	0	0	0	10	1	1	1	1	1	1	0	34	0	0	0	0	0	54	
	24	0	0	1	0	0	1	14	5	2	6	5	12	0	7	0	2	1	1	1	62	
	25	1	1	0	0	1	3	2	13	4	6	14	12	1	20	1	2	3	3	0	98	
	26	1	0	0	0	1	1	1	4	164	45	35	22	19	32	15	3	14	8	2	409	
	27	1	1	0	0	1	1	1	4	26	55	29	12	23	50	12	1	6	5	0	252	
	28	1	1	0	0	1	2	3	5	12	19	32	9	7	20	4	1	2	2	0	144	
	29	1	1	1	0	1	6	3	7	35	29	53	436	10	32	19	97	21	33	0	835	
	45T47	4	5	3	5	2	3	2	3	13	10	12	21	3	20	5	5	4	4	5	156	
49	4	3	2	2	2	4	4	2	4	4	6	4	2	16	6	6	2	3	1	106		
69T75	3	1	1	2	1	2	1	2	5	2	4	4	1	21	14	1	8	3	0	106		
77T82	1	1	0	1	0	1	1	1	1	1	1	2	2	22	7	3	1	3	1	63		

Source: compilation of the authors using [OECD \(2021\)](#).

¹⁰The table shows selected rows and columns of matrices Z_{HUNCN1} II F_{HUNGN} and Z_{HUNCN2}.



Table 7. Inter-industry relations with direct forward linkages from Hungary to CN2 (2018, million USD)¹¹

Hungarian supplying industries	Chinese semi-final use industries						Total
	26	27	28	29	30	Total	
22	4	2	1	0	0	8	
23	1	0	0	0	0	1	
24	1	1	0	0	0	3	
25	2	1	1	0	0	5	
26	84	9	2	0	2	98	
27	13	11	2	0	2	28	
28	6	4	2	0	1	13	
29	18	6	3	4	1	33	
45T47	6	2	1	0	0	11	
49	2	1	0	0	0	4	
Total	146	38	13	5	9	222	

Source: compilation of the authors using OECD (2021).

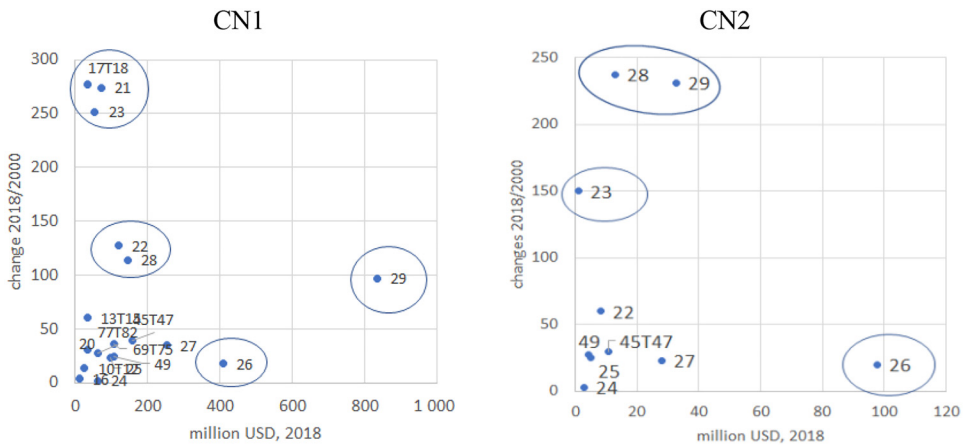


Fig. 4. Value and dynamics of Hungarian industries’ direct forward linkages to China
 Source: compilation of the authors using OECD (2021).

5.1. A Chinese multinational corporation: Huawei

Huawei Technologies Limited is the flagship ICT company in China, with substantial investments in Hungary. As we saw, the computer, electronic, and optical industries excel in Hungary-China GVC relations. Huawei may be one of the key players in that respect.

¹¹The table shows selected rows and columns of matrices $Z_{HUN,CN1}$ II $F_{HUN,CHN}$ and $Z_{HUN,CN2}$.



Huawei was founded in 1987 and is headquartered in Shenzhen, China. It provides various goods but also solutions (services) for its partners. As of December 2021, Huawei had over 195,000 employees and subsidiaries around the world, with operations in more than 170 countries and regions, serving more than 3 billion people worldwide (Huawei 2021), and it can be considered a global company. Its internationalisation is not confined to production or services: it has 21 R&D institutes, 36 joint innovation centres, and 14 research institutes around the world, all of which are part of Huawei's synchronised global R&D system. In 2021, Huawei's business benefited from 5G network construction and the digital, intelligent transformation of the enterprise. Among its markets, the largest revenue came from Europe and Middle East Africa, surpassing substantially Asia Pacific and the Americas (Huawei 2021).

In the global network of Huawei, there are executive centres (in the US; France, UK, and Germany in Europe; Germany hosts the European headquarters); finance centres (Romania and UK in Europe); R&D centres (Belgium, Finland, France, Germany, Ireland, Italy, Sweden, and the UK in Europe); network operation centres (Italy, Netherlands, Romania, Spain, and the UK); and supply chain centres (Hungary and Poland in Europe). It has announced plans to open its first outside-China manufacturing plant in France in 2020 (Albert 2020).

Huawei has been present in Hungary since 2005; thus, it could influence changes in bilateral trade between 2000 and 2018, as analysed in the previous section (ACEH 2022). The Hungarian government considers Huawei a strategic partner, as evidenced by the agreement signed in 2013 (AP 2019). Huawei has two factories and a logistics centre in Hungary, with a total warehousing area of 62,000 square metres. Huawei has built the largest overseas production and supply centre in Hungary, the Huawei Europe Production and Supply Centre, which provides product supply and logistics services to more than 50 countries. The principal activity of the company is the wholesale trade of electronic and communication equipment and parts. Up to now, Huawei has invested over US\$1.2 billion in Hungary, directly or indirectly creating more than 2,000 jobs. Local purchases exceeded USD 246 million and contributed USD 277 million to local taxes. Huawei's local partners include all the leading local telecommunications firms in Hungary. Huawei obtained a leading market position in mobile networks, next-generation fixed access networks, core networks, optical networks, mobile broadband terminals, and mobile phones (Cooperation Between China and the Central and Eastern European Countries 2020). It has a considerable impact on the Hungarian economy (Oxford Economics 2020).

As far as flows within the company network are concerned, an estimation based on the information contained in the supplement to the balance sheet of Huawei Technologies Hungary Ltd. revealed that the most significant revenue was generated by Huawei International Co. Limited for the provision of headquarters services to the European Supply Chain, the Regional Centre, the European Supply Centre, and the European Returns Centre. Furthermore, on the revenue side of the Hungarian subsidiary, Huawei Device (Hong Kong) Co. Limited paid a substantial amount for the sale of spare parts for consumer equipment to support repair services. Altogether, revenues from linked (by ownership) companies amounted to around one third of the total. On the other hand, the Hungarian subsidiary is more closely linked to fellow companies in terms of the goods and services it offers, as these represent more than three-fourths of total costs. The most significant parts are represented by Huawei Device Co. Limited (a production company located in China and Vietnam) (D&B n.d.), which supplies all consumer devices sold in Hungary, and by Huawei International Co. Limited (registered in Hong Kong). As the company is the only skilled distributor of Huawei products in Hungary, significant



purchases of equipment and services related to the network and enterprise and government business groups are realised from the latter company. Of course, these only cover the partially realised trade flows in GVCs led and managed by Huawei. Also, these flows represent a minor part of bilateral trade (2% of Hungarian exports to China and 1% of Hungarian imports from China in 2021, based on the foreign trade data of the Hungarian Central Statistical Office). However, this short case study illustrates how GVCs affect China-Hungary trade, even in the case of Chinese multinational corporations.

5.2. A non-Chinese multinational corporation present both in China and Hungary

Though the importance of these firms is still dominant, it is declining gradually at the expense of Chinese-owned firms. Third-country-owned multinational corporations are the ones that determine bilateral trade flows between the two countries. From these, we have found relatively detailed data for a US subsidiary in Hungary, which owns subsidiaries in China as well. National Instruments produces computer hardware and software; thus, it is active in the computer, electronic, and optical industries highlighted in the statistical analysis. It has been present in Hungary since 2002. The Hungarian subsidiary executed transactions with numerous affiliated companies (74 affiliated firms), including one China-based (Shanghai) and one Hong Kong-based subsidiary. For the Hungarian company, these two subsidiaries represented very low shares in foreign supplies coming from affiliated companies (0.001% and 0.003%, respectively); however, they accounted for a relatively large portion of foreign sales realised towards affiliated companies (10% and 1.3%, respectively). This latter is true for the overall sales of the Hungarian subsidiary as well because the overwhelming majority of transactions were realised between the parents and subsidiaries, i.e., within the company network (National Instruments 2021). In terms of total Hungarian exports to China, the Hungarian subsidiary represented 3.4% in 2021.

5.3. A Hungarian multinational company

The pharmaceutical industry (21) figures among the top industries in Chinese intermediate and final use from Hungary (Table 3). One key company player here is Richter Gedeon, a well-known Hungarian pharmaceutical multinational company with a long tradition. Its predecessor was established in 1901. Richter Gedeon is a highly innovative company responsible for the highest share of Hungarian R&D (as a company), and it has registered a large number of patents. Its main activities are research, development, manufacturing, and marketing of pharmaceutical products. It is a highly internationalised company with a TNI¹² above 50% (Antalóczy – Sass 2018). The company is present in 50 countries and has eight manufacturing sites. In terms of foreign affiliates and subsidiaries, it is present mainly with representative offices and three production units in former CMEA countries (Poland, Romania, and Russia). In Western Europe, it is present in almost all EU member states, with trading affiliates and two production units in Germany and Switzerland. From the point of view of our analysis, it is especially important that a key focus of its foreign expansion is in Asia, where there is a production unit in India and numerous trade representative offices. In China, Richter Gedeon

¹²TNI or the Transnationality Index is a composite index measuring the level of internationalisation of a multinational firm. It is the arithmetic mean of the ratios of foreign assets to total assets, foreign sales to total sales, and foreign employment to total employment.



formed a joint venture, Rxmidas Joint Venture Co. Ltd. In 2013, it acquired GRMed Company Ltd, and by 2017, the joint venture and the acquired company were merged (Richter Gedeon 2021: 169). The fully owned Chinese (and Hong Kong-based) subsidiaries carry out distribution and marketing activities. (The fourth main locus of foreign expansion is the Americas, where the firm is present mainly through trading affiliates and trading joint ventures.)

Detailed data are available about the share of various markets in Richter Gedeon's sales. However, data are not available about where the locally sold pharmaceutical products are produced. In 2021, China accounted for 3.4% of total sales and was ranked 7th among the countries in terms of sales (behind the US, Russia, Hungary, Germany, Poland, and Spain). The majority of the sales are concentrated on women's healthcare pharmaceutical products (Richter Gedeon 2021). Assuming all Chinese sales originated from Hungary, this would represent 2% of Hungarian exports to China.

6. DISCUSSION AND CONCLUSION

In terms of the research questions, the analysis revealed some novel information about the Sino-Hungarian direct trade relations and contributed to the literature: Participation in global value chains involving China is increasingly significant in the Hungarian foreign economic network. While the backward links to China have a higher share of the production than the forward sales in the expenditure, the forward linkages have been more dynamic in the past ten years. The analysis has revealed that mainly the flow of semi-final products has increased over time, both in terms of backward and forward participation, which supports the increasing importance of global value chains in the bilateral relations of the two countries.

The industry content is quite concentrated. The CN1 (mainly Chinese multinational corporations) and CN2 (foreign multinational corporations operating in China) relations are not similar, though they overlap, and a significant shift can be seen between 2000 and 2018. In terms of CN1, we found that backward relations are dominated by the (final product) textile industry, while motor vehicle components and final products characterise mostly the forward links. The computer and electronics industries have a relatively high weight but lower dynamics than the average. The non-metal minerals have an increasing role, and the fabricated metal products have a determining influence on backward relations.

In the CN2 relation, the computer and electronic industry has the most significant relevance both in backward and forward terms, while machinery products provide a higher-than-average rise over time. Motor vehicle industry relations are unbalanced: in backward chains, they have a relatively small weight in value but high dynamics, while in forward links, the importance is outstanding with a smaller-than-average increase. Electronic equipment is also inconsistent: their supply has a considerable weight and low dynamics backward, and while their importance remains high, their future growth is relatively low.

Fabricated metal products receive special attention, not only because the industry has become significant in Hungarian-Chinese relations, but also because the value chain flow of fabricated metal products has shifted around: while in 2000, Hungary supplied mainly to China, in 2018, Chinese production and export have taken over this relationship.

As for the case studies, the activities of multinational companies have a significant impact on bilateral trade. High shares of individual intra-company trade flows in total Sino-Hungarian



bilateral trade lend credence to the idea that transactions within the network of multinational companies have a determining impact on foreign trade between the two analysed countries. While foreign (third country) multinational corporations can be of determining importance from the point of view of bilateral foreign trade developments, 'own' multinational corporations increasingly influence trade flows, as was indicated in the statistical analysis on the part of China and, to some extent, Hungary.

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