LUND UNIVERSITY
School of Economics and Management

Master's Programme in Economic Development and Growth (MEDEG)

THE IMPACT OF THE "CHINA SHOCK" ON EMPLOYMENT LEVELS IN CENTRAL EUROPE

Laura Albers
la7661al-s@lu.se

Abstract: The coexisting rise of China and Central European economies in the early 2000s as respectively the "Factory of the World" and the "Factory of Europe" raises the question whether Central Europe has either benefited from, or been harmed by the rise of China. This thesis therefore investigates the impact of the China shock on employment levels in Central Europe between 2000 and 2014. Using the WIOD 2016, it follows the proposition by Feenstra and Sasahara (2017) and quantifies the "net employment effect" of the China shock in Central European countries. In doing so, it compares the (positive) job impact of increased exports to China with the (negative) job impact of increased Chinese import penetration. Results show that increased bilateral trade with China between 2000 and 2014, has had a heterogeneous impact across Central European countries, where The Czech Republic and Slovakia see a net rise in employment levels, whereas Hungary, Poland and Slovenia experience a net demand reduction in jobs. Heterogeneity in net effects is on the export side caused by cross-country differences in export-openness and industry specialization, and on the import-side by differences in import-openness, initial domestic trade volumes and industry specialization.

Key words: China Shock, Central Europe, employment, international trade

EKHS42
Master thesis, Second Year (15 credits ECTS)
June 2018
Supervisor: Astrid Kander
Examiner:
Words: 16,959

Acknowledgements

I would like to express my sincerest appreciation to my supervisor Astrid Kander, for her supportive guidance during the writing process. Additionally, I would like to thank Bart Los for his constructive advice, patience and support. Lastly, I dedicate a special thanks to everyone who contributed in any possible way to the outcome of this work.

Laura Albers

Lund, May 2018

Table of Contents

List of Tables

List of Figures

1. Introduction

The rise of global value chains (GVCs) in the past two decades has been one of the most profound developments in international trade (Kummritz, 2015). Decreased coordination costs and trade costs have made it attractive to offshore certain production stages, which have manifested in a rapid expansion of trade in intermediates and a rise in foreign-value added content of exports (Johnson and Noguera, 2012). The global value chain revolution has particularly offered growth- and development opportunities to low- and middle-income countries, who were then able to benefit from an easier access to existing value chains, and were allowed to specialize in certain activities according to their technological capabilities (Baldwin, 2012). A notorious example of such a country is China. Since its entrance to the World Trade Organization (WTO) in 2001, China has experienced a rapid rise in (intermediates) exports – known as the “China Shock”, and eventually became the “Factory of Asia” and lately also the “Factory of the World”.

The emergence of China as a world economic power is often seen as the driver of a so-called “epochal shift in the patterns of trade” (Autor et al., 2016). Whereas fifteen years ago, the conventional economic wisdom was that trade was almost indubitably beneficial, most recently, economists have been rethinking this idea. Part of this rethinking is done by Autor et al. (2016), who zoom in at the employment impact of the China shock and conclude that employment has fallen in industries that are highly exposed to Chinese import penetration. These losses usually concentrate in industries that are either directly exposed to import competition or indirectly through input-output linkages. Even though Autor and his colleagues do not find any evidence of offsetting employment gains in other industries, various studies emphasize the existing correlation between import competition and export opportunities (Dauth et al., 2014a; Steinwender, 2015). These findings shed light on the dual role of trade exposure, where on the one hand it can create increased import competition and job displacement, and on the other hand, it might lead to growing export opportunities and thereby leading to the creation of new jobs (Feenstra and Sasahara, 2017).

Simultaneously with the rise of China, the post-communist transition in Central European countries (i.e. The Czech Republic, Hungary, Poland, Slovakia and Slovenia) induced the liberalization of trade and opening up to the world-economy (Shields, 2004). During the 1990s and 2000s, Central European firms, particularly automotive suppliers, increasingly started to integrate into both European and global value chains, thereby creating huge welfare benefits to the region, and eventually causing the region to develop into the “Factory of Europe” (Shields, 2004; Fritsch and Matthes, 2017; Los, personal communication, 18 May 2018).

The concurrent rise of China as the world’s factory, and Central Europe as the “Factory of Europe” has also greatly intensified China-Central European trade (Shang et al., 2016) Between 2002 and 2011, average annual growth rates of Central European exports to China amounted to 30.1%, and China in its turn increased exports to CEE economies by an average of 27.1% per year. Taking a quick look at the WIOD indeed confirms that China-Central

European trade has increased rapidly between 2000 and 2014. Contrary to the protectionist voices heard in the US, Central Europe seems to be more welcoming towards Chinese interference, where the Polish government describes the closer ties with Beijing as a "tremendous opportunity", and Hungary officially declares "high levels of mutual trust" (Financial Times, 2017).

The coexisting rise of China and Central European economies, and its severe intensification of bilateral trade raises the question in which way the rise of China has either contributed to, or harmed employment levels in Central European countries. Therefore, this thesis aims at answering the following research question:

"What has been the impact of the China shock on employment levels in Central Europe between 2000 and 2014?"

Using the WIOD 2016 including data on 43 countries and 56 industries for the period from 2000 to 2014, this thesis performs a similar input-output analysis as performed by Feenstra and Sasahara (2017). In order to answer the research question properly, the following three supporting sub-questions are formulated:

- *How big is the share of Chinese imports in Central Europe compared to the United States?*
- *What is the employment effect of export expansion in Central Europe to China between 2000 and 2014?*
- *What is the employment effect of increased import penetration by China in Central European countries between 2000 and 2014?*

The fact that trade between China and Central Europe is highly characterized by intra-industry trade (i.e. trade of products that belong to the same industry) makes it complex to make predictions on the actual employment effect. Intra-industry trade can either create export opportunities due to back-and-forth linkages (Dauth et al., 2014a) or lead to increased competition as both parties specialize in the same products (Hanson, 2010). Another source of ambiguity arises when considering the industry structures in Central Europe. Data exploration of the WIOD shows that these countries are mainly specialized in manufacturing industries, which tend to be the sectors that are mostly harmed by import penetration. However, from Dauth et al. (2014b), we know that if these sectors are at the same time highly export-oriented, they may even benefit from import competition. Finally, Los (personal communication, 22 December 2017) argues that there exists a lot of heterogeneity across Central European countries, where The Czech-Republic and Hungary seem to be better at keeping their competitive power than their neighbouring countries. This investigation therefore aims to bring clarity in these issues.

The remainder of this work will be structured as following. Section 2 presents an overview of the literature and empirical findings in order to provide a thorough background of this work. Section 3 and 4 continue by describing the data and methodology used for this work, whereupon section 5 provides the main empirical results and findings. Section 6 offers a critical discussion, where after section 7 concludes.

2. Literature review

This chapter provides comprehensive background knowledge by discussing the main findings from existing literature. Section 2.1 briefly introduces the emergence of global value chains (GVCs), where after section 2.2 discusses the key features of the China shock. Section 2.3 continues with a thorough overview on the labour market impact of trade shock, and section 2.4 provides background information on Central European markets, and the region's trade relationship with China.

2.1. The emergence of global value chains (GVCs)

Globalisation has given rise to more intricate cross-border flows of goods, know-how, investment, services and people - in short 'supply-chain trade' (Baldwin and Lopez-Gonzalez, 2015). Global and regional supply-chains have hugely transformed the existing patterns of trade, where production processes are increasingly split into separated but interconnected activities, and countries start to specialize in certain stages of production (Los et al. 2015). Decreased coordination costs and trade costs have made it attractive to offshore certain production stages, which have manifested in a rapid expansion of trade in intermediates and a rise in foreign-value added content of exports (Johnson and Noguera, 2012). This supply-chain revolution took off between 1985 and 1995, when 'Northern' high-tech and 'Southern' low-wage nations intensified its level of bilateral trade. Developing nations that formerly detested the liberalization of international trade, started to recognize the benefits of openness, where international production sharing enables these countries to join supply chains rather than having to invest decades in building their own (Baldwin, 2012; Baldwin and Lopez-Gonzalez, 2015). It furthermore restructured and revolutionized global manufacturing, where between 1970 and 2009, the share of global manufacturing output by industrialized countries dropped from 71% to 46%. On the contrary, developing countries, particularly China experienced a significant surge in its shares (Baldwin and Lopez-Gonzalez, 2015). Baldwin (2012) stresses that the offshoring of labour-intensive manufacturing stages and the accompanying international mobility of technology has induced tremendous growth in emerging markets. This change triggers and is being triggered by domestic policy reforms that increasingly embrace market openness and international trade liberalization.

Concerning the measurement of GVCs, Feenstra and Hanson (1999) were one of the pioneers in measuring fragmentation in a macroeconomic setting. In order to measure the magnitude of offshored activities by US firms, they defined the share of imported intermediate inputs in the value of all intermediate inputs used in that particular industry. Hence, one of the biggest short-comings of their measurement is that they do not account for the fact that the production of intermediate goods in its turn require additional production activities. In doing so, it disregards back and forth trade in intermediates, which is nowadays becoming increasingly important. Los et al. (2015) argue that computations based on the information from the World Input-

Output Tables (WIOT) can circumvent this problem, as it takes into account all production rounds and can detect the geographical location where value is added.

2.2. The rise of China

Between 1991 and 2013, China's share of world manufacturing exports rapidly rose from 2.3% to 18.8% (Storesletten and Zilibotti, 2014). Existing literature on the reasons for the dizzying exports during this period genuinely point at the country's economic and political reforms. Vogel (2011), Yu and Tian (2012) and Alder et al. (2013) for example stress that the reform of economic policy in the early 1990s has led to the creation of special economic zones (SEZs), which provided possibilities for foreign enterprises to establish factories that import inputs and export final outputs without strict government supervision. They argue that the global view embraced by the Chinese reformers induced a surge in the number of SEZs, thereby leading to a spectacular rise in China's share of world manufacturing production for foreign markets. Naughton (2007) additionally stresses that the export surge due to economic reforms was reinforced by China's accession to the World Trade Organization (WTO) in 2001. He proves so by showing that China's share in US manufacturing imports rose from 4.5% to 10.0% between 1991 and 2001, where after it showed a meteoric surge to 23.1% by 2011.

Autor et al. (2016) disclose three characterizing features of China's rise and its integration into the world economy. First, they point at the unexpected nature of the country's export growth, where even after the first reform implementations in the 1980s, few foresaw the development of China towards becoming one of the world's economic leaders. Secondly, they argue that the high degree of isolation under Mao's regime kept the country far inside its production frontier, but at the same time created huge opportunities for later catch up (Zhu, 2012; Brandt et al., 2012). Finally, China's rise is hugely characterized by its distinctive comparative advantage. Whereas other large emerging economies, such as Brazil, Russia and Indonesia genuinely specialize in primary commodities, China has a huge comparative advantage in industrial goods. Between 1991 and 2012 the country's share of world manufacturing value added rose from 4.1% to 24.0% (Autor et al., 2016). The country's strength in manufacturing can be explained by the dramatic increase in China's industrial labour force resulting from de-collectivization of agriculture, the shut-down of inefficient state-owned enterprises (SOEs), the mass migration of workers from farms to cities (Amiti and Freund, 2010; Li et al. 2012), massive capital accumulation and particularly its cheap labour. Concerning the latter, data from The Conference Board (2018) reveal that average hourly compensation costs of manufacturing employees in China amounted $0.60 dollar in 2002, which increased to $4.11 dollar per hour by 2013.

2.3. Trade exposure and the labour market

Traditional economists have long believed that trade improves overall welfare, where under standard conditions the losses from increased foreign competition are more than offset by the gains to winners (Autor et al., 2016). At the same time, the Stomper-Samuelson theorem teaches us that trade is not always Pareto-improving, but that it is likely to benefit the owners of a country's abundant factors, and harm those that own a country's scarce factors (Krugman et al., 2009). Around the 1990s, increased wage inequality and big drops in demand for manufacturing work incentivized economists to find the prime suspect of these labour-market disruptions. By that time scholars collectively believed that changes in employment and wages can be attributed to technological changes, and not so much to international trade. Hence, at the time this belief reached consensus, China broke through as a great (economic) power, thereby largely shifting the patterns of world trade and changing the conventional assumptions on the impact of trade on labour (Autor et al., 2016).

From that moment on, literature on the labour-market impact of trade increasingly assessed the distributional consequences of trade shocks at different levels of analysis (i.e., worker, firm, industry and region). In line with the scope of the study, this § starts with introducing a simple conceptual framework that decomposes the total national employment impact (2.2.1). Then subsection 2.2.2 delves into the cross-industry differences of trade exposure, where after the final subsection (2.2.3) outlines the main findings on the divergent impact of trade across different levels of development. In the remainder of this section, trade shocks are referred to the China shock as explained in section 2.1.

2.3.1. The national employment impact of trade shocks

Acemoglu et al. (2016) employ a relatively straight-forward decomposition technique to break down the total national employment impact of increased trade exposure. The computation used is as following

National employment impact = direct impact on exposed industries + indirect impact on exposed industries + Aggregate reallocation effects + Aggregate demand effects *(1)*

In Equation 1, the direct impact refers to the expected decrease of employment in industries whose output is substitutable for Chinese imports. Subsequently, indirect effects arise in the industries that are linked to the affected industry through the input-output matrix. These effects consist of both upstream- and downstream effects, where the former implies that a demand shock for a manufactured good indirectly affects demand for employment in industries – both manufacturing and non-manufacturing, that supply inputs to the affected industry. The latter effect refers to the fact that a trade shock to suppliers of a given industry may also have a substantial impact on consuming industries that are located down-stream in the input-output matrix. Acemoglu et al. (2016) argue that both direct and indirect effects can be captured using industry-level analyses, whereas the final two effects can only be grasped using local-labour market analyses. The reallocation effect deals with increases in employment in certain industries caused by freed-up labour in other contracting industries, and the aggregate demand effect refers to the presumed negative Keynesian effect, which assumes that money spent on imports cannot be spend on domestic output. Hence, from Amiti and Konings (2007) and Goldberg et al. (2010) we know that Chinese exports may also have an additional positive effect if they provide cheaper and a larger variety of imported intermediate inputs to trade-exposed firms. In this case, the Keynesian effect actually turns out positive, where cheaper imports from China could lead to an aggregate price level decline, eventually leading to an increase in aggregate demand.

Research by Autor et al. (2013) has proved that China's entry in the WTO in 2001 had a severe impact on jobs and wages of low-skilled workers in trade-exposed sectors in the US. The expected offsetting gains in other industries have not yet materialized, where workers who lost their jobs have not find new employment in another sector, and those that are still employed in the vulnerable sectors face major drops in their wages. A similar study for Germany (Dauth et al. 2014a) does not find any harmful impact on the German labour market as a consequence of the rise of China. First of all, they argue that Germany's initial exposure to China was less profound compared to the US, which may have already explained a part of the story. Furthermore, the rise of China has caused Germany to redirect their import flows from other low-cost countries, such as Greece, Italy and Turkey towards China. In doing so, it caused job losses in these countries, and not in Germany. Additionally, Dauth et al. (2014a) argue that the rise of intra-industry trade with Eastern Europe offered new export opportunities for Germany, leading to a rapid increase in manufacturing employment. Surprisingly, they do not find any positive effect from German exports to China, even though German exports to China increased six-fold between 1988 and 2008. The rapid rise in Germany's exports to China is caused by China's love for German high-quality goods.

Caliendo et al. (2017) apply a more dynamic approach, and study the general equilibrium effects of an increase in Chinese productivity and relatedly Chinese import penetration on the US labour market. Their model accounts for the role of labour – and goods mobility frictions, geographic factors and input-output linkages in order to determine allocations. Over the period 2000-2007, they study how the China shock has affected US households employed in different US sectors and states and find that the manufacturing sector lost 0.8 million jobs as a results of the China shock, which accounted to 25% of the total decrease in US employment. On the aggregate level, the US gains, but welfare and employment effects are unevenly distributed across US labour markets. The next section therefore delves deeper into the uneven distribution of the impact of trade shocks across sectors.

2.3.2. The employment impact of trade across industries

The results by Acemoglu et al. (2016) reveal that surged import competition from China between 1999 and 2011 has led to a direct loss of 1 million jobs in US manufacturing, and an additional 1 million jobs throughout the entire economy through input-output linkages. They argue that the direct effects of Chinese import penetration are likely to be felt more severely in manufacturing industries, whereas the sizable, often negative indirect effects can be transferred to manufacturing as well as non-manufacturing sectors.

First of all, and related to the direct consequences of trade shocks, Autor et al. (2013) stress that local labour-markets differ in their exposure to import competition due to a variation in initial industry specialization. As mentioned before, they find that employment has particularly fallen in trade-exposed manufacturing industries. The motivation why manufacturing industries are more reactive to Chinese import penetration than non-manufacturing industries can be traced back to China's comparative advantage. China's specialization in the production of industrial goods causes domestic, trade-exposed manufacturers to face severe competition by the larger variety and often cheaper substitutes from China. By taking a more disaggregated approach, Dauth et al. (2014b) argue that the consequences of import penetration depend on the level of export and import orientation. They qualify export industries as those with above-median, and import-industries those with below median net export exposure with respect to China and 21 other countries in Eastern Europe. Doing so, they stress that export-oriented industries, such as the automobile industry, may actually benefit from import competition as it creates opportunities for new markets, while import-oriented industries will largely be harmed by the negative effects of foreign competition. Combining both findings tells us that the impact of import penetration is differently felt both across as well as within industries.

Concerning the indirect consequences, Acemoglu et al. (2016) highlight the importance of intermediate goods linkages across countries and sectors, where a decrease in exports of Country A's manufacturing industry will have a negative trickle-down effect on all input suppliers to that industry. From Johnson and Noguera (2012) we know that trade in intermediate inputs accounts for almost two-thirds of total national trade, which presumably means that the indirect effects of a trade shock play a large role in explaining the total impact. Hence, the final impact remains largely ambiguous as both manufacturing and non-manufacturing industries supply inputs to the directly-affected manufacturing industries.

By highlighting the potential gains from import competition, Dauth et al. (2014b) also refute the belief that Chinese import competition can solely be seen as a unilateral trade shock. Hence, it can also be seen a mutual trade expansion, where in some cases both involved parties can actually gain from higher trade integration. This result coincides with the empirical results by Campbell and Lusher (2015) that stress that export shares and import penetration are highly correlated. This finding can potentially be explained by the fact that new imported inputs can have a positive effect on product creation and provide a substantial boost to output growth in the manufacturing sector, and subsequently may lead to a growth in export levels (Kasahara and Rodrigue, 2008; Goldberg et al. 2010). Feenstra, Ma and Xu (2017) indeed find that import competition from China has contributed significantly to US employment gains due to the US global export expansion. By using stacked long differences between 1991-1999 and 1999-2007, they find that a 1 percentage-point increase in industry import penetration reduces domestic industry employment by 1.3 percentage-points. At the same time, a 1 percentage-point increase in industry export expansion increases industrial employment by 0.87 percentage-point. In the end, their quantitative results reveal that US export expansion net of China import penetration has led to an increase of 525,000 jobs in the first period, whereas the second period showed a loss of 520,000 jobs. This shows that over the entire period, job gains and losses from both increased global exports and Chinese imports are practically balanced.

In line with Feenstra, Ma and Xu (2017), but now focused on the period 1995 to 2011, Feenstra and Sasahara (2017) also aim to quantify the employment impact of changes in US exports and imports and specifically imports from China. The performed methods of both studies differ significantly, where the former uses equilibrium changes in employment and tries to isolate exogenous changes in exports and the latter exploits an inputs-output analysis solely considering the demand side. Even though the methods used diverge hugely, the results of both estimates appear to be surprisingly similar. Feenstra and Sasahara (2017) find that the growth in merchandise (i.e. manufacturing and resource industries) exports in the period under analysis has led to a total demand of 6.6 million jobs, of which 2 million in manufacturing, 0.5 million in resource industries, and 4.1 million jobs in the services industries. In order to capture the effect of Chinese imports, they determine the added US production if imports from China had not grown. Their preferred estimates reveal that between 1995 and 2011 imports from China have reduced US employment demand with 1.4 million jobs in manufacturing, and 1 million in services. The reduction in the resource sectors appears to be marginal. They also find that one half of the lost jobs in services is due to the increase in US services imports, and the other half due to intermediate demand for merchandise exports. In the end, the expansion of exports relative to the imports from China has led to a 1.7 million net increase of jobs.

From the above-outlined results, it can be concluded that the direct consequences of a trade shock are particularly felt in the manufacturing industries, or more specifically in the import-oriented manufacturing industries. These industries face severe competition from the larger variety of often cheaper Chinese imports. Hence, large and increasing trade in intermediates causes not only manufacturing industries to be affected, but also the buying and/or supplying industries linked through the input-output matrix. Finally, this subsection argues that considering the ‘China shock’ as a mutual trade extension sheds light on the opportunities of growing exports and its coinciding positive effect on employment.

2.3.3. The divergent impact of trade across levels of development

A vast majority of the empirical literature on the employment effect of trade shocks focuses on developed countries, particularly the US. Hence, just as industry-level responses to trade can differ, labour-market effects may also differ per country´s level of development (Shiferaw and Hailu, 2016). This subsection aims to clearly outline the main findings on the impact of trade on employment across different levels of development.

The World Bank currently categorizes countries into four income groups (low-, lower-middle-, upper-middle-, and high-income) by looking at gross national income (GNI) per capita, in US dollars converted from local currencies. Hence, it is often argued that the relatively broad ranges of these categories and big within-category heterogeneity makes it a less useful analytical tool. Taking a quick look at the United States and Central European countries already provides valid evidence to support this belief. From the World Bank classification, it can be derived that both the US and Central European economies are classified as high income countries, exceeding the threshold of $12,236 US$ per year. However, ranking the individual country levels within this high-income category reveals that the United States is located in the upper quartile of the ranking, showing a GNI per capita of 56,810 US$ in 2016, whereas all Central European economies are positioned below the median, where Slovak Republic, Poland

and Hungary are even in the lower quartile (Table A.1), showing an average GNI per capita of 16,240 US$ in the same year (World Bank, 2016).

The large within-category variation of income levels makes an assessment of the differences in the employment impact based on an economy´s level of development rather complex and ambiguous. What we do know from observing the World Bank data is that the average GNI level of Central European countries (16,240 US$) lies closer to the median of the upper-middle-income class (6,770 US$) than to the median of the high-income class (31,720 US$). This coincides with the statement of the European Bank of Reconstruction and Development (EBRD) Chief Economist Sergei Guriev, who stresses in the Transition Report of 2017 that many of the Central and Eastern European countries have reached the middle-income status and have to overcome the problem of the 'middle-income trap' (Transition Report EBRD, 2017). Also, considering the hourly wages in the manufacturing industry, Central Europe shows an average of $4.06 per hour in 2002, which increases to $10.82 in 2013. The US on the other hand payed its manufacturing workers an average compensation of $27.35 per hour in 2002, which rose to $36.49 in 2013 (The Conference Board, 2018). The main point here is that potentially the China shock had a different impact on the US than on Central European countries, as income and wage levels in the latter case are more similar to Chinese levels. So to say, the income differential between the US and China is much wider than the gap between China and Central European levels. Being aware of this fact encourages to shortly describe the effect of trade shocks in countries having similar income- and wage levels, which are in this case middle- and low-income countries.

Minondo (1999) assesses the labour-market effect of trade in middle-income countries by performing a factor content analysis of Spain. His findings insinuate that countries whose domestic production is substitutable for imports will be harmed more severely than countries who perform non-competing activities compared to their import equivalents, coincides with the results by Autor et al. (2013). More specifically on the China shock, Lall and Albaladejo (2004) suggest that China forms an increasingly competitive threat to middle-income countries, which can, according to Fu and Zhang (2012) be explained by the fact that imports from middle-income countries are in tight price competition with those from China. In analyzing the unit prices of Chinese manufactured imports into the EU, Japan and the US between 1986 and 2006, they find that the prices of China and the middle-income countries are moving towards the same direction. This indicates that the products exports by China are close substitutes with the products that middle-income countries export.

Fu and Zhang (2012) furthermore find that for low-income countries, the threat of Chinese exports is formed by market expansion and not so much by price competition. They also find that prior to the late 1990s, low-income countries were mostly affected by Chinese exports, whereas after 1997, this impact shifted towards middle-income countries. Shiferaw and Hailu (2016) also investigate which sectors were mostly harmed in these lower-income countries. By using a labour demand model, they find that in these countries, most job losses were found in the capital-intensive, medium-technology industries. On the contrary, they stress that import penetration does not have a labour-reducing effect in low-technology industries in these countries, whereas on the other hand it creates significant job displacement in the same industries in developed countries. As a final note, they emphasize that, independent on a country's income- and wage-levels, a diverse export basket most likely contributes to job creation, mainly in skill-intensive industries.

Classifying Central European countries as middle-income countries, the findings above suggest that CE countries face relatively severe competitive threat from China, due to the fact that both specialize and export similar goods. Nevertheless, this does not necessarily mean that the final effect is also detrimental. As section 2.3.1 will show, intra-industry trade, where countries exchange similar products belonging to the same industry, may potentially level out the negative effects of producing substitutable products.

2.4. Central Europe

Since the accession to the European Union (EU) in 2004, trade flows of Central Europe (CE) – incorporating The Czech Republic, Hungary, Poland, Slovak Republic and Slovenia, have become more dynamic, where increased access to trade partners until the global financial crisis provided a boost to exports (Allard, 2009). Trade networks within the region strengthened, and CE countries intensified trade routes with their eastern neighbours and fast-growing regions, such as Asia (IMF, 2000). At the same time, export growth also drove imports up, which can be related to the growing import content of exports in Central European countries (Allard, 2009). According to Traistaru et al. (2003), increased economic integration also leads to higher levels of industry specialization. Therefore, this section first briefly summarizes the industry specialization and comparative advantage of each of the countries under analysis (2.3.1). This subsection also describes the empirical results on the openness to trade of Central European countries, where after subsection 2.3.3 digs into the specific characteristics of China-Central European trade (2.3.2).

2.4.1. Openness to trade

Literature on a country's proneness to exogenous shocks often refers to the degree of economic openness (Farrugia, 2004). Economic openness can be measured by computing the ratio of international trade (imports + exports) to GDP, where a high degree of openness infers that a country is more vulnerable to external economic conditions, which are beyond their control. The term openness can be decomposed into both export-openness – also export dependency, and import openness, also referred to as import dependency. With respect to export dependency, it often holds that countries with a small domestic market have limited options but to call upon exports. From the UNDP (2011), we know that these countries showing high exports shares to GDP, also face considerable fluctuations in their export earnings as well as their economic growth rates. Speaking in terms of import openness, countries that are poorly endowed with natural resources tend to be considerably dependent on foreign inputs to keep their production processes up and running. Similarly, the high degree of import dependency makes the country more vulnerable to the fluctuations in the cost and availability of imports.

Concerning the trade openness of Central European countries, the World Bank database reveals data on the sum of exports and imports of goods and services measured as a share of GDP for each of the countries. The results of overall trade openness are shown in Table A3 for both the year 2000 and 2014. Table A4 and A5 display respectively the countries' export openness and import openness. It can be seen that export and import openness in all Central European countries have greatly increased between 2000 and 2014, and that Hungary and The Slovak Republic export as well as import the largest share of GDP in 2014. On the contrary, Poland exports and imports the least.

2.4.2. Patterns of specialization

Many authors in the literature employ the Herfindahl index to measure the degree of absolute industrial specialization. A value of $S_{i,t}$ close to zero means little specialization, or an equal specialization in each of the sectors, while a value close to 100 implies a single monopolistic producer (Sapir, 1996). Besides the fact that one can measure to what extent a country is becoming more specialized or diversified over time, it also allows for computing the share of each industry in total exports of the country under analysis. In doing so, one can measure and rank the industries according to export specialisation. The Herfindahl index is defined as following:

$$S_{i,t} = \sum_{k=1}^{J} (s_{i,t}^{k})^2, \qquad (2)$$

Where $s_{i,t}^{k} = x_{i,t}^{k} / \sum_{k=1}^{J} x_{i,t}^{k}$ denotes the export share of industry k in country i at time t in total exports of country i at time t. The higher the Herfindahl index is, the more specialized the country is.

Crabbé and Beine (2005) construct these indices for 13 Central and Eastern European countries on the Harmonized System (HS) 8-digit product level for the period 1989-2000. They find that on average Central and East Europe have become more specialized in the most recent years of their analysis. The Observatory of Economic Complexity provides data on the export shares of different sectors in each of the CE countries at HS2, HS4, HS8 and STIC2 and 4 levels. Table A.1 provides information on the biggest exporting industries at SITC2 level in 2014, and gives the main contributor(s) at SITC4 level in the final column. It can be seen that all countries specialize mostly in machinery, particularly in cars and car parts. Furthermore, except for Slovenia, these countries are also relatively big exporters of electronics and construction material and equipment. For Hungary, Poland and Slovenia, exports of chemical products also takes a big proportion in total exports.

In terms of imports, Table A.2 outlines the biggest industries from which Central European countries import. These shares reveals that roughly all countries import products from the same industries as they export, particularly machinery and electronics. Furthermore, for Poland and Slovakia a relatively big share of their imports consists of oil. The fact that these countries export the same type of products as they imports confirms the earlier statement that Central Europe is largely engaged in intra-industry trade.

Intra-industry trade (IIT) is generally associated with welfare gains from trade, due to an increase in product variety, economies of scale and the intensification of competitive pressures (Helpman and Krugman, 1985). More complex manufactured products benefit the most from economies of scale, and from splitting up production across countries (OECD Outlook, 2002). Furthermore the increase of trade with high or growing IIT is believed to entail lower costs of factor market adjustment than inter-industry trade (Balassa, 1966). This means that for example during an export boom (i.e. relative demand for imports fall), smooth transition leads to a quick attainment of a new equilibrium, where wages in terms of exports have fallen, and affected employees switch from the contracting import sectors to the growing export sectors (Helpman and Krugman, 1985). This has become known as the "smooth-adjustment hypothesis" (SAH). In light of this hypothesis, Balassa (1966, p. 472) stresses that "it is apparent that the increased (intra-industry) exchange of consumer goods is compatible with unchanged production in every country". Hence, as movements in exports and imports are closely aligned under high levels of intra-industry trade, changes in net export volumes will be small too. In the end, this makes it rather ambiguous and complex to make clear-cut assessments of the vulnerability of countries to (cyclical) trade shocks (OECD Outlook, 2002). Empirically, Dauth et al. (2014a) find that the German labour market experienced a positive effect from the rise of intra-industry trade with Eastern Europe. They stress that the rise of Eastern Europe created increased import competition from these economies, but at the same time created more export opportunities in the same import-penetrated sectors.

2.4.3. China-CEE trade

According to Shang et al. (2016), in 2011, Central and Eastern European (CEE)[1] countries were underrepresented as a destination of Chinese exports. The same holds the other way around, where China appears to be a less popular destination for exports by CEE countries. Hence, in the very same article, they argue that even though intra-European trade remains the largest segment of CEE trade, the expected European growth slowdown has encouraged the CEE countries to seek for new markets outside the European hemisphere (Xin, 2012). At the same time, the CEE countries attracted Chinese attention as a strategic transfer point for further geographical expansion of Chinese exports into the competitive European internal market (Shang et al., 2016). Pencea (2013) argues that the interrelated needs and interests creates promising prospects for future expansion of the China-CEE cooperation.

By employing a constant market share analysis (CMSA), Shang et al. (2016) show that, recently, bilateral export levels between Chinese and CEE markets have grown substantially. They find that between 2002 and 2011, except for Romania, both China and CEE economies tremendously increased exports towards each other's markets, where the average annual growth rate of CEE exports to China amounted 30.1%, and that of China to CEE economies amounted 27.1%. Table 1 shows the average annual growth rates of both China to each of the ten CEE economies individually, and the CEE economies towards China.

[1] The CEE countries consists of Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia.

Table 1: Annual growth rates China-CEE trade (%) between 2002 and 2011

Annual growth (%) of	*CEE exports to China*	*Total exports*	*Chinese exports to CEE*	*Total exports*
Bulgaria	47.0	19.3	29.6	16.9
Czech Republic	30.3	15.5	28.4	13.5
Estonia	33.6	17.2	26.4	13.8
Hungary	30.4	13.9	18.8	11.6
Latvia	38.6	20.2	37.6	16.0
Lithuania	45.2	19.9	33.6	17.1
Poland	27.9	18.7	28.3	16.2
Romania	11.2	18.2	28.5	17.5
Slovakia	55.0	20.7	44.5	18.5
Slovenia	21.8	12.1	37.5	12.4
CEE	20.1	17.0	27.1	15.0
China	N/A	21.6	N/A	21.8

Note. Reprinted from Shang et al. (2016) "The Changing Patterns of China-CEE trade".

COMTRADE data reveals insights on the composition of bilateral exports by Central Europe and China (Trade Economics, 2018). First, with respect to CE exports to China, it shows that Poland and Hungary mainly export copper and vehicle parts respectively. The Czech Republic, Slovakia and Slovenia predominantly export machinery, vehicles and electronic equipment. More specifically, Xin (2012) stresses that China's high growth in levels of imports from Slovakia, as shown in Table 1, can mainly be attributed to the Volkswagen factory in Bratislava, who started to export cars and car parts to China by 2011. A similar explanation applies to countries such as The Czech Republic and Hungary, where exports by multinational firms in the transportation industry have largely shaped the country's overall export pattern towards China. In The Czech Republic, total export growth to China was particularly driven by exports of Skoda parts, whereas for Hungary, a large share of the country's total exports to China consists of Audi motors and General Motor gear boxes (Xin, 2012). Second, with respect to China's exports to Central Europe, a comparable analysis finds that for all Central European countries, its imports from China consists predominantly of electronics. Slovenia imports a more varied mix of products from China, consisting of electronics, garment and machinery (OEC, 2018).

Table 1 furthermore triggers one's curiosity on the main causes for these excessive growth rates. According to Dean et al. (2011), and Shang et al. (2016), these drastic growth rates can be explained by the improved competitiveness of intermediate goods. Increased vertical specialization and fragmentation of the global value chains (GVCs) have given rise to the share of intermediate input trade in total trade (Dean et al. 2011). Hence, one should be aware that Table 1 does not inform us about the size of trade as a share of either Chinese total exports or CEE total exports. Data exploration within WIOD provides us with extensive information on these shares, which results will be provided in section 5.1.

3. Data

3.1. Contents of the World Input-Output Database (WIOD)

In order to examine and test the trade-related effects of the China shock on employment in Central European countries, this work employs data from the World Input-Output Database

(WIOD) 2016 (Timmer et al. 2015). The database includes 28 EU countries and 15 other major countries in the world, and provides industry-level data for 56 sectors that are classified according to the International Standard Industrial Classification revision 4 (ISIC rev 4). The tables provide annual times series for the period 2000 till 2014. Figure 1 shows a stylized example of a World Input-Output Table (WIOT) involving three countries, country *S, R* and a group of uncovered countries called "rest of the world" (ROW). Each country has data available on two industries, denoted as *i* and *j*. The table provides an inclusive overview of all global transactions between industries and final users across countries, where the row industries are the selling industries and the column industries are the buying industries. The rows of the table provide information on the distribution of output over the user categories, consisting of intermediates by other industries (***Z***) or as final products by households, the government and firms (***Y***) (Timmer et al. 2015). The columns provide information on production processes, where each cell, when expressed as ratios to gross output, tells you the shares of inputs in total output. A crucial accounting identity of these input-output tables is that gross output of each industry as given in the last element of each column equals to the sum of all uses of output from that industry, as displayed in the last element of each row.

Figure 1: Stylized example of a World Input-Output Table (WIOT)

		S		R		ROW		S		R		ROW	Gross Output
		i	*j*	*i*	*j*	*i*	*j*	FD	FD	FD	FD	FD	
S	*i*	***Z***						***Y***					***x***
	j												
R	*i*												
	j												
ROW	*i*												
	j												
Value added	Labour income	***p′***											
	Other value added	***w′***											
Gross output		***x′***											

Note. Adapted from: Los et al. (2017) "The Mismatch between Local Voting and the Local Economic Consequences of Brexit".

3.2. Decomposition of a World Input-Output Table (WIOT)

Consider the case of n countries, and c sectors. The $nc\ x\ nc$ $\boldsymbol{Z}$ matrix includes intermediate inputs deliveries. More specifically, it contains the values of intermediate inputs delivered by all industries in all countries, to all industries in all countries (Los et al. 2017). The full matrix bloc consists of multiple $c\ x\ c$ submatrices, such as $\boldsymbol{Z}^{RS}$, of which its typical element z_{ij}^{RS} reflects the deliveries of intermediate inputs from industry i in country R to industry j in country S. $\boldsymbol{Y}$ is an $nc\ x\ k$ matrix including deliveries to the final demand categories in all countries. $\boldsymbol{Y}$ again consists of multiple $n\ x\ k$ submatrices, where $\boldsymbol{Y}^{RS}$ gives final demand in each of the final demand categories in country R for products coming from industries in country R. Summing over the k columns of this matrix creates the final demand vector $\boldsymbol{y}^{RS}$, where its typical element y_i^{RS} includes the final use in country S of goods and services produced by industry i in country R. In order to aggregate all final demand categories k of all countries into a single column vector $\boldsymbol{y}$, one can multiply the $\boldsymbol{Y}$ matrix with a summation vector $\boldsymbol{u}$ consisting entirely of ones.

Summing over the sales of intermediate inputs and final goods row-wise creates an $nc\ x\ 1$ column vector of gross outputs, which is denoted as $\boldsymbol{x}$. $\boldsymbol{x}^R$ refers to the column vector that presents total gross output in country R, where its typical element x_i^R gives the gross output of industry i in country R. Finally, as can be derived from Figure 1, value added can be split into labour income and other value added. Both $\boldsymbol{p}'$ and $\boldsymbol{w}'$ are $1\ x\ nc$ row vectors containing respectively labour income and other value added of all industries in all countries. $\boldsymbol{p}'^R$ then represents total labour income levels per industry in country R, where p'^R_i - being its typical element, gives the labour income in industry i of country R. The same explanation applies to the $1\ x\ nc$ row vector of value addeded. Finally, and as mentioned earlier, due to double-entry bookkeeping the column sum over the intermediate inputs $\boldsymbol{Z}$ and primary inputs ($\boldsymbol{p}'$ and $\boldsymbol{w}'$) gives the row vector $\boldsymbol{x}'$, which equals the values in the column vector $\boldsymbol{x}$.

3.3. Measuring employment

Similar to Los et al. (2015), this study measures employment by looking at the number of workers – measured in thousands, per industry per country. In order to capture the final job impact, this work makes computations based on employment ratios, which are the number of workers required per dollar of output in each industry in each country. Let x_i^R be the value of output in industry i of country R, and g_i^R be the number of workers in industry i of country R, which data can be extracted from the WIOD Socio-Economic Accounts (SEA) 2016.[2] Now q_i^R can be defined as the number of workers required per dollar of output in industry i in country R: $q_i^R = g_i^R / x_i^R$. Subsequently the $nc\ x\ 1$ column vector $\boldsymbol{q}$ can be created, containing all employment ratios for all industries in all countries. In the remainder of this work, this vector will be stacked into a $nc\ x\ nc$ diagonal matrix, denoted as $\boldsymbol{Q}$.

4. Methodology

The methodology of this work is an adjustment and extension of the method used in Feenstra and Sasahara (2017). They employ an input-output analysis to quantify the US employment effects of both increased US exports and a rise in Chinese import competition. In doing so, the methods in Los et al. (2015; 2016) are used, which look at the demand side of the labour market and perform the method of "hypothetical extraction" to determine the employment impact of changing export and import levels. Therefore, section 4.1 will first provide a brief introduction on the application of the extraction technique by Los et al. (2016), where after section 4.2 describes the method used to measure the employment effect of export expansion. Section 4.3 follows up by outlining how the employment impact of increased Chinese import competition can be quantified.

4.1. Hypothetical extraction

"Hypothetical extraction" is a powerful mathematical technique used to extract a set of transactions from an input-output structure represented by both the **A** matrix containing

[2] The number of employees (thousands) is denoted as the variable EMPE in the SEA 2016.

intermediate input ratios and the **Y** matrix of final good flows (Los et al. 2016).[3] The initial idea behind this approach is to compare value added in the actual world to value added in a hypothetical world where trade linkages are set to zero. In doing so, the amount of value added related to the extracted transactions can be computed. Los et al. (2016) apply this method to compute domestic value added (DVA) in exports of country *S*, by subtracting the hypothetical value added from the actual value added in country *S*. This application assumes that those transactions simply do not exist anymore, instead of taken over by either domestic or foreign production. Hence, as "hypothetical extraction" is not exclusively bounded to value added computation, Feenstra and Sasahara (2017) also employ this method for their computations of the employment effect of export expansion and increased import competition. As Los et al. (2016) provide a clear and thorough description of the approach, this section uses their equations as an introduction to the concept of hypothetical extraction, which will be extended in the next section.

As mentioned, the global input-output structure consists of the matrices **A** and **Y**, which are depicted in Equation 3,

$$\underbrace{\mathbf{A}}_{nc\,x\,nc} = \begin{bmatrix} \mathbf{A}^{SS} & \mathbf{A}^{SR} & \mathbf{A}^{ST} \\ \mathbf{A}^{RS} & \mathbf{A}^{RR} & \mathbf{A}^{RT} \\ \mathbf{A}^{TS} & \mathbf{A}^{TR} & \mathbf{A}^{TT} \end{bmatrix} \; and \; \underbrace{\mathbf{Y}}_{nc\,x\,nc} = \begin{bmatrix} \mathbf{y}^{SS} & \mathbf{y}^{SR} & \mathbf{y}^{ST} \\ \mathbf{y}^{RS} & \mathbf{y}^{RR} & \mathbf{y}^{RT} \\ \mathbf{y}^{TS} & \mathbf{y}^{TR} & \mathbf{y}^{TT} \end{bmatrix} = \underbrace{\mathbf{Yu}}_{nc\,x\,1} = \begin{bmatrix} \sum_{\boldsymbol{k}} \mathbf{y}^{S,k} \\ \sum_{\boldsymbol{k}} \mathbf{y}^{R,k} \\ \sum_{\boldsymbol{k}} \mathbf{y}^{T,k} \end{bmatrix} \quad (3)$$

Assuming a world with n countries and c sectors, the global input-output matrix **A** is an $nc\,x\,nc$ matrix, where each of the elements is a $c\,x\,c$ sub-matrix describing the ratios of intermediate good flows from a country to another. This **A** matrix, containing intermediate input coefficients is created by diving the elements in the matrix by the gross output in the destination sectors of the destination country (Feenstra and Sasahara, 2017). The typical element a_{ij}^{RS} can thus be defined as z_{ij}^{RS}/x_j^S and indicates how much intermediate inputs are required from the row industry i in country R to produce one unit of gross output in column industry j in country *S*. As mentioned in section 3.2, the final demand matrix **Y** consists of final demand vectors **y**, where the $c\;x\;1$ vector $\boldsymbol{y}^{RS}$ denotes the final demand of country *S* buying from country *R*. By multiplying the **Y** matrix with the summation vector **u**, all final demand categories k of all countries are aggregated into a single $nc\;x\;1$ column vector.

As mentioned, Los et al. (2016) subtract the hypothetical value added from the actual value added in order to define the amount of domestic value added that is embodied in the exports from country *S* to country *R*. First, they compute actual value added in country *S* as following:

$$\mathrm{GDP}^{S} = \mathbf{v}^{S}(\mathbf{I}-\mathbf{A})^{-\mathbf{1}}\mathbf{Yu} \quad (4)$$

Here, $\mathbf{v}^S$ is a $nc\;x\;1$ vector including value added to gross output ratios in all industries in country *S*. These ratios can be calculated by dividing the row vector of value added by the gross output vector $\mathbf{x}'$.[4] Furthermore, $(\mathbf{I}-\mathbf{A})^{-\mathbf{1}}$ is the Leontief matrix, which accounts for the fact

[3] The construction of the **A** matrix will be discussed in the following paragraph.

[4] The row vector containing value added can be computed by summing the row vectors of labour income ($\mathbf{p}'^{S}$) and other value added ($\mathbf{w}'^{\boldsymbol{S}}$) (Figure 1)

that the production of final demand requires intermediate inputs, supplied both domestically as well as internationally. Finally, $\mathbf{Y}$ indicates the final demand matrix and $\mathbf{u}$ is a summation vector, which solely contains of ones (Section 3.1).

Subsequently in order to compute hypothetical value added, they first extract exports from country S to R in both matrices $\mathbf{A}$ and $\mathbf{Y}$. This relatively static approach replaces both exports of intermediate inputs $\mathbf{A}^{SR}$ and deliveries of final goods from country S to R $\mathbf{y}^{SR}$ by zero. Doing so causes a drop in exports of value added, and only the parts of GDP in country S that remain when exports from S to R are extracted are left. The hypothetical input-output structure then looks as following,

$$\underbrace{\mathbf{A}^*}_{nc\,x\,nc} = \begin{bmatrix} \mathbf{A}^{SS} & \mathbf{0} & \mathbf{A}^{ST} \\ \mathbf{A}^{RS} & \mathbf{A}^{RR} & \mathbf{A}^{RT} \\ \mathbf{A}^{TS} & \mathbf{A}^{TR} & \mathbf{A}^{TT} \end{bmatrix} \; and \; \underbrace{\mathbf{Y}^*}_{nc\,x\,nc} = \begin{bmatrix} \mathbf{y}^{SS} & \mathbf{0} & \mathbf{y}^{ST} \\ \mathbf{y}^{RS} & \mathbf{y}^{RR} & \mathbf{y}^{RT} \\ \mathbf{y}^{TS} & \mathbf{y}^{TR} & \mathbf{y}^{TT} \end{bmatrix} = \underbrace{\mathbf{Yu}^*}_{nc\,x\,1} = \begin{bmatrix} \sum_{k \neq R} \mathbf{y}^{S,k} + \mathbf{0} \\ \sum_{\boldsymbol{k}} \mathbf{y}^{R,k} \\ \sum_{\boldsymbol{k}} \mathbf{y}^{T,k} \end{bmatrix} \quad (5)$$

The hypothetical GDP in country S can then be computed as following:

$$\mathrm{GDP}^{S*} = \mathbf{v}^S(\mathbf{I} - \mathbf{A}^*)^{-1}\mathbf{Yu}^* \quad (6)$$

$(\mathbf{I} - \mathbf{A}^*)^{-1}$ and $\mathbf{Y}^*$ denote respectively the hypothetical Leontief inverse and final demand matrix. Finally, in order to compute DVA that is included in the exports of country S they subtract the hypothetical GDP of country S from the actual GDP, which is

$$\mathrm{DVA}^S = \mathrm{GDP}^S - \mathrm{GDP}^{S*} \quad (7)$$

As indicated, the technique of hypothetical extraction is not restricted to value added computations only. This research (as well as Feenstra and Sasahara (2017) for the US) employ the performed method to determine how much employment (thousands of employees) is embodied in both Central European exports to China and Chinese exports to Central Europe. In doing so, it aims to discover how Central European employment levels have responded to both increased export opportunities to China and Chinese import penetration during the period 2000-2014. This work makes two main adjustments to the technique by Los et al. (2016) in order to calculate the differences in employment levels between the actual and hypothetical situation. First of all, the vector $\mathbf{v}^S$ including value added ratios will be replaced by the $nc\ x$ 1 column vector $\mathbf{q}^S$ containing the ratio of employment levels (thousands of employees) to gross output. For the remainder of the calculations this vector will be stacked into the $nc\ x\ nc$ diagonal matrix $\mathbf{Q}$. A detailed description of the computation of $\mathbf{q}$ can be found in section 3.3. Second, instead of setting certain trade linkages to zero, this work replaces the volume of these trade linkages in 2014 by its equivalent volume in 2000. Doing so allows to compute the employment effect of changing trade volumes between 2000 and 2014.

4.2. Quantifying the employment effect of Central European export expansion

In this section, the hypothetical extraction technique explained above will be extended to quantify the employment effect of increased Central European exports to China. Assume that country S is a Central European country, say The Czech Republic, country R is China, and T

are all other countries[5]. Furthermore, there are two industries *i* and *j.* This study makes two adjustments to the export expansion computations performed by Feenstra and Sasahara (2017). First, instead of analyzing the employment effect of total export expansion, this work is only interested in analyzing how the rising importance of China as an export destination has influenced employment levels in Central Europe. Instead of accounting for increased exports to all countries in the world as done by Feenstra and Sasahara (2017), this work therefore assesses the employment effect of increased exports to only China. The logic behind this choice is that the rise of China can be seen from both the supply and demand side, where China increases its deliveries to Central European countries, and at the same time provides increased export opportunities to these CE countries. Hence, in order to compare both effects, it makes more sense to consider increased exports to only China, instead of increased exports to all other countries in the world. The second adjustment is made in the computation of the hypothetical input-output matrix $\tilde{\boldsymbol{A}}^{EX}_{2000,2014}$. Instead of calculating new values of **A** by dividing the elements in the intermediate input matrix **Z** in year 2000 by the associated elements in the gross output vector **x** of 2014, this work replaces the submatrix $\boldsymbol{A}^{SR}_{2014}$ (i.e. the amount of intermediate inputs delivered by all industries in The Czech Republic, needed for the production of 1 unit of gross output in all industries in China) by $\boldsymbol{A}^{SR}_{2000}$[6].

As we are interested in computing how employment levels have changed in each of the Central European countries between the year 2000 and 2014, the employment effect of increased final good exports can be calculated as following:

$$\widetilde{labour}^{EX1}_{2000,2014} = \boldsymbol{Q}_{2014}(\boldsymbol{I} - \boldsymbol{A}_{2014})^{-1}\mathbf{Yu}_{2014} - \boldsymbol{Q}_{2014}(\boldsymbol{I} - \boldsymbol{A}_{2014})^{-1}\tilde{\mathbf{Y}}\mathbf{u}^{EX}_{2000,2014} \tag{8}$$

The first term on the right defines the actual employment levels in 2014, which is – except for the diagonal matrix **Q**, computed in the same fashion as equation 1 given in the previous section. Subsequently, the second term computes the amount of employees in the hypothetical world. In this world, the exports of final goods from country *S* to country *R* in 2014 are replaced by its level in 2000. Domestic purchases from final good producers in country *S* as well as trade in all other countries are allowed to change over time. Eventually, this creates the stacked hypothetical final demand matrix $\tilde{\mathbf{Y}}\mathbf{u}^{EX}_{2000,2014}$.

$$\underbrace{\tilde{\mathbf{Y}}\mathbf{u}^{EX}_{2000,2014}}_{nc\,x\,1} = \begin{bmatrix} \mathbf{y}^{SC}_{2000} + \sum_k \mathbf{y}^{S,k}_{2014} \\ \sum_k \mathbf{y}^{R,k}_{2014} \\ \sum_k \mathbf{y}^{T,k}_{2014} \end{bmatrix} \tag{9}$$

Eventually, the difference between the two terms in Equation 8 refers to the employment effect of export expansion, where a positive number indicates job creation and a negative number job displacement (Feenstra and Sasahara, 2017).

[5] The given example of country *S* (Czech Republic) is replicated for Hungary, Poland, Slovak Republic and Slovenia.

[6] This adjustment is also applied in the measurement of the import penetration effect described in Section 4.3.

Even though the first situation considers the increase in exports of country *S* to all final demand categories *k* in country *R*, it does not account for exports of intermediate inputs included in the **A** matrix. Therefore, the second situation also includes changes in the exports of intermediate goods by country *S* to country *R*. The employment effect of increased exports can now be computed as:

$$\widetilde{labour}^{EX2}_{2000,2014} = \boldsymbol{Q}_{2014}(\boldsymbol{I}-\boldsymbol{A}_{2014})^{-\mathbf{1}}\mathbf{Yu}_{2014} - \boldsymbol{Q}_{2014}(\boldsymbol{I}-\widetilde{\boldsymbol{A}}^{EX}_{2000,2014})^{-\mathbf{1}}\widetilde{\mathbf{Y}}\mathbf{u}^{EX}_{2000,2014} \quad (10)$$

where,

$$\underbrace{\widetilde{\boldsymbol{A}}^{EX}_{2000,2014}}_{nc\ x\ nc} = \begin{bmatrix} \boldsymbol{A}^{SS}_{2014} & \boldsymbol{A}^{SR}_{2000} & \boldsymbol{A}^{ST}_{2014} \\ \boldsymbol{A}^{RS}_{2014} & \boldsymbol{A}^{RR}_{2014} & \boldsymbol{A}^{RT}_{2014} \\ \boldsymbol{A}^{TS}_{2014} & \boldsymbol{A}^{TR}_{2014} & \boldsymbol{A}^{TT}_{2014} \end{bmatrix} \quad (11)$$

is the global input-output matrix, where the sub-matrix of country *S* delivering intermediate inputs for the use of gross output in country *R* $\boldsymbol{A}^{SR}_{2014}$ is replaced by the submatrix containing equivalent ratios for 2000.

The difference between the two terms in equation 10 reveals the employment impact of increased exports of both final goods and intermediate inputs by country *S* to country *R* between 2000 and 2014. Both $\widetilde{labour}^{EX1}_{2000,2014}$ and $\widetilde{labour}^{EX2}_{2000,2014}$ are $nc\ x\ 1$ vectors of the employment effects over all sectors and countries. Hence, as this study is only interested in the employment effect for country *S*, the $c\ x\ 1$ sub-vectors $\widetilde{labour}^{EX1,S}_{2000,2014}$ and $\widetilde{labour}^{EX2,S}_{2000,2014}$ are extracted from the full column vectors.

Finally, the total effect is disaggregated into a natural resources effect, which include the WIOD sectors 1-4 and a manufacturing and services effect, which are respectively sectors 5-23 and 24-56.[7] These sectoral effects can be calculated as:

$$\begin{aligned} \widetilde{labour}^{EX,S}_{2000,2014}(resource) &= \sum_{s=1}^{4} \widetilde{labour}^{EX,S}_{2000,2014}(s) \\ \widetilde{labour}^{EX,S}_{2000,2014}(manufacturing) &= \textstyle\sum_{s=5}^{19} \widetilde{labour}^{EX,S}_{2000,2014}(s) \\ \widetilde{labour}^{EX,S}_{2000,2014}(services) &= \sum_{s=24}^{33} \widetilde{labour}^{EX,S}_{2000,2014}(s) \end{aligned} \quad (12)$$

[8]

and the overall employment effect in country *S* is

$$\widetilde{labour}^{EX,S}_{2000,2014}(all\ sectors) = \textstyle\sum_{s=1}^{56} \widetilde{labour}^{EX,S}_{2000,2014}(s) \quad (13)$$

These computations will also be used in measuring the import penetration effect in section 4.3.

This work recognizes an important limitation in the application by Feenstra and Sasahara (2017). In computing the employment impact of export expansion, Feenstra and his colleague assume that US export levels towards the world simply stagnate at their 2000 level, and ignore

[7] Table B.1 in the Appendix displays the list of WIOD sectors.
[8] Note that S indicates country S, while s refers to sectors.

the fact that these countries now import fewer intermediate inputs for their production processes as well as final goods to fulfil demand. Hence, this work believes this is a rather static assumption, and argues that producers need a set ratio of intermediate inputs in order to retain their initial levels of production. Similarly, deliveries of final goods should be retained in order to satisfy demand for final goods in these countries. Hence, it appears that accounting for this issue by means of the two forms also used for import penetration (Section 4.3), does not – or negligibly, change the findings. For simplicity reasons, this work therefore decides to only present the basic method to compute the job impact of export expansion.

4.3. Quantifying the employment effect of increased Chinese import penetration

Concerning the import penetration effect, Feenstra and Sasahara (2017) provide evidence that replicating the steps in section 4.2 for Chinese import values leads to misleading results. They argue that simply replacing imports from China to country *S* – still The Czech Republic, with the levels in 2000 creates a counter-intuitive positive employment effect due to the fact that the production of country *S* is not adjusted. The intuition behind their argumentation is as following. If country *S* receives less imports from country *R* (assuming increased trade volumes in 2014 compared to 2000), country *R* simply receives too few deliveries of both final goods and intermediate inputs in order to meet final demand and to keep production function intact. As an alternative they come up with three functional forms to calculate both hypothetical demand to final good producers and intermediate input producers, where domestic production is also adjusted. The exact forms can be found in Appendix C on page 32. This section briefly describes the intuition behind the functional forms used in Feenstra and Sasahara (2017). Hence, it also shows why two of the three forms are less reliable and comes up with an alternative way of computing hypothetical final demand and intermediate inputs.

Similar to the computations of export expansion, the calculations of the import penetration effect in country *S* also distinguish between two scenarios. The first scenario only assumes that Chinese import penetration has changed the amount and structure of deliveries to final demand categories, whereas the second also accounts for changes in the ratios of intermediate inputs. As for both scenarios the same three functional forms are used, the intuition behind the formulas is similar too. Consider situation 1; the first form assumes that without the rise of China (country *C*), domestic production of final goods would be higher. More specifically, it presumes that the difference in imports of Chinese final goods from sector *i* flowing into The Czech Republic (country *S*) between 2000 and 2014 is fully taken over by increased domestic production of sector *i*. The second form assumes that without the rise of country *C,* the increase in domestic production of sector *i* in country *S* is proportionally increased to the actual increase in total final demand in country *S.* In determining the proportions of each of the domestic industries, this form assumes that the market share in country *S*´s domestic market remains constant at a 2000 level. The last form uses a similar calculation as the second functional form, but domestic market share of industry *i* in country *S* is – except for country *C*, now determined by taking 2014 levels of final good demand. Imports from country *C* remain constant in the share term. For all three forms, the same intuition applies to intermediate inputs in scenario 2.

Hence, taking a closer look at the three functional forms raises a concern regarding the perseverance of the production function, and final demand requirements under functional form 2 and 3. Functional form 1 clearly keeps this production function, and final good deliveries intact, where only the imports coming from country *C* are reallocated towards domestic production in country *S*. However, replicating forms 2 and 3 for country *S* shows that actual total final demand (and intermediate inputs) of country *S* in 2014 is lower than the adjusted total final demand (and intermediate inputs) (i.e. where deliveries by country *C* to country *S* are set to their 2000 level, and domestic production is adjusted according to either formula 2 or 3). This would indicate a rather unlikely scenario that total final demand of country *S* has increased as a consequence of fewer imports from China and increased domestic production. Instead, this thesis argues that total deliveries of final – and intermediate goods to country *S* should remain the same after the reallocation of final good production and therefore proposes proportional redistribution of the change in imports from *C* flowing to country *S* between 2000 and 2014 (i.e. as if country *C* has not experienced their rapid rise). In doing so, it assumes that if country *C* had not increased its deliveries of final goods (and intermediate inputs) to country *S,* both domestic production of country *S* as well as foreign deliveries to country *S* should increase based on their market share in 2014. By redistributing the so called "Chinese import gap" exactly based on the producers' market share, this approach circumvents the problem of different total demand and – in the case of intermediate inputs, unbalanced production processes.

In computing the employment effect of increased import penetration by country *C* in both situations, this thesis still follows the basic equations proposed by Feenstra and Sasahara (2017), which are

$$\widetilde{labour}^{IM1}_{2000,2014} = \boldsymbol{Q}_{2014}(\boldsymbol{I}-\boldsymbol{A}_{2014})^{-\mathbf{1}}\mathbf{Yu}_{2014} - \boldsymbol{Q}_{2014}(\boldsymbol{I}-\boldsymbol{A}_{2014})^{-\mathbf{1}}\widetilde{\mathbf{Y}}\mathbf{u}^{IM}_{2000,2014} \quad (14)$$

$$\widetilde{labour}^{IM2}_{2000,2014} = \boldsymbol{Q}_{2014}(\boldsymbol{I}-\boldsymbol{A}_{2014})^{-\mathbf{1}}\mathbf{Yu}_{2014} - \boldsymbol{Q}_{2014}(\boldsymbol{I}-\widetilde{\boldsymbol{A}}^{IM}_{2000,2014})^{-\mathbf{1}}\widetilde{\mathbf{Y}}\mathbf{u}^{IM}_{2000,2014} \quad (15)$$

for situation 1 and 2 respectively.

Instead of using the three functional forms proposed in Feenstra and Sasahara (2017), this thesis employs two forms, of which the first one replicates the first functional form performed by FS. Subsequently, the second form employs the above-mentioned technique of proportional redistribution of the change in Chinese imports by country *S,* both in terms of final demand and intermediate inputs. Both forms assume that imports from country *C* to country *S* are hold fixed at their 2000 level. In order to determine the hypothetical final good deliveries of industry *i* in country *S* (situation 1), the following two forms are executed:

Form 1: $\tilde{y}^{SS}_{i\,(2000,2014)} = y^{SS}_{i\,(2014)} + \left[y^{CS}_{i\,(2014)} - y^{CS}_{i\,(2000)}\right]$ (16)

Form 2: $\tilde{y}^{SS}_{i\,(2000,2014)} = y^{SS}_{i\,(2014)} + \left[\frac{y^{SS}_{i\,(2014)}}{\sum_{k\neq C}^{N} y^{kS}_{i\,(2014)}} \circ (y^{CS}_{i\,(2014)} - y^{CS}_{i\,(2000)})\right]$ (17)

Both forms include the term $y^{CS}_{i\,(2014)} - y^{CS}_{i\,(2000)}$, which is country *S'* change in imports of final goods from sector i in country *C* between 2000 and 2014. At the same time, it refers to the value of final goods from industry i in country *C* that needs to be redistributed either solely towards domestic production (form 1) or over all final good producers of all industries *i* other than those of country *C* (form 2).

The idea behind functional form 1 is relatively straight-forward. It assumes that if country *S'* imports of country *C* had not grown between 2000 and 2014, domestic production would have gone up by the exact amount of the change in imports. In doing so, final demand requirements in country *S* are still met, even though imports from country *C* have stagnated at their 2000 level. The first term on the right hand side denotes the actual final demand deliveries by industry *i* in country *S* to country *S* in 2014 and the second term shows the redistributed value that industry *i* in country *S* takes over from industry *i* in country *R*. However, based on logic thinking it still seems unlikely that if country *S* has not imported final goods from industry *i* in country *C,* the full amount would be produced by domestic industry *i*. A more reasonable alternative would be that country *S* – besides increasing domestic production, also starts to import from other countries *T*. Therefore, form 2 assumes that both industry *i* in country *S* and all industries *i* in all other countries *T* will take proportionally take over the redistributed value $(y^{CS}_{i\,(2014)} - y^{CS}_{i\,(2000)})$.

The first term on the right hand side of form 2 again refers to the actual final demand deliveries. The second term between brackets includes the portion of the final demand deliveries that should be added to the actual amount. The first term between brackets shows the size of final demand deliveries in industry *i* of country *S* to country *S* in 2014 relative to the sum of final demand deliveries of all industries *i* in all countries except for China. This proportion determines the share of the total redistributed value that is taken over by industry *i* in country *S* delivering to country *S.* These steps are replicated for all industries in all countries other than China that deliver to the final demand categories in country *S*. These new final demand values for all industries in countries *S* and *T* together with the fixed 2000 levels of imports from China to country *S* eventually create the hypothetical final demand matrix $\widetilde{\mathbf{Y}}\mathbf{u}^{IM}_{2000,2014}$.

For both forms, hypothetical employment as well as the actual employment effect of Chinese import penetration can be calculated.

Subsequently, scenario 2 creates a hypothetical input-output structure in a similar way. The first step is again to replace the elements in submatrix $\boldsymbol{A}^{RS}_{2014}$ for the associated elements in $\boldsymbol{A}^{RS}_{2000}$. Then, to determine hypothetical intermediate input deliveries of industry *i* in country *S* used to produce one unit of gross output in industry *j* of country *S*, the same calculations as used for final goods are made:

$$\textbf{Form 1: } \tilde{a}^{SS}_{ij\,(2000,2014)} = a^{SS}_{ij\,(2014)} + \left[a^{CS}_{ij\,(2014)} - a^{CS}_{ij\,(2000)}\right] \qquad (18)$$

$$\textbf{Form 2: } \tilde{a}^{SS}_{ij\,(2000,2014)} = a^{SS}_{ij\,(2014)} + \left[\frac{a^{SS}_{ij\,(2014)}}{\sum_{k\neq C}^{N} a^{kS}_{ij\,(2014)}} \circ \left(a^{CS}_{ij\,(2014)} - a^{CS}_{ij\,(2000)}\right)\right] \qquad (19)$$

The intuition behind both forms is similar to the intuition related to final goods. With respect to form 1, these steps are replicated for all industries in country S delivering to all domestic industries, eventually creating the hypothetical input-output matrix $\widetilde{\boldsymbol{A}}^{IM}_{2000,2014}$. Form 2 also adjusts the intermediate input ratios for all industries in countries S and T in order to obtain $\widetilde{\boldsymbol{A}}^{IM}_{2000,2014}$.

Finally, for each of the forms, both hypothetical employment and the actual employment effect of Chinse import penetration can be computed.

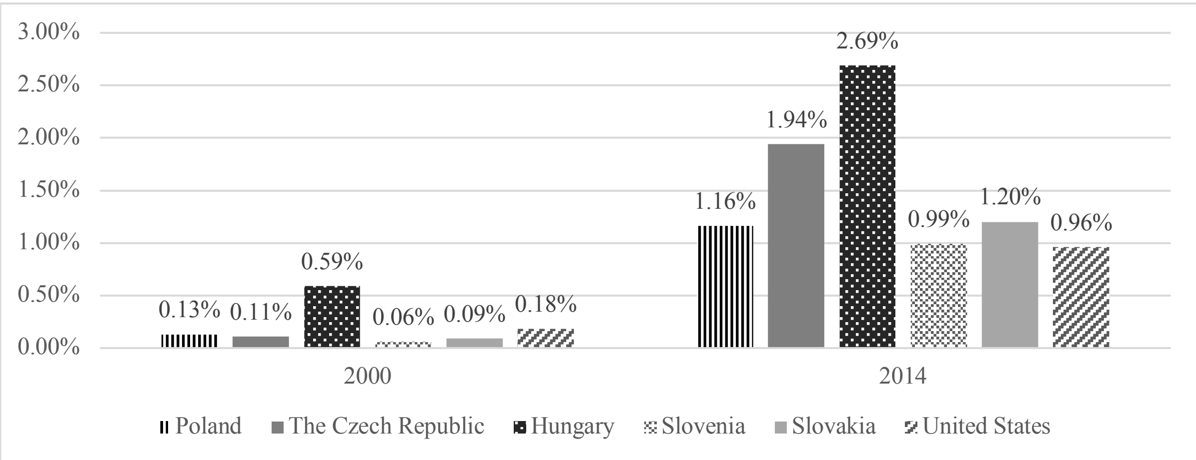
5. Results

This section presents the main results from the empirical analysis. Section 5.1 compares the Chinese import shares in Central Europe to those in the US in order to roughly predict the magnitude of the employment effect of increased bilateral trade with China for Central European economies. Section 5.2 provides results on the net employment effect of increased China-CE trade between 2000 and 2014, where after section 5.3 and 5.4 shed light on the export and import effects respectively.

5.1. Chinese imports in Central Europe versus United States

Figure 2 displays the shares of Chinese intermediate goods imports in total intermediate consumption in Central European economies and the US in both 2000 and 2014. It can be seen that in 2000 the shares of Chinese imports in intermediate consumption are tiny in Central European countries as well as in the US. Despite the very small shares, Hungary appears to be the biggest absorber of Chinese imports in their production of intermediate inputs, where after the US follows. Slovakia and Slovenia show the smallest shares of Chinese imports.

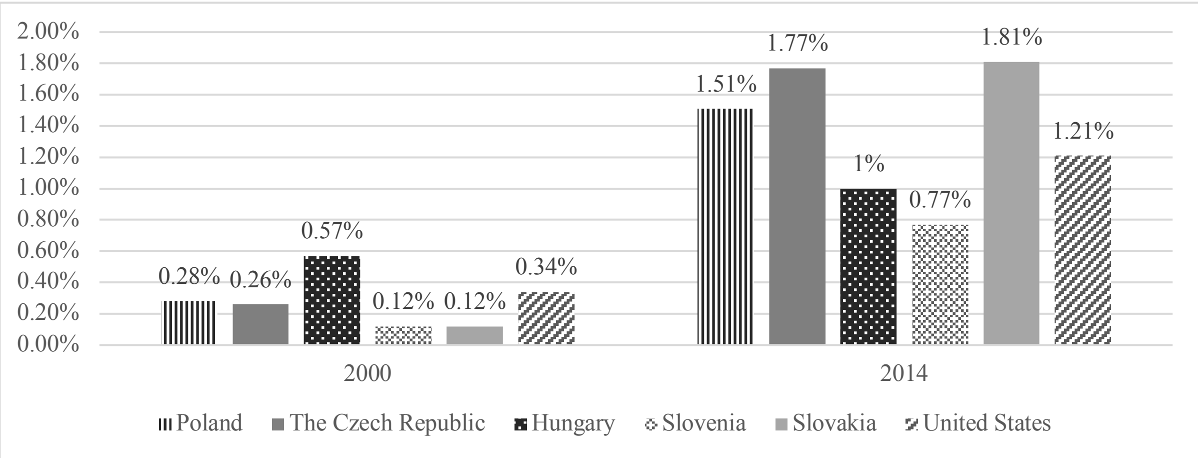
Figure 2: Share of Chinese imports in Central European and US intermediate consumption, 2000-2014 (% of total intermediate consumption)



Note. Author's own calculations based on the World Input-Output Database (2016 release). A detailed overview of the absolute volumes of Chinese intermediate goods imports and total intermediate consumption in Central Europe and the US can be found in Tables D1, D2 and D3.

Similarly, Figure 3 presents these shares for final good consumption. In 2000, the same pattern occurs, where Hungary is the biggest importer of Chinese imports, followed by the US.

Figure 3: Share of Chinese imports in Central European and US in final good consumption, 2000-2014 (% of total final demand)



Note. Author's own calculations based on the World Input-Output Database (2016 release). A detailed overview of the absolute volumes of Chinese final good imports and total final demand consumption in Central Europe and the US can be found in Tables D1, D2 and D3.

Subsequently, looking at the shares in 2014 in Figure 2 and 3 reveals that Chinese imports hugely increased their role in both production processes and in order to fulfill final demand in all Central European countries. Over all five countries, the average growth in the share of Chinese imports in intermediate consumption amounts to 1119%, The Czech Republic undergoing the biggest increase. With respect to final goods, the average growth in the share of Chinese imports totals up to 609%, where Slovenia shows the biggest increase over time. Exact growth percentages per country can be found in Table D4. Comparing the Chinese import shares in Central Europe to those in the US in 2014 tells us an interesting story. By 2014, all Central European countries have surpassed the US in terms of its share of Chinese imports used in production processes and in order to fulfil final demand. This is pretty impressive since by 2000, except for Hungary, the US was a relatively larger importer of both Chinese intermediates and final goods.

This work has furthermore performed an additional analysis focusing on the manufacturing industry alone. A reasonable expectation is that the shares of manufactured Chinese imports in both total manufactured inputs and final goods would be even larger, as the majority of the services can only be delivered locally (i.e. due to legislations (Timmer et al. 2016) or the fact that they require face-to-face interaction between workers and customers (Autor and Dorn, 2013)) and China as well as Central European economies have a comparative advantage in manufactured goods. Table D5 and D6 in the Appendix show the results for 2000 and 2014 respectively, which indeed confirm that the manufacturing sectors of Central European countries use an even bigger share of Chinese imports in their production processes and in order to fulfil final demand. This makes it realistic to expect even stronger employment effects from Chinese trade in Central Europe (in relation to the size of the economies) than was found in previous work for the US (Feenstra and Sasahara, 2017).

5.2. Net employment effect of trade expansion

This section brings us over to the issue of the employment effect from trade with China for each of the Central European economies. In doing so, it compares the (positive) employment effects of Central European export expansion to China to the (negative) employment effects of Chinese import penetration between 2000 and 2014. Subsection 5.2.2 outlines the net results of these counteracting factors, when assuming full import substitution, after which subsection 5.2.3 displays the results under the more realistic assumption of a proportional redistribution of the lost Chinese imports among all the relevant trading partners.

5.2.2. Assuming full import substitution

Figure 4 shows the net employment changes relative to the total employment levels in 2000, while assuming full import substitution. The exact percentages, as well as the net absolute changes in employment can be found in Table D7.

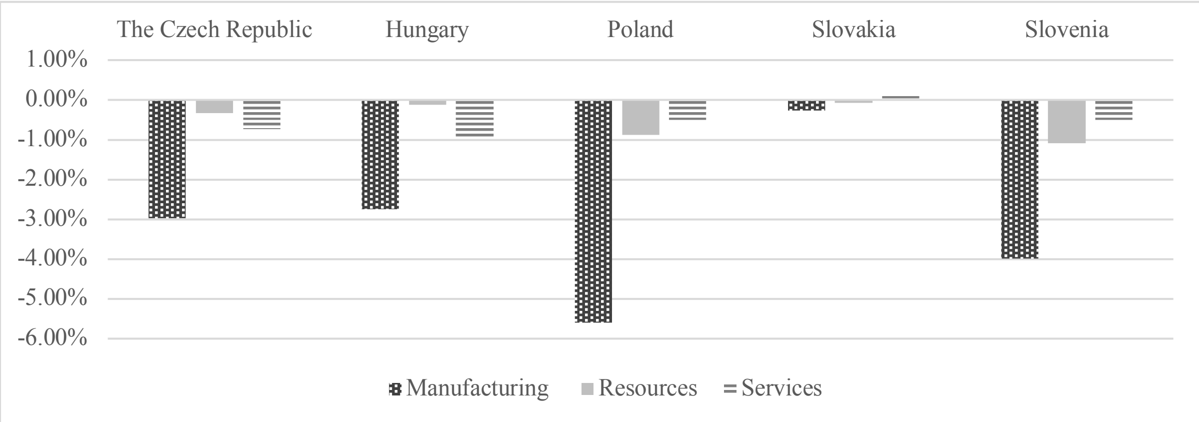
Figure 4: Net Employment Effects while assuming full import substitution, 2000-2014 (relative to total employment in 2000)

Note. Author's own calculations (for equations (10), (15), (16) and (18)) based on the World Input-Output Database (2016 release).

These findings show that all Central European countries, except for Slovakia, experience a relative decline in employment levels as a consequence of increased trade in final – and intermediate goods with China. Poland and Slovenia face the biggest relative level of job displacement, whereas Slovakia shows a small relative increase in labour demand. Furthermore, it can be seen that changes in trade in intermediate inputs is relatively dominant in explaining the total employment effect in The Czech Republic, Hungary and in a modest way also in Slovakia. In Poland and Slovenia on the contrary, it is the adjusted volume of final good trade with China that primarily causes job displacement.

Besides the cross-country differences in employment effects, this work is furthermore interested in the divergent impact across sectors.[9] Therefore, Figure 5 outlines the net employment effects in the manufacturing, natural resources and services sectors for each of the five Central European countries[10]. Again, for a more detailed overview of both relative and absolute net employment effects, please consult Table D7. From Figure 5, it can be derived that all sectors in all countries, except for the services sector in Slovakia, experience a decline in demand for jobs. Also, in all countries, manufacturing employment is hit harder than natural resources – and services employment, of which Poland and Slovenia are showing the biggest decline in jobs relative to the total amount of jobs in 2000. Concerning the natural resources – and services jobs, it can be seen that Poland, Slovakia and Slovenia face a bigger relative job displacement in the natural resources sector than the services sector, whereas it is the other way around for The Czech Republic and Hungary.

Figure 5: Net Employment Effect per sector, while assuming full import substitution, 2000-2014 (relative to total employment in 2000)



Note. Author's own calculations (for equations (10), (12), (15), (16) and (18)) based on the World Input-Output Database (2016 release).

5.5.3. Assuming proportional redistribution

Obviously, it is not a very realistic assumption that in the absence of trade with China, the Central European countries would produce these goods themselves. Rather it is realistic that they would replace some of it with domestic consumption and the rest with imports from other trading partners. Figure 6 outlines the net employment effects relative to the total employment levels in 2000, under the assumption of proportional redistribution of the absent Chinese trade. Now, the exact percentages together with the absolute changes in net employment levels can be found in Table D8.

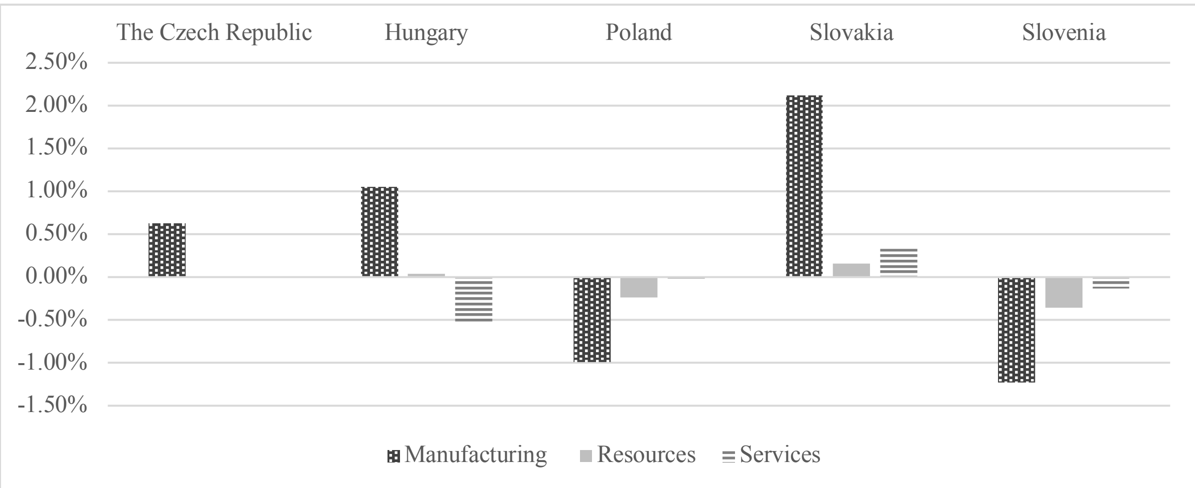
[9] An overview of which WIOD sectors belong to each of the three sectoral groups can be found in Table B1.
[10] In doing so, it accounts for adjusted trade in final goods as well as intermediate goods.

Figure 6: Net Employment Effects, while assuming proportional redistribution, 2000-2014 (relative to total employment in 2000)

Note. Author's own calculations (for equations (10), (15), (17) and (19)) based on the World Input-Output Database (2016 release).

Assuming proportional redistribution of Chinese imports creates slightly different net employment effects than assuming full import substitution (Figure 4). Overall, it can be seen that the net employment impact of increased trade with China is now more heterogeneous across the Central European countries. The Czech Republic and Slovakia are able to offset the reduction in employment due to Chinese import penetration by increased labour demand, due to export growth towards China. On the contrary, Slovenia, Poland and Hungary still experience negative net employment effects due to increased bilateral trade with China. Hence, concerning Hungary, results show that job gains through increased exports of final goods to China exceed job losses caused by increased import penetration of Chinese final goods, thereby creating a positive net employment effect. However, this effect remains no longer positive when one accounts for trade in intermediates too.

Figure 7: Net Employment Effect per sector, while assuming proportional redistribution, 2000-2014 (relative to total employment in 2000)



Note. Author's own calculations (for equations (10), (12), (15), (17) and (19)) based on the World Input-Output Database (2016 release).

Figure 7 shows which sectors have benefitted from the surge in bilateral trade with China and which sectors got harmed by it, for each country. A couple of remarkable results stand out. First of all, it appears that the manufacturing sector is still the most reactive sector in terms of net employment effects. Meanwhile, the net impact on natural resources jobs is non-existing or negligible for The Czech Republic and Hungary respectively. The same holds for job changes in the services sector in Poland and Slovenia. Second, it can be seen that manufacturing employment in Central Europe is very differently affected by increased trade with China, where in The Czech Republic, Hungary and Slovakia, the gains in manufacturing jobs due to export growth to China are large enough to offset the lost jobs caused by Chinese import penetration. On the contrary, these gains are insufficient in the Polish and Slovene manufacturing sectors.

In order to create a better understanding of the net results, section 5.3 and 5.4 consider the separate labour market effects of export expansion and import penetration respectively.

5.3. Employment effect of export expansion

This section briefly summarizes the effect of Central European export expansion to China between 2000 and 2014 for each of the five Central European countries. Results are displayed in Figure 8 and 9, and in greater detail in Table D9. Besides the relative change, this table also displays the absolute employment effects.

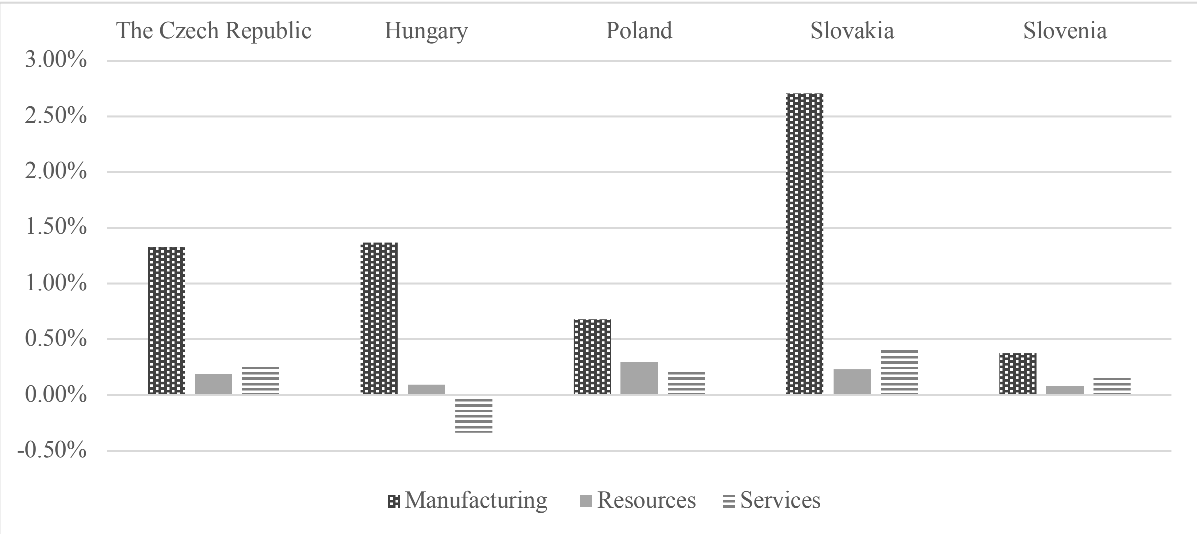
Figure 8: Employment Effect of Export Expansion, 2000-2014 (relative to total employment in 2000)

Note. Author's own calculations (for equations (8)-(11)) based on the World Input-Output Database (2016 release).

First of all, it appears that surged exports to China have increased aggregate labour demand in all Central European countries. Slovakia and The Czech Republic show the biggest increase in jobs relative to their employment levels in 2000 (0.99% and 0.58%), whereas Hungary benefits the least in terms of employment gains (0.14%). Hence, it appears that Hungary's total employment effect is substantially affected by the unexpected negative employment effect in the services industry, which can be seen in Figure 9 and will be explained in greater detail in section 6. With respect to the absolute change in employment levels, Table D9 shows that for example in Slovakia, the increase in final goods exports to China adds demand for 10,630 manufacturing jobs, 110 resource jobs and 3,810 services jobs, summing up to a total of 14,550 jobs, which is 0.80% of total employment in 2000. Accounting for increased intermediate input deliveries to China, increased labour demand becomes 12,440, 300 and 5,140 in respectively the manufacturing, resource and services sector. In total, increased exports to China have led to a total demand creation of 17,880 in Slovakia, which was 0.99% of its employment level in 2000 (Figure 8).

Considering the job impact of export growth across sectors, it can be seen that in all countries, the manufacturing sector experiences the biggest increase in labour demand relative to total manufacturing employment in 2000 (Figure 9). Relative to manufacturing employment levels in 2000, Slovakia shows the biggest employment gains, of which 2.31% is due to increased final good exports and 2.71% due to both final- and intermediate good exports (Table D9). The manufacturing sectors in Poland and Slovenia gain considerably less. Finally, with respect to the other sectors, it can be seen that, except for Poland, services jobs seem more reactive to export growth to China than resource jobs.

Figure 9: Employment Effect of Export Expansion per sector, 2000-2014 (relative to total employment in 2000)



Note. Author's own calculations (for equations (8)-(12)) based on the World Input-Output Database (2016 release).

To wrap up, the results on the employment impact of export expansion show that all sectors in all Central European countries gain from increased exports of final goods and intermediate inputs to China between 2000 and 2014 (except for the services sector in Hungary). Slovakia and The Czech Republic show the biggest relative gains, whereas Hungary's total employment gains remain very moderate. Most of the jobs are created in the manufacturing sectors, whereas the services and resource sector show significantly smaller increases, and in Hungary even a slight decrease.

5.4. Employment effect of Chinese import penetration

After assessing the job-creating effect of export expansion, this section presents the main results on the employment effects of imports from China using the two forms given in section 4.3.

5.4.1. Assuming full import substitution

The results from estimating the employment effect of import penetration under the assumption of full import substitution are presented in Figure 10 and 11, and more extensively outlined in Table D10. Again, this table presents the absolute changes in job demand per sector per country.

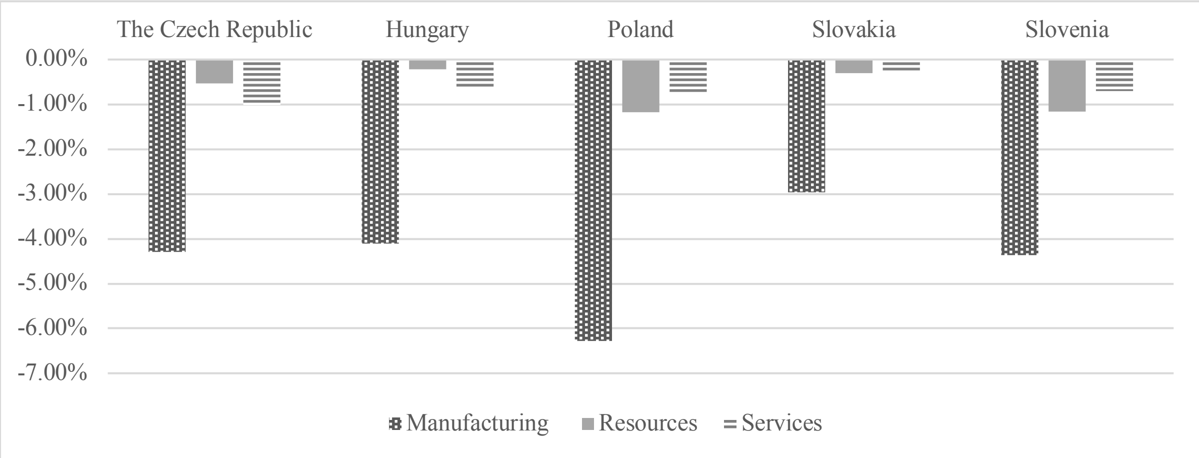
Concerning the aggregate employment effect displayed in Figure 10, it can be derived that all Central European countries have lost jobs due to increased imports from China between 2000 and 2014. Remind that this scenario assumes higher domestic production, and consequently higher job demand in the hypothetical world than in the actual world. Eventually, this causes the negative employment effects displayed in Figure 10 and Table D10. Relative to the employment levels in 2000, Poland shows the biggest reduction in labour demand (-2.17%). This means that if Poland had not imported both final and intermediate goods from China, it would have saved 2.17% of jobs, or in absolute numbers 229,710 jobs in total (see Table D10). Slovakia on the contrary faces the least profound employment effects relative to their 2000 employment levels (-0.96%). Furthermore, Figure 10 shows that job displacement in The Czech Republic, Hungary and Slovakia is for the bigger part caused by increased imports of Chinese intermediates, and less by increased imports of Chinese final goods. In Poland and Slovenia however, it is the adjusted volume of final good trade with China that primarily causes job displacement.

Figure 10: Employment Effect of Import Penetration, while assuming full import substitution, 2000-2014 (relative to total employment in 2000)

Note. Author's own calculations (for equations (14), (15), (16) and (18)) based on the World Input-Output Database (2016 release).

At a sectoral level, Figure 11 shows that in all countries, the manufacturing sectors show bigger declines in labour demand than the resource and services sectors. Poland loses most manufacturing jobs relative to its total in 2000 (-6.27%), which can then explain the big drop in aggregate labour demand shown in Figure 10. Slovakia experiences the least severe job reduction, although this reduction still amounts 2.97% of total manufacturing employment in 2000. Digging deeper into Table D10 tells us that Chinese imports of final goods have a substantial labour reducing effect in the Central European manufacturing industry, but that Chinese imports of intermediate goods is by far the biggest destructor of employment. This reasoning also holds for the resource and services sector, however in a less powerful way.

Figure 11: Employment Effect of Import Penetration per sector, while assuming full import substitution, 2000-2014 (relative to total employment in 2000)



Note. Author's own calculations (for equations (12), (14), (15), (16) and (18)) based on the World Input-Output Database (2016 release).

5.4.2. Assuming proportional redistribution

Finally, Figure 12 and 13 present respectively the aggregate and sectoral labour demand effect of import penetration under the assumption of proportional redistribution of the "Chinese import gap". The detailed relative as well as absolute effects can be found in Table D11.

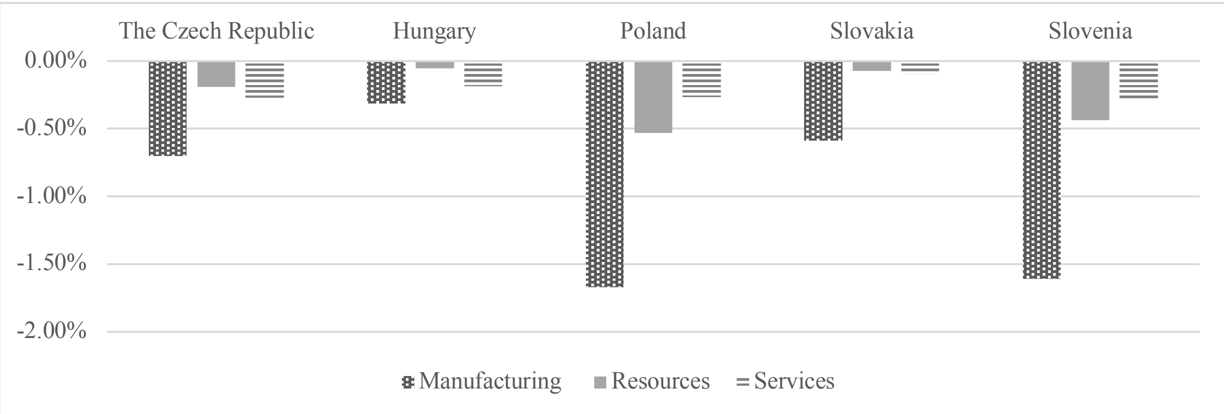
Figure 12: Employment Effect of Import Penetration, while assuming proportional redistribution, 2000-2014 (relative to total employment in 2000)

Note. Author's own calculations (for equations (14), (15), (17) and (19)) based on the World Input-Output Database (2016 release).

First of all, it shows that the country-specific aggregate employment impact of Chinese import penetration is still negative, however less compelling than with full import substitution. Under this assumption, Slovenia faces the biggest job reduction of 0.71% relative to its 2000 level, whereas with full import substitution, Poland faces a job displacement of 2.17%. At the same time, this tells us that Poland is no longer the country that faces the biggest relative decline in employment levels, but that its position is taken over by Slovenia who experience a decline of 5,220 jobs, amounting to 0.71% of their employment level in 2000.

Similar to the aggregate effect, the sectoral impact is still negative but less profound than for our full import substitution scenario. The manufacturing sector still loses the most jobs, where Poland and Slovenia are being the biggest losers with 44,700 (1.67%) and 3,760 lost jobs (1.61%).

Figure 13: Employment Effect of Import Penetration per sector, while assuming proportional redistribution, 2000-2014 (relative to total employment in 2000)



Note. Author's own calculations (for equations (12), (14), (15), (17) and (19)) based on the World Input-Output Database (2016 release).

To conclude, Figures 10-13 indicate that Chinese import penetration leads to reduced labour demand in all sectors in all Central European countries (except for the services sector in Hungary). Hence, the magnitude of the results on import penetration are sensitive to the assumed functional form, where assuming full import substitution in the hypothetical world leads to bigger employment losses than assuming proportional redistribution.

6. Discussion

Considerable attention is devoted to the negative impact of trade with China, particularly projecting its job-destructing effect in the manufacturing sector. However, from Feenstra and Sasahara (2017) we know that these findings only present one side of the story and fail to underscore the dual role of trade with China in terms of employment. They rightly stress the importance of the "net-effect", where in assessing the final employment impact of the rise of China one should consider simultaneously the import and export effect. Focusing on Central

Europe between 2000 and 2014, this work employs an input-output analysis to quantify the employment impact of increased bilateral trade with China. In doing so, it follows Feenstra and Sasahara (2017) by distinguishing between an export expansion- and import penetration effect.

Before delving straight into the interpretation of the results, it should be noticed that the net impact on jobs is evidently sensitive to the assumptions made, where the net effects are more detrimental under the assumption of full import substitution (form 1) than when assuming proportional redistribution. Full import substitution in the hypothetical world leads to a net job-destructing effect in all Central European countries, except for Slovakia, whereas assuming proportional redistribution creates more heterogeneous, but less compelling effects. Here The Czech Republic, and Slovakia benefit from increased bilateral trade with China, whereas Hungary, Poland and Slovenia get harmed in terms of employment numbers. The difference in net effects between both assumptions can be fully explained by the assumptions made with respect to the import penetration effect. Central European countries have "more to lose" under the assumption of full import substitution, as it assumes that without the rise of China, the redistributed amount will be completely added to its domestic production, thereby leading to a substantial increase in labour demand. Compared to the actual situation, Central European countries have therefore more to lose than with proportional redistribution, where domestic production takes over only a proportion of the production, and the rest is satisfied with imports from other countries. This leads to a smaller increase in the demand for jobs, and therefore "less to lose" compared to the actual situation. Hence, from Dean et al. (2011), we know that globalization has led to an increase in vertical specialization and fragmentation of the global value chain. This makes the assumption of proportional redistribution more plausible than fully reallocating production to domestic Central European industries. Therefore, the interpretation of the results will be based on the assumption that the "Chinese import gap" will be proportionally redistributed. In this case, The Czech Republic and Slovakia are net gainers of increased bilateral trade with China, whereas Hungary, Poland and Slovenia lose out in terms of employment.

Three main insights can be withdrawn from the findings on the net job impact. First of all, the net impact is relatively small across all countries. Most likely this is caused by the fact that the rise of intra-industry trade in Central European countries have offered new export opportunities, thereby offsetting the employment losses due to import penetration (Dauth et al. 2014). Second, results show that the total net employment effect is particularly driven by changed trade volumes of final goods, instead of trade in intermediate inputs (Figure 6). This result contrasts with the findings by Johnson and Noguera (2012), who state that trade in intermediate inputs takes a larger share in total trade, and is consequently expected to play a larger role in explaining the total impact of a trade shock. To find an alternative explanation, the next subsections dig into the separate effects of export expansion and import competition. Finally, we see that the net impact on jobs is relatively heterogeneous across countries, which confirms the predictions made by Los (personal communication, 22 December 2017) that within Central Europe there exists substantial heterogeneity in the level of resistance to trade shocks. Hence, instead of The Czech Republic and Hungary, it is The Czech Republic and Slovakia that are mostly able to remain their competitive power during the rise of China. On the contrary, Poland, Slovenia and in a less profound way also Hungary, are unable to offset the reduction in employment due to import penetration by increased labour demand due to export growth. Delving deeper into the separate effects, will furthermore provide understanding on the causes of this substantial heterogeneity.

6.1. Reaping the benefits from export expansion

Concerning the job impact of export growth, this study finds that the differences in a country's level of responsiveness to demand shocks can be explained by two factors, which are export openness and industry specialization. With respect to export openness, data exploration shows that The Czech Republic and Slovakia have a relatively high level of openness to trade (Table A.3-A.5). From Faruggia (2004), and the UNDP (2011) we know that higher degrees of economic openness infer that a country is more vulnerable to external economic conditions, due to fluctuations in either export earnings or availability and costs of imports. This explains why The Czech Republic and Slovakia experience the effects of export expansion more severely than the rest of the economies. Poland, on the other hand, is less open to trade (with China), which causes its employment levels to be less vulnerable to changing export volumes to China. Hungary derogates from the expectations, as the country is relatively open, but shows lower than expected job gains due to export expansion. Digging into the sector specific changes in employment shows that this is particularly driven by a large decrease in employment in the services sector, more specifically in the "other service activities". The reason why this sector shows a negative employment effect, is due to the fact that its exports of intermediate inputs to China have decreased instead of increased between 2000 and 2014, thereby automatically leading to a decrease in employment. Most likely, the country has intensified its advantage in manufacturing and at the same time shifted away from services activities. This coincides with findings by Xin (2012), who state that manufacturing exports have largely shaped the country's overall export pattern.

A second factor that provides insights on a country's level of responsiveness to export expansion is its industry specialization, where results show that the manufacturing sectors appear to be more sensitive to export changes than the services – and natural resources sectors. This result confirms the general belief in the literature that the direct consequences of a trade shock, in this case a demand shock, are particularly felt in the manufacturing industries (Feenstra and Sasahara, 2017; Dauth et al. 2014b). These industries are highly export-oriented and therefore get a substantial boost to output growth (Dauth et al. 2014b; Kasahara and Rodrigue, 2008). Results show that the manufacturing sectors in Slovakia, Hungary and The Czech Republic have experienced the biggest relative gains in employment levels. This can be explained by the fact that their manufacturing industries are more open to trade with China, and integrated in the global value chains than the manufacturing industries in Poland and Slovenia. The latter countries are in general less open to trade (Table A3-A5) and have experienced subtler increases in exports towards China between 2000 and 2014. Eventually, this has led to rather modest increases in employment levels.

As a final note, Figure 8 displays the job impact of changed exports of final goods as well as the employment change due to changed exports of both final – and intermediate goods. The difference between the two measures the contribution of increased trade in intermediates. In Poland and Hungary, total employment change is to a larger share driven by increased exports of intermediates, which may be explained by the large copper exports, and exports of vehicle parts respectively. The Czech Republic, Slovakia and Slovenia mainly gain jobs due to increased exports of final goods, most likely by exports of machinery, vehicles and electrical equipment respectively (Trade Economics, 2018).

6.2. The labour market threats of increased Chinese import competition

In order to fully understand the cross-country differences in net employment effects, one should also consider the other side of the story, which is the divergent job impact of Chinese import penetration. In this case, there are three main indicators that help to explain why certain countries are hit harder by supply shocks than others, which are a country's level of import openness towards China, its initial domestic trade volumes and its industry specialization.

First of all, this work argues that, contrary to the export openness hypothesis, substantial declines in relative employment levels cannot be explained by a country's high level of import openness towards China. Poland and Slovenia for example show the biggest relative declines in jobs (Figure 12), but are at the same time among the least-open countries (Figure 2 and 3). Additionally, The Czech Republic has a relatively high level of Chinese import dependency, but experiences only modest relative decreases in its labour demand. These findings basically point to an adverse relationship, where countries that are least dependent on imports from China face the biggest reductions is employment relative to their 2000 levels. Although this finding seems counter-intuitive, this work suggests that it can be explained by the emergence of Global Value Chains (GVCs). From Baldwin and Lopez-Gonzalez (2015) and Johnson and Noguera (2012) we know that the emergence of GVCs has hugely transformed the existing patterns of trade, where production processes have become more fragmentated, and the share of intermediate input trade in total trade has surged. A clarification for this finding can therefore be found in the input-output linkages, which directly leads to the second indicator to address a country's vulnerability to supply shocks.

This indicator, argues that a country's vulnerability to supply shocks is dependent on its intermediate trade linkages (Johnson and Noguera, 2012), and more specifically its initial domestic trade volumes. As a consequence of stagnated Chinese imports, the production structure and final demand production in *all* countries that deliver to Central Europe change. In reallocating the redistributed value, sectors that already used to supply a relatively great volume of intermediates or final goods, take over more of the redistributed value than the sectors, which initial deliveries to the Central European country were more marginal. A likely explanation for the fact that Slovenia and Poland see their employment levels decline severely can be found in the fact that both countries are more closed to trade, and therefore take over a substantial part of the redistributed value in the hypothetical world. Eventually, this creates higher levels of employment in the hypothetical situation, and subsequently a bigger gap between the actual and hypothetical situation. In the end, this causes the employment effect for these countries to be heavier than for countries that already imported larger volumes.

Finally, in every country it is again the manufacturing sector that is more reactive to import penetration than non-manufacturing industries. A recurring explanation is that manufacturing sectors are highly susceptible to supply shocks, as they face severe competition from the larger variety of often cheaper Chinese imports (Autor et al. 2013). In the case of China-Central European trade, this effect may even be reinforced by the fact that price-levels and wages in China and Central Europe are more comparable than Chinese and US levels. The tight price competition in the manufacturing sectors creates even larger substitutability of products (Fu et al. 2012). Hence, as expected by Acemoglu et al. (2016), a decrease in the imports of Chinese manufactured goods, will also have a negative trickle-down effect on all input suppliers to that industry. This explains why, besides the direct consequences for the manufacturing industry, also the resource and services sector get harmed by import penetration. The uneven sectoral distribution, where manufacturing is hit the hardest, and the resource industry shows relatively marginal changes in employment levels, furthermore coincides with the findings by Feenstra and Sasahara (2017) for the US.

Again as a final remark, the overall effect of import competition is only in Slovenia triggered by adjusted imports of final goods, whereas in the rest of Central Europe the contribution is balanced, or dominated by changed imports of intermediate inputs. Contrary to the findings on export expansion, this finding supports the literature on the emergence of GVCs, and the increasing amount and power of trade in intermediates (Baldwin and Lopez-Gonzalez, 2015; Johson and Noguera, 2012).

7. Conclusion

Increased international trade and its impact on the labour market has become an increasingly debated topic in the US and around the world. Whereas Trump supporters largely invoke the Autor studies, that devote a strong focus to the job-reducing effect of increased Chinese import penetration in the US, the job-creating effect of increased exports has much been neglected. Contrary to the protectionistic voices heard in the US, Central Europe seems to be more welcoming towards Chinese interference in the region, where the Polish government describes the closer ties with Beijing as a "tremendous opportunity", and Hungary officially declares "high levels of mutual trust" (Financial Times, 2017). Applying an input-output analysis, this study quantifies the employment effect of the China shock on Central European countries between 2000 and 2014. In doing so, it views trade with China as a 'two-way' street and therefore accounts for the employment effects of increased Chinese import competition as well as export expansion. Results show that increased bilateral trade with China between 2000 and 2014, has a heterogeneous impact across Central European countries, where The Czech Republic and Slovakia see a net rise in employment levels, whereas Hungary, Poland and Slovenia experience a net demand reduction in jobs.

Heterogeneity across Central European countries, is on the export-side caused by the fact that countries that are more dependent on exports to China and are specialized in the manufacturing sector will benefit more from export expansion than countries that are closed to trade and specialized in the resources or services sectors. On the import-side, heterogeneity is caused by the fact that countries differ in terms of import-openness to China, initial domestic trade volumes and industry structures. Countries that are less open to trade, have larger initial domestic trade deliveries, and specialize in the manufacturing sector will be disproportionally hit by a supply shock, such as Chinese import competition. In the end, the large degrees of export openness in The Czech Republic and Slovakia have caused a sufficient surge in labour demand enough to offset the losses due to import penetration. On the contrary, the closed economies of Poland and Slovenia are unable to benefit from export expansion, and at the same time are hit severely by Chinese import penetration.

Although the research has reached its aims, it is also aware of its limitations. One of the biggest limitations of this study is that it does not account for one of the most important negative effects of the rise of China, which is the fact that China has most likely substituted a large share of Central European exports to for example Germany and other countries (Dauth et al., 2014a). This means that the rise of China as the "Factory of the World" has contracted the importance of Central Europe as the "Factory of Europe". The second and third limitations concern the static feature of the employed input-output method. The input-output analysis calculates the employment effects from the demand side of the labour market, and does not account for labour market clearing, due to changed wages. In order to capture dynamic labour market effects, this work could have incorporated the input-output tables into a computable model with frictional labour market clearing, as performed by Caliendo et al. (2015). Building such a model would have considerably reduced the amount of assumptions made in this work. Furthermore, in order to compute the impact of changing trade volumes on employment, this work uses the actual changes in trade flows, which incorporates all changes from all causes, such as tariff changes, demand shifts and so on. This limitation could be addressed in future research by using an instrumental variable similar to Autor et al. (2013). They use Chinese exports to eight other countries to instrument for Chinese exports to the US. A final limitation touches on the fact that the employment results are expressed in numbers of employees. As this means changing working hours per employee are not accounted for, this work assumes that hours worked per employee do not change in the interpretation of the results.

For future research, this work proposes a decomposition of the employment effects of export expansion and import penetration, where the different principle contributors, such as tariff – and policy changes and so on, that drive changes in trade flows can be isolated. Furthermore, a rational suggestion for further research would be to extent the analysis by assessing the impact of the China shock on job – and wage polarization in Central Europe. Are low-skill workers hit harder than high-skill workers? And how has the rise of China adjusted the wage distribution in Central European countries?

Bibliography

Acemoglu, D., Autor, D.H., Dorn, D., Hanson, G.H., & Price, B. (2016). Import Competition and the Great US Employment Sag of the 2000s, *Journal of Labor Economics,* vol. 34, no 1, pp. 141-198.

Alder, S., Shao, L., & Zilibotti, F. (2013). The Effect of Economic Reform and Industrial Policy in a Panel of Chinese Cities, CEPR Discussion Paper No. 9748.

Allard, C. (2009). Competitiveness in Central-Europe: What has happened since EU accession?, International Monetary Fund working paper, Available Online: https://www.imf.org/external/pubs/ft/wp/2009/wp09121.pdf [Accessed 23 Apr. 2018].

Amiti, M., and Freund C. (2010). The anatomy of China's export growth. China's growing role in world trade, University of Chicago Press: 35-56.

Amiti, M., & Konings J. (2007). Trade liberalization, intermediate inputs, and productivity: Evidence from Indonesia. *American Economic Review*, vol. 97, no. 5, pp. 1611-1638.

Autor, D.H. & Hanson, G.H. (2013). The Growth of Low-Skill Service Jobs and the Polarization of the US Labor Market. *American Economic Review*, vol. 103, no. 5, pp. 553–1597.

Autor, D.H., Dorn, D., & Hanson G.H. (2013), The China Syndrome: Local Labor Market Effects of Import Competition in the United States, *American Economic Review*, vol. 103, no. 6, pp. 2121-2168.

Autor, D.H., Dorn, D., & Hanson G.H. (2016). The China Shock: Learning from Labor Market Adjustment to Large Changes in Trade, *Annual Review of Economics*, no. 8, pp. 205-240.

Baldwin, R. (2012). Trade and Industrialisation after Globalisation's Second Unbundling: How building and joining a supply chain are different and why it matters, in: R. Feenstra and A. Taylor (eds) *Globalization in an age of crisis: Multilateral Economic Cooperation in the Twenty-First Century,* chapter 5.

Baldwin, R. & Lopez-Gonzalez, J. (2015). Supply-chain Trade: A portrait of global patterns and several testable hypotheses, *The World Economy,* vol. 38, no. 11, pp. 1682-1721.

Balassa, B. (1966). Tariff reductions and trade in manufactures among the industrial countries, *American Economic Review*, vol. 56, pp. 466–473.

Brandt, L., van Biesbroeck, J., & Zhang, Y. (2012). Creative accounting or creative destruction? Firm-level productivity growth in Chinese manufacturing, *Journal of Development Economics*, vol. 97, no. 2, pp. 339-351.

Caliendo, L., Dvorkin, M., & Parro, F. (2015). Trade and Labor Market Dynamics: General equilibrium analysis of the China trade shock, Working paper 2015-9, Federal Reserve Bank of St. Louis.

Campbell, D. L., & Lusher, L. (2015). Adverse Trade Shocks and Inequality in American Manufacturing, working paper, Available online: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.704.4335&rep=rep1&type=pdf [Accessed 23 Apr. 2018].

Crabbé, K., & Beine, M. (2005). Trade integration and industrial specialization in Central Europe, Proceedings of ETSG seventh Annual Conference, 8-10 September 2005 (online), University College Dublin.

Dauth W., Findeisen, S., & Suedekum, J. (2014a). The Rise of the East and the Far East: German labor markets and trade integration. Journal of European Economic Association, vol. 12, no. 6, pp. 1643-1675.

Dauth, W., Findeisen, S., & Suedekum, J. (2014b). Trade and manufacturing jobs in Germany, *American Economic Review*, vol. 107, no. 5, pp. 337-342.

Dean, J. M., Fung, K. C., & Wang, Z. (2011). Measuring Vertical Specialization: The Case of China, *Review of International Economics,* vol. 19, no. 4.

Farrugia, N. (2004). Economic Vulnerability: Developing a New Conceptual Framework and Empirically Assessing its Relationship with Economic Growth, Working Paper, University of Malta.

Feenstra, R.C., & Hanson, G.H. (1999). The Impact of Outsourcing and High-Technology Capital on Wages: Estimates for the U.S., 1979-1990, *Quarterly Journal of Economics*, vol. 114, pp. 907-940.

Feenstra, R.C., & Sasahara, A. (2017). The 'China Shock', Exports and U.S. Employment: A Global Input-Output Analysis, NBER Working Paper No. 24022

Feenstra, R. C., Ma, H., & Xu, Y. (2017). US Exports and Employment, NBER working paper no. 24056, University of California, Davis and Tsinghua University, Beijing.

Financial Times. (2017). Brussels rattled as China reaches out to eastern Europe. Available online: https://www.ft.com/content/16abbf2a-cf9b-11e7-9dbb-291a884dd8c6, [Accessed 23 Apr. 2018].

Fritsch, M., & Matthes, J. (2017). Factory Europe and its Ties to Global Value Chains, Global Economic Dynamics Focus Paper, available online: https://www.iwkoeln.de/fileadmin/publikationen/2017/371972/Gutachten_NW_Factory_Europe.pdf, [Accessed 23 Apr. 2018].

Fu, X. & Zhang, J. (2012). The Impact of China on Low and Middle Income Countries' Export Prices in Industrial-Country Markets, *World Development,* vol. 40, no. 8, pp. 1483-1496.

Goldberg, P., Khandelwal, A. Pavcnik, N., & Topalova, P. (2010). Imported intermediate inputs and domestic product growth: Evidence from India, *Quarterly Journal of Economics,* vol. 125, no. 4, pp. 1727-1767.

Hanson, G.H. (2010). Why isn't Mexico rich? *Journal of Economic Literature,* American Economic Association, vol. 48, no. 4, pp. 987-1004.

Helpman, E., & Krugman, P. (1985). Market Structure and Foreign Trade, Cambridge, Mass: MIT Press.

International Monetary Fund (2000). Transition Economies: An IMF Perspective on Progress and Prospects -- An IMF Issues Brief. Available online: https://www.imf.org/external/np/exr/ib/2000/110300.htm [Accessed 23 Apr. 2018].

Johnson, R. C. & Noguera, G. (2012). Accounting for intermediates: Production sharing and trade in value added, *Journal of international Economics*, vol. 86, no. 2, pp. 224-236.

Kasahara, H., & Rodrigue, J. (2008). Does the use of imported intermediates increase productivity? Plant-level evidence. *Journal of Development Economics*, vol. 87, no. 1, pp.106-118.

Krugman, P. R. (1979). Increasing returns, monopolistic competition, and international trade, *Journal of International Economics,* vol. 9, no. 4, pp. 469-479.

Krugman, P. & Venables, A. (1995), Globalization and the Inequality of Nations, *Quarterly Journal of Economics*, vol. 110, no. 4, pp. 857-80.

Krugman, P. R., Obstfeld, M., & Meltiz, M.J. (2009). Internationale Wirtschaft: Theorie und Politik der Außenwirtschaft (e-book) Pearson Deutschland GmbH. Available online: http://aleph.unisg.ch/hsgscan/hm00398709.pdf, [Accessed 23 Apr. 2018].

Kummritz, V. (2015). Global Value Chains: Benefiting the Domestic Economy? IHEID Working Papers 02-2015, Economics Section, The Graduate Institute of International Studies.

Lall, S., & Albaladejo, M. (2004). China's Competitive Performance: A threat to East Asian Manufactured Exports? *World Development,* vol. 32, no. 9, pp. 1441-1466.

Li, H., Li, L., Wu, B., & Xiong, Y. (2012). The end of cheap Chinese labor, *Journal of Economic Perspectives,* vol. 26, no. 4, pp. 57-74.

Los, B., Timmer, M.P., & de Vries, G.J. (2015). How Important are Exports for Job Growth in China? A Demand-side Analysis, *Journal of Comparative Economics*, vol. 43, no. 1 pp. 19-32.

Los, B., Timmer, M.P., & de Vries, G.J. (2016), Tracing Value-Added and Double Counting in Gross Exports: Comment, *American Economic Review*, vol. 106, no. 7, pp. 1958-1966.

Los, B., McCann, P., Springford, J., & Thissen, M. (2017). The Mismatch between Local Voting and the Local Economic Consequences of Brexit. *Regional Studies,* 51(5): 786-799.
Minondo, A. (1999). The Labour Market Impact of Trade in Middle-income Countries: A Factor Content Analysis of Spain. *The World Economy*, vol. 22, no. 8, pp. 1095-1117.

Naughton, B. (2007). The Chinese economy: Transitions and growth, MIT press.

Observatory of Economic Complexity (OEC). (2018). China. Available online: https://atlas.media.mit.edu/nl/profile/country/chn/, [Accessed 23 Apr. 2018].

Organisation for Economic Cooperation and Development (OECD). (2002). Intra-Industry and Intra-Firm Trade and the Internationalisation of Production. Available online: https://www.oecd.org/eco/outlook/2752923.pdf [Accessed 23 Apr. 2018].

Pencea, S. (2013). Windows of Opportunity in China-CEE Economic Relations, *Global Economic Observer*, vol. 1, no. 2, pp. 4-13.

Sapir, A. (1996). The effects of Europe's internal market program on production and trade: a first assessment, *Weltwirtschaftliches Archiv*, vol. 132, pp. 457-475.

Shang, Y., Ponikvar, N., & Kejzar, K.Z. (2016). The Changing Patterns of China–CEE Trade, *Europe-Asia Studies*, vol. 68, no. 9, pp. 1486-1505.

Shields, S. (2004) Global restructuring and the Polish state: transition, transformation, or transnationalization?, *Review of International Political Economy*, vol. 11, no. 1, pp. 132-154.

Shiferaw, A. & Hailu, D. (2016). Job creation and trade in manufactures: industry-level analysis across countries, *IZA Journal of Labor & Development*, vol. 5, no. 3, pp. 1-36.

Steinwender, C. (2015). The Roles of Import Competition and Export Opportunities for Technical Change, CEP Discussion Paper no. 1334, London School of Economics and Political Science.

Storesletten, K. & Zilibotti, F. (2014). China's great convergence and beyond, *Annual Review of Economics,* vol. 6, pp. 333-362.

The Conference Board. (2018). International Comparisons of Hourly Compensation Costs in Manufacturing, 2016. Available online: https://www.conference-board.org/ilcprogram/index.cfm?id=38270#Table4, [Accessed 23 Apr. 2018].

Timmer, M. P., Dietzenbacher, E., Los, B., Stehrer, R. & de Vries, G. J. (2015). An Illustrated User Guide to the World Input–Output Database: the case of global automotive production, *Review of International Economics*, vol. 23, pp. 575–605

Trade Economics. (2018). Exports to China. Available online: https://tradingeconomics.com/, [Accessed 23 Apr. 2018].

Traistaru, I., Nijkamp, P., & Longhi, S. (2003). Specialization of regions and concentration of industries in EU accession countries. In I. Traistaru, P. Nijkamp and L. Resmini (eds.), *The Emerging Economic Geography in EU Accession Countries* (pp. 331-370). Alderschot: Aschgate.

Transition Report EBRD. (2017). Sustaining Growth (pdf) Available online: http://2017.tr-ebrd.com/wp-content/uploads/2017/09/Foreword.pdf [Accessed 23 Apr. 2018].

United Nations Development Programme. 2011. Export Dependence and Export Concentration. In: *Towards Human Resilience: Sustaining MDG Progress in an Age of Economic Uncertainty.* UN Bureau for Development Policy, 19-55.

Venables, A. (1996). Equilibrium Locations of Vertically Linked Industries, *International Economic Review*, vol. 37, no. 2, pp. 341-359.

Vogel, J. (2011). Spatial Price Discrimination with Heterogeneous Firms, *Journal of Industrial Economics*, vol. 59, no. 4, pp. 661-676.

World Bank. (2016). GNI per capita, Atlas Method (current US$). Available online: https://data.worldbank.org/indicator/NY.GNP.PCAP.CD?end=2016&locations=GL&start=1962, [Accessed 23 Apr. 2018].

Xin, C. (2012). Trade and Economic Cooperation between China and CEE Countries, Working Paper Series on European Studies, 6, Beijing, Institute of European Studies, Chinese Academy of Social Sciences.

Yu, M., & Tian, W. (2012). China's firm-level processing trade: trends, characteristics, and productivity, *SSRN Electronic Journal*, Available online: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2037827 [Accessed 23 Apr. 2018].

Zhu, X. (2012). Understanding China's growth: Past, present, and future, *Journal of Economic Perspectives,* vol. 26, no. 4, pp. 103-124.

Appendices

Appendix A

Table A 1: Export shares of Central European countries in 2014 (% of total exports)

Country	*Export share (SITC2)*	*Export share (SITC4)*
Czech Republic	Machinery (40%)	Cars (10%) and vehicle parts and accessories (7.6%)
	Electronics (19%)	Processors (2.5%) and computers (1.7%)
	Construction material and equipment (11%)	Electric wires (1.7%) and chairs and couches (1.5%)
Hungary	Machinery (41%)	Cars (9.8%) and motor vehicles and piston engines (5.8%)
	Electronics (15%)	TVs (2.4%) and telecom parts and accessories (1.7%)
	Construction materials and equipment (8.1%)	Electric wires (2.0%)
	Other chemicals (7.1%)	Medicaments (3.6%), miscellaneous articles of plastic (1.2%)
Poland	Machinery (25%)	Vehicle parts (4.9%) and cars (3.1%)
	Construction material and equipment (14%)	Chairs and couches (2.6%) and miscellaneous furniture (2.0%)
	Electronics (11%)	TVs (2.3%) and TV and radio transmitters (1.5%)
	Other chemicals (6.6%)	Miscellaneous articles of plastic (1.6%) and medicaments (1.5%)
Slovakia	Machinery (40%)	Cars (17%) and vehicle parts and accessories (4.6%)
	Electronics (21%)	TVs (8.3%) and TV and radio transmitters (4.7%)
	Construction materials and equipment (7.1%)	Electric wire (1.6%)
Slovenia	Machinery (34%)	Cars (8.6%) and vehicle parts and accessories (2.8%)
	Other chemicals (14%)	Medicaments (9.6%) and perfumery and cosmetics (1.2%)
	Construction material and equipment (14%)	Electric current (1.8%), processed aluminium (1.7%) and chairs and couches (1.3%)

Source: Observatory of Economic Complexity (OEC) via https://atlas.media.mit.edu/en/

Table A 2: Import shares of Central European countries in 2014 (% of total imports)

Country	*Import share (SITC2)*	*Import share (SITC4)*
Czech Republic	Machinery (28%)	Vehicle parts and accessories (5.6%), circuit breakers and panels (2.3%) and cars (2%)

	Electronics (17%)	Electronic microcircuits (2.0%), computer parts and accessories (2.0%) and personal computers (1.9%)
	Construction material and equipment (7.8%)	Electric wires (1.5%)
Hungary	Machinery (29%)	Vehicle parts and accessories (5.1%) and engine parts (2.5%)
	Electronics (17%)	Telecom parts (3.0%) and electronic microcircuits (2.2%)
Poland	Machinery (23%)	Vehicle parts and accessories (2.9%) and cars (2.8%)
	Electronics (11%)	Telecom parts and accessories (1.5%)
	Oil (8.8%)	Crude petroleum (7.9%)
Slovakia	Machinery (30%)	Vehicle parts and accessories (9.1%) and cars (2.5%)
	Electronics (20%)	TV and radio transmitters (5.6%) and telecom parts and accessories (2.5%)
	Oil (7.8%)	Crude petroleum (4.8%) and petroleum gases (2.8%)
Slovenia	Machinery (26%)	Cars (6.3%) and vehicle parts and accessories (2.3%)
	Not classified (15%)	Unclassified transaction (11%)
	Construction material and equipment (9.2%)	*No specific contributor*

Table A 3: Trade openness (Trade as a % of GDP), 2000 and 2014.

	2000	**2014**
Czech Republic	98.23	158.73
Hungary	136.99	168.92
Poland	60.79	93.73
Slovak Republic	110.70	180.28
Slovenia	103.68	144.23
United States	24.98	30.16

Source: The World Bank (2018), available at:
https://data.worldbank.org/indicator/NE.TRD.GNFS.ZS

Table A 4: Export openness (Export of goods and services as a % of GDP), 2000 and 2014

	2000	**2014**
Czech Republic	48.19	82.55
Hungary	66.68	87.65
Poland	27.23	47.59
Slovak Republic	54.07	91.85
Slovenia	50.01	75.81
United States	10.66	13.62

Source: The World Bank (2018), available at:
https://data.worldbank.org/indicator/NE.EXP.GNFS.ZS

Table A 5: Import openness (Import of goods and services as a % of GDP), 2000 and 2014

	2000	**2014**
Czech Republic	50.04	76.18
Hungary	70.31	81.27
Poland	33.56	46.15

Slovak Republic	56.63	88.43
Slovenia	53.67	68.41
United States	14.32	16.54

Source: The World Bank (2018), available at:
https://data.worldbank.org/indicator/NE.IMP.GNFS.ZS

Appendix B

Table B 1: Industries in WIOD release 2016 (according to ISIC Rev. 4) and sectoral aggregation

Nr	Industries		Aggregation
1	A01	Crop and animal production, hunting and related service activities	
2	A02	Forestry and logging	Resources (1-4)
3	A03	Fishing and aquaculture	
4	B	Mining and quarrying	
5	C10-C12	Manufacture of food products, beverages and tobacco products	
6	C13-C15	Manufacture of textiles, wearing apparel and leather products	
7	C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	
8	C17	Manufacture of paper and paper products	
9	C18	Printing and reproduction of recorded media	
10	C19	Manufacture of coke and refined petroleum products	
11	C20	Manufacture of chemicals and chemical products	
12	C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	
13	C22	Manufacture of rubber and plastic products	
14	C23	Manufacture of other non-metallic mineral products	Manufacturing (5-23)
15	C24	Manufacture of basic metals	
16	C25	Manufacture of fabricated metal products, except machinery and equipment	
17	C26	Manufacture of computer, electronic and optical products	
18	C27	Manufacture of electrical equipment	
19	C28	Manufacture of machinery and equipment n.e.c.	
20	C29	Manufacture of motor vehicles, trailers and semi-trailers	
21	C30	Manufacture of other transport equipment	
22	C31_C32	Manufacture of furniture; other manufacturing	
23	C33	Repair and installation of machinery and equipment	
24	D35	Electricity, gas, steam and air conditioning supply	
25	E36	Water collection, treatment and supply	
26	E37-E39	Sewerage; waste collection, treatment and disposal activities; materials recovery; etc	
27	F	Construction	
28	G45	Wholesale and retail trade and repair of motor vehicles and motorcycles	
29	G46	Wholesale trade, except of motor vehicles and motorcycles	
30	G47	Retail trade, except of motor vehicles and motorcycles	
31	H49	Land transport and transport via pipelines	
32	H50	Water transport	
33	H51	Air transport	
34	H52	Warehousing and support activities for transportation	
35	H53	Postal and courier activities	
36	I	Accommodation and food service activities	
37	J58	Publishing activities	
38	J59_J60	Motion picture, video and television programme production, sound recording and music publishing activities; etc	
39	J61	Telecommunications	
40	J62_J63	Computer programming, consultancy and related activities; information service activities	Services (24-56)
41	K64	Financial service activities, except insurance and pension funding	
42	K65	Insurance, reinsurance and pension funding, except compulsory social security	
43	K66	Activities auxiliary to financial services and insurance activities	
44	L68	Real estate activities	
45	M69_M70	Legal and accounting activities; activities of head offices; management consultancy activities	
46	M71	Architectural and engineering activities; technical testing and analysis	
47	M72	Scientific research and development	
48	M73	Advertising and market research	
49	M74_M75	Other professional, scientific and technical activities; veterinary activities	
50	N	Administrative and support service activities	
51	O84	Public administration and defence; compulsory social security	
52	P85	Education	
53	Q	Human health and social work activities	
54	R_S	Other service activities	
55	T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	
56	U	Activities of extraterritorial organizations and bodies	

Note. The table shows the list of 56 WIOD sectors and the definition of the three aggregate sectors in the main text.

Appendix C

Three functional forms to calculate hypothetical final demand in country *S* for products coming from sector *i* in country *S* (Feenstra and Sasahara, 2017):

$$\tilde{y}_{i\ (2000,2014)}^{SS} = y_{i\ (2014)}^{SS} + \left[y_{i\ (2014)}^{CS} - y_{i\ (2000)}^{CS}\right]$$

$$\tilde{y}_{i\ (2000,2014)}^{SS} = \frac{y_{i\ (2000)}^{SS}}{\sum_{k=1}^{N} y_{i\ (2000)}^{kS}} \times \sum\nolimits_{k} y_{i\ (2014)}^{kS}$$

$$\tilde{y}_{i\ (2000,2014)}^{SS} = \frac{y_{i\ (2014)}^{SS}}{y_{i\ (2000)}^{CS} + \sum_{k \neq C}^{N} y_{i\ (2014)}^{kS}} \times \sum\nolimits_{k} y_{i\ (2014)}^{kS}$$

Three functional forms to calculate hypothetical intermediate inputs sold from sector *i* to sector *j* in country *S* (Feenstra and Sasahara, 2017):

$$\tilde{z}_{i\,j\ (2000,2014)}^{SS} = z_{i\,j\ (2014)}^{SS} + \left[z_{i\,j\ (2014)}^{CS} - z_{i\,j\ (2000)}^{CS}\right]$$

$$\tilde{z}_{i\,j\ (2000,2014)}^{SS} = \frac{z_{i\,j\ (2000)}^{SS}}{\sum_{k=1}^{N} z_{i\,j\ (2000)}^{kS}} \times \sum\nolimits_{k} z_{i\,j\ (2014)}^{kS}$$

$$\tilde{z}_{i\,j\ (2000,2014)}^{SS} = \frac{z_{i\,j\ (2014)}^{SS}}{y_{i\,j\ (2000)}^{CS} + \sum_{k \neq C}^{N} z_{i\,j\ (2014)}^{kS}} \times \sum\nolimits_{k} z_{i\,j\ (2014)}^{kS}$$

Appendix D

Table D 1: Share of Chinese imports in Central European intermediate consumption and final demand in 2000 (% of total)

	Poland	Czech Republic	Hungary	Slovakia	Slovenia
Intermediate inputs from China (in millions of US$)	227.4	84.7	324.3	15.5	18.2
Total intermediate consumption (in millions of US$)	170,977.9	78,395.5	55,213.8	28,204.6	20,017.34
Share of Chinese imports in intermediate consumption	0.13%	0.11%	0.59%	0.06%	0.09%
Final goods delivered by China (in millions of US$)	480.0	158.0	258.3	26.7	24.9
Total final demand (in millions of US$)	173,500.7	60,043.5	45,557.6	22,672.2	21,347.6
Share of Chinese imports in final goods	0.28%	0.26%	0.57%	0.12%	0.12%

Note. Author's own calculations based on the World Input-Output Database (2016 release).

Table D 2: Share of Chinese imports in Central European intermediate consumption and final demand in 2014 (% of total)

	Poland	Czech Republic	Hungary	Slovakia	Slovenia
Intermediate inputs from China (in millions of US$)	6,854.9	5,724.0	4,238.4	1,304.1	589.8
Total intermediate consumption (in millions of US$)	593,416.0	294,442,0	157,803.0	131,823.7	49,016.3
Share of Chinese imports in intermediate consumption	1.16%	1.94%	2.69%	0.99%	1.20%
Final goods delivered by China (in millions of US$)	7,461.3	3,173.8	1,157.2	697.5	779.3
Total final demand (in millions of US$)	492,953.4	178,965.7	115,685.8	90,340.6	43,025.7
Share of Chinese imports in final goods	1.51%	1.77%	1%	0.77%	1.81%

Note. Author's own calculations based on the World Input-Output Database (2016 release).

Table D 3: Share of Chinese imports in US intermediate consumption and final demand, 2000-2014 (% of total)

	2000	2014
Intermediate inputs from China (in millions of US$)	14,750	130,243
Total intermediate consumption (in millions of US$)	8,248,353	13,554,177

Share of Chinese imports in intermediate consumption	0.18%	0.96%
Final goods delivered by China (in millions of US$)	36,825	217,068
Total final demand (in millions of US$)	10,675,889	17,897,422
Share of Chinese imports in final goods	0.34%	1.21%

Table D 4: Growth in Chinese import shares in total intermediate consumption and final goods from China, 2000-2014 (%)

	Poland	Czech Republic	Hungary	Slovakia	Slovenia
Intermediate goods	792,31%	1663,64%	355,93%	1550,00%	1233,33%
Final goods	439,29%	580,77%	75,44%	541,67%	1408,33%

Note. Author's own calculations based on the World Input-Output Database (2016 release).

Table D 5: Share of Chinese manufactured intermediate inputs in total manufactured inputs per country in 2000 (%)[11]

	Poland	Czech Republic	Hungary	Slovakia	Slovenia
Chinese man. intermediates (in millions of US$)	182.7	58.0	319.0	12.7	15.0
Total man. intermediates (in millions of US$)	57,045.3	32,296.9	28,559.2	10,914.0	8,600.3
Share of Chinese man. imports in total man. inputs	0.32%	0.18%	1.12%	0.12%	0.17%

Note. Author's own calculations based on the World Input-Output Database (2016 release).

Table D 6: Share of Chinese manufactured intermediate inputs in total manufactured inputs per country in 2014 (%)

	Poland	Czech Republic	Hungary	Slovakia	Slovenia
Chinese man. intermediates (in millions of US$)	6,291.2	5,203.1	3,927.9	1,252.3	545.0
Total man. intermediates (in millions of US$)	240,181.4	121,135.7	74,662.2	60,641.7	18,882.1
Share of Chinese man. imports in total man. inputs	2.62%	4.30%	5.26%	2.07%	2.89%

Note. Author's own calculations based on the World Input-Output Database (2016 release).

Table D 7: Net Employment Effects while assuming full import substitution, 2000-2014 (thousands of employees)

Country	Sector	Through final good exports only	Through final good and intermediate exports	Employment in 2000
Czech Republic	Manufacturing	-10,23 (-0.83%)	-36,39 (-2.97%)	1226,77
	Resource	-0,31 (-0.13%)	-0,81 (-0.33%)	241,01
	Services	-0,79	-19,82	2687,18

[11] In line with the ISIC Rev 4 industry classification, manufactured goods belong to WIOD sectors 5-23.

		(-0.03%)	(-0.74%)	
	All sectors	-11,33 (0.27%)	-57,01 (-1.37%)	4154,96
Hungary	Manufacturing	0,11 (0.01%)	-25,27 (-2.74%)	921,24
	Resource	0,04 (0.02%)	-0,25 (-0.12%)	204,52
	Services	3,29 (0.14%)	-22,47 (-0.94%)	2400,31
	All sectors	3,44 (0.10%)	-47,99 (-1.36%)	3526,07
Poland	Manufacturing	-86,17 (-3.22%)	-149,95 (-5.60%)	2679,30
	Resource	-2,22 (0.02%)	-4,45 (-0.89%)	502,20
	Services	-19,07 (0.14%)	-38,58 (-0.52%)	7419,50
	All sectors	-107,46 (0.10%)	-192,97 (-1.82%)	10601,00
Slovakia	Manufacturing	3,73 (0.81%)	-1,20 (-0.26%)	459,91
	Resource	-0,05 (-0.04%)	-0,09 (-0.07%)	130,06
	Services	2,50 (0.20%)	1,80 (0.15%)	1222,06
	All sectors	6,18 (0.34%)	0,51 (0.03%)	1812,03
Slovenia	Manufacturing	-5,66 (-2.43%)	-9,30 (-3.98%)	233,52
	Resource	-0,07 (-0.39%)	-0,18 (-1.08%)	17,00
	Services	-1,51 (-0.31%)	-2,69 (-0.55%)	489,75
	All sectors	-7,24 (-0.98%)	-12,17 (-1.64%)	740,27

Notes. The numbers without parentheses reflect the net employment effect of increased bilateral trade with China measured in thousands of employees. The values in parentheses refer to the ratio of the change in (sectoral) employment level to the total (sectoral) employment level in the base year 2000. These numbers are based on the author's calculations using the WIOD (2016). Positive numbers mean increased net labour demand, while negative numbers mean reduced net labour demand.

Table D 8: Net Employment Effects while assuming proportional redistribution, 2000-2014 (thousands of employees)

Country	Sector	Through final good exports only	Through final good and intermediate exports	Employment in 2000
Czech Republic	Manufacturing	4,58 (0.37%)	7,69 (0.63%)	1226,77
	Resource	-0,05 (-0.02%)	0,00 (0.00%)	241,01
	Services	4,68 (0.17%)	0,16 (0.01%)	2687,18

	All sectors	9,21 (0.22%)	7,85 (0.19%)	4154,96
Hungary	Manufacturing	6,04 (0.66%)	9,72 (1.05%)	921,24
	Resource	0,12 (0.06%)	0,08 (0.04%)	204,52
	Services	4,78 (0.20%)	-12,52 (-0.52%)	2400,31
	All sectors	10,93 (0.31%)	-2,72 (-0.08%)	3526,07
Poland	Manufacturing	-15,07 (-0.56%)	-26,54 (-0.99%)	2679,30
	Resource	-0,95 (-0.19%)	-1,19 (-0.24%)	502,20
	Services	-1,97 (-0-03%)	-2,65 (-0.04%)	7419,50
	All sectors	-17,99 (-0.17%)	-30,38 (-0.29%)	10601,00
Slovakia	Manufacturing	9,34 (2.03%)	9,74 (2.12%)	459,91
	Resource	0,06 (0.04%)	0,21 (0.16%)	130,06
	Services	3,39 (0.28%)	4,00 (0.33%)	1222,06
	All sectors	12,78 (0.71%)	13,95 (0.77%)	1812,03
Slovenia	Manufacturing	-1,89 (-0.81%)	-2,88 (-1.23%)	233,52
	Resource	-0,03 (-0.15%)	-0,06 (-0.35%)	17,00
	Services	-0,44 (-0.09%)	-0,65 (-0.13%)	489,75
	All sectors	-2,35 (-0.32%)	-3,59 (-0.48%)	740,27

Notes. The numbers without parentheses reflect the net employment effect of increased bilateral trade with China measured in thousands of employees. The values in parentheses refer to the ratio of the change in (sectoral) employment level to the total (sectoral) employment level in the base year 2000. These numbers are based on the author's calculations using the WIOD (2016). Positive numbers mean increased net labour demand, while negative numbers mean reduced net labour demand.

Table D 9: Employment effect of Central European exports, 2000-2014 (thousands of employees)

Country	Sector	Through final good exports only	Through final good and intermediate exports	Employment in 2000
Czech Republic	Manufacturing	8,21 (0.67%)	16,29 (1.33%)	1226,77
	Resource	0,15 (0.06%)	0,46 (0.19%)	241,01
	Services	6,85 (0.26%)	7,46 (0.28%)	2687,18
	All sectors	15,22	24,21	4154,96

		(0.37%)	(0.58%)	
Hungary	Manufacturing	7,17	12,61	921,24
		(0.78%)	(1.37%)	
	Resource	0,17	0,19	204,52
		(0.08%)	(0.09%)	
	Services	4,39	-8,03	2400,31
		(0.18%)	(-0.33%)	
	All sectors	11,73	4,78	3526,07
		(0.33%)	(0.14%)	
Poland	Manufacturing	9,14	18,14	2679,30
		(0.16%)	(0.68%)	
	Resource	0,51	1,48	502,20
		(0.10%)	(0.30%)	
	Services	6,89	17,09	7419,50
		(0.09%)	(0.23%)	
	All sectors	16,54	36,72	10601,00
		(0.16%)	(0.35%)	
Slovakia	Manufacturing	10,63	12,44	459,91
		(2.31%)	(2.71%)	
	Resource	0,11	0,30	130,06
		(0.09%)	(0.23%)	
	Services	3,81	5,14	1222,06
		(0.31%)	(0.42%)	
	All sectors	14,55	17,88	1812,03
		(0.80%)	(0.99%)	
Slovenia	Manufacturing	0,67	0,88	233,52
		(0.28%)	(0.38%)	
	Resource	0,00	0,01	17,00
		(0.03%)	(0.08%)	
	Services	0,34	0,74	489,75
		(0.07%)	(0.15%)	
	All sectors	1,01	1,64	740,27
		(0.14%)	(0.22%)	

Notes. The 56 WIOD sectors are classified into three sectors, which are the natural resource sector (sectors 1-4), the manufacturing sector (sectors 5-23) and the service sectors (sectors 24-56). The row 'All sectors' refers to the sum of employment effects in all 56 sectors.

Table D 10: Employment Effect of Imports from China while assuming full import substitution, 2000-2014 (thousands of employees)

Country	Sector	Through final good only	Through final good and intermediate good imports
Czech Republic	Manufacturing	-18,45	-52,68
		(-1.50%)	(-4.29%)
	Resource	-0,46	-1,27
		(-0.19%)	(-0.53%)
	Services	-7,65	-27,28
		(-0.28%)	(-1.02%)
	All sectors	-26,56	-81,23
		(-0.64%)	(-1.96%)

Hungary	Manufacturing	-7,06 (-0.77%)	-37,89 (-4.11%)
	Resource	-0,13 (-0.06%)	-0,44 (-0.22%)
	Services	-1,10 (-0.05%)	-14,45 (-0.60%)
	All sectors	-8,29 (-0.24%)	-52,77 (-1.50%)
Poland	Manufacturing	-95,31 (-3.56%)	-168,10 (-6.27%)
	Resource	-2,73 (-0.54%)	-5,93 (-1.18%)
	Services	-25,97 (-0.35%)	-55,68 (-0.75%)
	All sectors	-124,00 (-1.17%)	-229,71 (-2.17%)
Slovakia	Manufacturing	-6,91 (-1.50%)	-13,64 (-2.97%)
	Resource	-0,16 (-0.12%)	-0,39 (-0.30%)
	Services	-1,31 (-0.11%)	-3,35 (-0.27%)
	All sectors	-8,38 (-0.46%)	-17,37 (-0.96%)
Slovenia	Manufacturing	-6,33 (-2.71%)	-10,18 (-4.36%)
	Resource	-0,07 (-0.41%)	-0,20 (-1.18%)
	Services	-1,85 (-0.38%)	-3,43 (-0.70%)
	All sectors	-8,25 (-1.11%)	-13,81 (-1.87%)

Notes. The numbers without parentheses reflect the employment effect due to Chinese import penetration measured in thousands of employees. The values in parentheses refer to the ratio of the decrease in employment level to the total (sectoral) employment level in the base year 2000. These numbers are based on the author's calculations of equations (4) and (5), using the WIOD (2016). Positive numbers mean increased labour demand, while negative numbers mean reduced labour demand.

Table D 11: Employment effect of imports from China while assuming proportional redistribution of change in Chinese imports, 2000-2014 (thousands of employees)

Country	Sector	Through final good only	Through final good and intermediate good imports
Czech Republic	Manufacturing	-3,63 (-0.30%)	-8,60 (-0.70%)
	Resource	-0,21 (-0.09%)	-0,46 (-0.19%)
	Services	-2,17 (-0.08%)	-7,30 (-0.27%)
	All sectors	-6,01	-16,37

		(-0.14%)	(-0.39%)
Hungary	Manufacturing	-1,13	-2,90
		(-0.12%)	(-0.31%)
	Resource	-0,05	-0,11
		(-0.02%)	(-0.05%)
	Services	0,38	-4,49
		(0.02%)	(-0.19%)
	All sectors	-0,80	-7,50
		(-0.02%)	(-0.21%)
Poland	Manufacturing	-24,22	-44,70
		(-0.90%)	(-1.67%)
	Resource	-1,46	-2,68
		(-0.29%)	(-0.53%)
	Services	-8,87	-19,75
		(-0.12%)	(-0.27%)
	All sectors	-34,54	-67,12
		(-0.33%)	(-0.63%)
Slovakia	Manufacturing	-1,30	-2,70
		(-0.28%)	(-0.59%)
	Resource	-0,06	-0,09
		(-0.05%)	(-0.07%)
	Services	-0,42	-1,14
		(-0.03%)	(-0.09%)
	All sectors	-1,78	-3,94
		(-0.10%)	(-0.22%)
Slovenia	Manufacturing	-2,55	-3,76
		(-1.09%)	(-1.61%)
	Resource	-0,03	-0,07
		(-0.18%)	(-0.41%)
	Services	-0,78	-1,39
		(-0.16%)	(-0.28%)
	All sectors	-3,36	-5,22
		(-0.45%)	(-0.71%)

Notes. The numbers shown reflect the employment effect due to Chinese import penetration measured in thousands of employees. These numbers are based on the author's calculations of equations (4), (5) and (6) using the WIOD (2016). Positive numbers mean increased labour demand, while negative numbers mean reduced labour demand.