INTERNATIONAL MONETARY FUND

CZECH REPUBLIC

SELECTED ISSUES

June 2019

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SOURCES OF EXTERNAL DEMAND SPILLOVERS

1.   Recent international developments pose potentially sizable downside risks to the Czech Republic's economy. The main downside risks revolve around Brexit, trade tensions between the United States and China, and weakening demand in the euro area. These developments could reduce the demand for Czech exports and increase the price of imports. This paper investigates the direct and indirect exposure of the Czech Republic to these external risks.

**Trade and Supply Chain Links**

2.   The Czech Republic is a small open economy that has become increasingly reliant on export-driven growth over the last three decades. In 2017, the exports-to-GDP ratio was nearly 0.8, up from about 0.3 in 1990. Over that same period, the imports-to-GDP ratio has increased from about 0.3 to 0.7. Trade is mostly concentrated in industrial and electrical machinery and motor vehicles. As shown in the figures below, the Czech Republic's main export destinations are, in order, Germany, Slovakia, Poland, the UK, and France. The main sources of Czech imports are Germany, China, Poland, Slovakia, and Italy.

Share of Exports by Destination
(Percent of total)
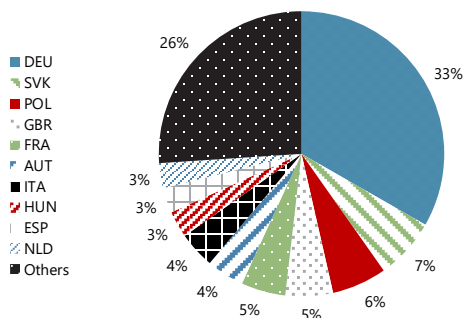
Source: Comtrade database, 2018.

Share of Imports by Source
(Percent of total)
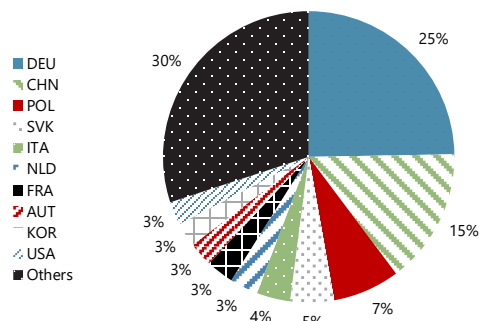
Source: Comtrade database, 2018.

3.   The participation of the Czech Republic in GVCs has increased over time. International trade has been one of the main drivers of economic development in the Czech Republic over the last few decades. The Czech Republic is an export-oriented small open economy that is highly integrated into GVCs. Smaller economies tend to have higher rates of participation in GVCs due to the higher "upstream" links of exports, as they source a large share of their intermediates from abroad.

4.   To measure the engagement of the Czech Republic in GVCs, we utilize input-output tables. The linkages and the structure of supply chain networks are measured by various datasets that differ in the number of countries and sectors covered. These tables depict the volume of goods and services traded between sectors of different countries. The tables indicate whether these goods and services are used as intermediate inputs in the production process of other sectors or are

consumed as final products. We utilize the TiVA Table[1] (which covers 64 countries and 36 sectors) primarily because it includes the Czech Republic and its main trading partners. 2015 is the most recent year for which the TiVA Table provides data.

5.   The share of foreign value-added in gross exports in the Czech Republic is higher than the average of the EU 28[2]**.** Gross exports of a country can be divided into domestic value added and foreign value added. The share of foreign value added in gross exports is defined as the *backward linkage* and is a measure of GVC participation. The Czech Republic has a backward linkage of 0.40, which is higher than the average of the EU 28. This observation implies that the domestic value added from exports (one minus the backward linkage) for the Czech Republic is lower than the average of the EU 28. This is mainly driven by the intensity of foreign intermediate inputs in the Czech production of gross exports. Advanced economies such as the US, the UK, and Japan have low backward linkages. Furthermore, primary commodity exporters such as Norway and Russia have low backward linkages as well.

6.   Domestic value-added in foreign exports as a share of gross exports in the Czech Republic is higher than the average share of the EU 28. The domestic value added in foreign exports as the share of the gross exports is defined as the *forward linkage*, another measure of GVC participation. This is the share of domestic value added that is not absorbed in the destination country and is, instead, exported to a third country. The forward linkage of the Czech Republic is 0.19, which is higher than the average of the EU 28. Advanced economies and primary commodity producers tend to have high forward linkages.

Foreign Value-added as Percent of Gross Exports (Backward Linkage - Percent)
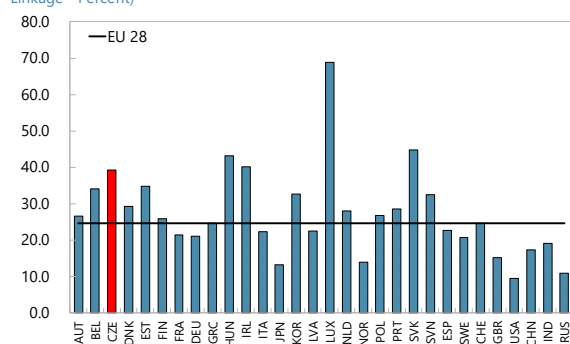
Source: OECD (TiVA Table), 2015.

Domestic Value-added in Foreign Exports as Percent of Gross Exports (Forward Linkage - Percent)
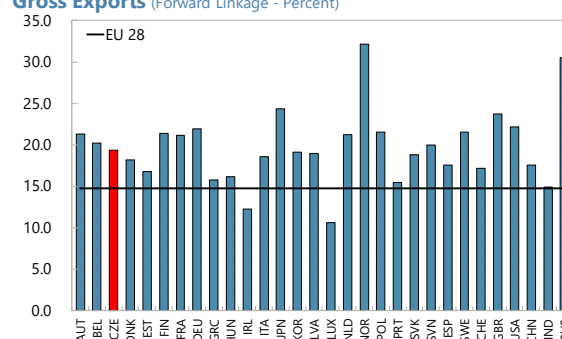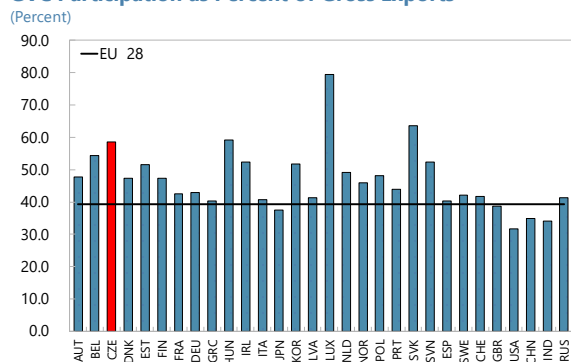

Source: OECD (TiVA Table), 2015.

7.   The Czech Republic is highly integrated into GVCs, but its net gains from participation is below the average of the EU 28. The sum of the forward and backward linkage is used as a measure of a country's GVC participation. The Czech Republic's GVC participation is nearly 0.59 of its gross exports. Countries such as Slovakia, Hungary, and Slovenia also have high GVC participation. Higher participation in GVC does not guarantee higher gains. If we assume that the net value added

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[1] https://www.oecd.org/sti/ind/measuring-trade-in-value-added.htm

[2] Member states of the European Union.

represents the gains, then high forward linkage relative to backward linkage indicates high gains from participating in GVCs. The ratio of the forward linkage to the backward linkage is shown in the figure below. Advanced economies such as the US, Japan, and the UK and the primary commodity exporters such as Norway and Russia enjoy high net gains from GVC participation. On the other hand, the Czech Republic has net gains of 0.50 and is below the average of the EU 28, 0.60. Slovakia, Hungary, and Ireland also have small net gains from GVC participation.

GVC Participation as Percent of Gross Exports
(Percent)

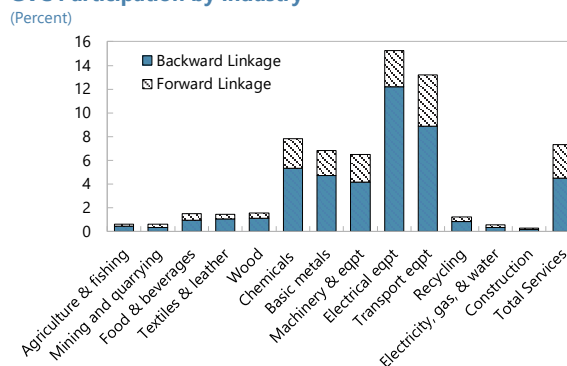

Source: OECD (TiVA Table), 2015.

Net Gains from GVC Participation
(Ratio)
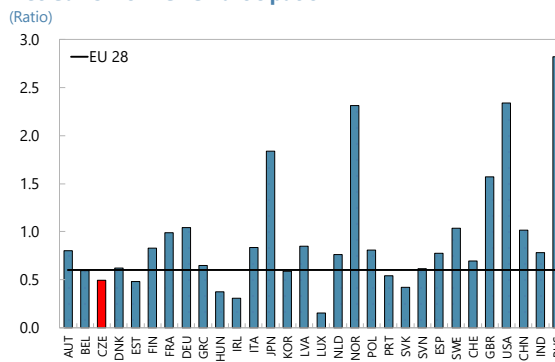
Source: OECD (TiVA Table), 2015.

8.   The electrical and optical equipment sector and the transport equipment sector have the highest GVC participation through exports in the Czech Republic.[3] In most sectors, backward linkage contributes more to the GVC participation of the sector compared to the forward linkage. These sectors source a high share of their intermediate inputs from abroad for their exports. Construction and mining and quarrying are the only sectors for which forward and backward linkages contribute equally to GVC participation.

9.   Services have a relatively low contribution to value-added in gross exports. The share of services in global trade and in value-added from exports has been increasing rapidly. The "smile curve" found in empirical trade work shows that, in the production process, service activities such as design, R&D, and marketing generate higher returns compared to

GVC Participation by Industry
(Percent)

Source: OECD (TiVA Table), 2011.

Decomposition of Gross Exports (Percent)
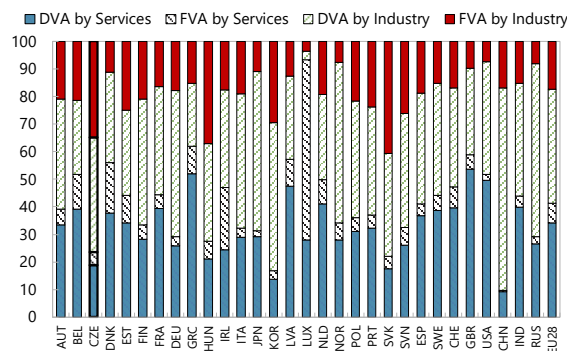
Source: OECD (TiVA Table), 2015.

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[3] Forward and backward linkages of each sector are computed as the share of total Czech exports (rather than the sector exports) in order to illustrate the importance of the sector in total GVC participation.

manufacturing activities. This suggests that services play a crucial role in increasing the share of domestic value-added in gross exports. On average, the share of services in gross exports and in domestic value-added of exports is around 0.41 and 0.45 for the EU 28. These shares are 0.23 and 0.31, respectively, for the Czech Republic, among the lowest of advanced countries in Europe. Furthermore, one can see that for several developed countries services contribute more than industry to the domestic value-added of exports.

10.   Given the high integration of the Czech Republic into global value chains (GVCs), it is crucial to take supply chain linkages into account when assessing the impact of trade shocks. Taking GVC linkages into account might yield very different results than using conventional trade measures. To measure the effects of external shocks on the Czech economy through GVC linkages, we use network analysis.

11.   We assume external shocks affect the demand for Czech products through three channels:

- *Direct channel*: lower demand for Czech goods due to lower demand[4] or higher prices[5] in the destination country. In the first exercise, we assume demand for goods and services are combined following a CES aggregator.

$$q_t(\varphi) = \frac{Y_t}{p_t^{\sigma}(\varphi)P_t^{1-\sigma}}$$

where Y_t is the output, $p_t(\varphi)$ is the price of variety φ, P_t is the aggregate price index, $q_t(\varphi)$ is the demand for variety φ, and σ is the elasticity of substitution. We assume that the slowdown in Germany does not have a short-term effect on aggregate price index and Czech producers do not react to it by changing their prices. Thus, an 'x' percent drop in German gross output results in an 'x' percent drop in the demand which reduces output and value-added of sector i in the Czech Republic by

$$x * exp_{is} \tag{1}$$

$$x * exp_{is} * VA_i/output_i \tag{2}$$

where exp_{ic} is the export volume of Czech's sector i to sector s in Germany. The impact on value-added is measured by the impact on output multiplied by the ratio of value-added to total output of sector i.

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[4] In the first exercise, we assume demand in Germany lowers due to worse economic conditions.

[5] Higher prices are the result of higher imposed tariffs in the hard Brexit scenario and the US-China trade disputes.

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In the next two exercises, we assume a τ percentage point increase in tariffs faced by sector i reduces output and value-added of the Czech Republic according to Equations (1) and (2) where $x = \tau * \alpha$ and α is the elasticity of demand with respect to tariffs.[6]

- *Second-round channel:* lower demand for Czech intermediates in the Czech Republic. Sectors that use domestic intermediates and export their products to the country with lower output (or higher tariff) will have lower demand for domestic intermediates. Output and gross value-added decrease by

$$x * exp_{isc} * int_{ji}/output_j$$

$$x * exp_{isc} * int_{ji}/output_j * VA_j/output_j$$

where int_{ji} is the volume of intermediates that sector i purchases from sector j.

- *Indirect channel:* lower demand for Czech intermediates that are exported to other countries and are eventually exported to the country with lower output. Lower output results in lower demand in the destination country for goods produced in other countries, the Czech Republic could be indirectly affected through other trading partners. To quantify the indirect impact, we first measure the drop in the demand of the main exporters to the destination country:

$$x * exp_{ksc}/output_k$$

We then compute the implications of lower demand on the Czech's output and value-added,

$$\mu * exp_{ib}$$

$$\mu * exp_{ib} * VA_i/output_i$$

where μ is the weighted average drop in the demand in country b for Czech exports and exp_{ib} is total exports of Czech sector i to country b.

Given this framework, we investigate the impact of lower gross output in Germany, Brexit, and US-China trade disputes on the Czech Republic's gross output and value-added.

Lower Output in Germany

12.   The main trading partner of the Czech Republic is Germany. The Czech Republic relies heavily on Germany for both imports and exports. Germany is the destination for a third of Czech

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[6] The literature estimates $\alpha \in [0.2, 1.5]$ (Ossa (2014) and Imbs and Mejean (2015)). We assume $\alpha = 1.5$ which provides an upper bound for the effect of shocks on output and value-added.
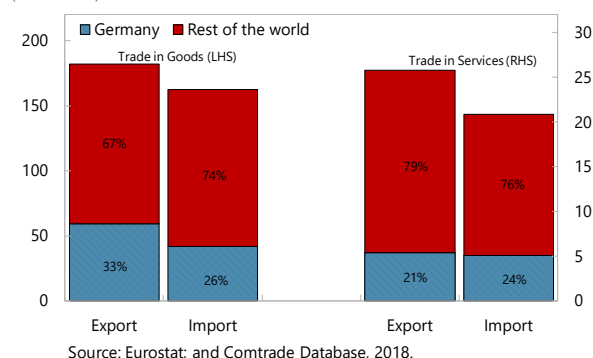
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exports in goods and over a fifth of its exports in services. Moreover, nearly a quarter of the Czech Republic's import in goods and services are sourced from Germany.

Trade with Germany and RoW
(Billion USD)

Source: Eurostat; and Comtrade Database, 2018.

**13.   The exposure to Germany is even more pronounced at the sectoral level.** Manufacturing of machinery and transportation vehicles account for a large share of exports and imports in the Czech Republic. These two sectors export over 30 percent of their products to Germany and import over 20 percent of their intermediates from Germany. The following figures illustrate that, overall, most goods-producing sectors are highly reliant on Germany for both exports and imports.[7] The exposure to Germany through services is more dispersed and, in most sectors, the import dependency is higher than export dependency.
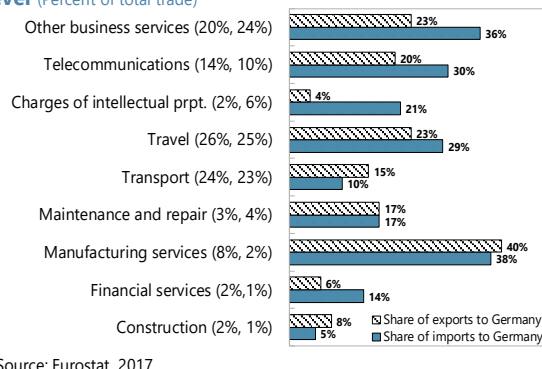
Direct Exposure to Germany through Goods Market at Sectoral Level (Percent of total trade)
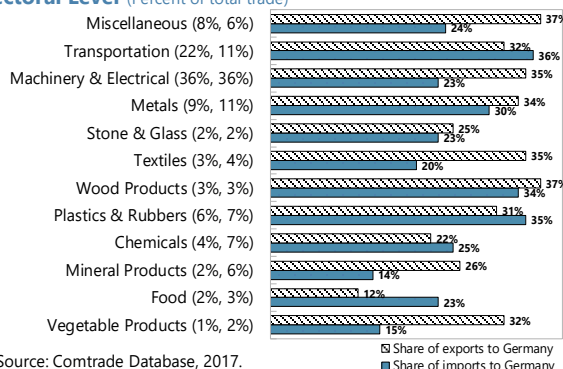
Source: Comtrade Database, 2017.

Direct Exposure to Germany through Services at Sectoral Level (Percent of total trade)

Source: Eurostat, 2017.

14.   A hypothetical decline of 1 percent in German gross output would result in a 0.15 percent drop in Czech gross output (nearly 740 million USD) and 0.12 percent decline in gross value-added (about 215 million USD). 0.10 percentage point of the decline in gross output is through direct effects, 0.03 percentage point due to second-round effects, and 0.02 percentage point due to indirect effects. For gross value-added, the values are 0.07 percentage point, 0.03 percentage point, and 0.02 percentage point, respectively. The motor vehicles sector experiences the largest drop in gross output (163 million USD) and gross value-added (31 million USD). Manufacturing of machinery and equipment, electrical equipment, fabricated metal products, and computer, electronic, and optical products are the sectors that suffer the largest losses.

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[7] The first percentage figure in the parentheses following the sector label is the share of the sector in total Czech exports of goods. The second percentage figure in parentheses shows the equivalent information for imports. Percentage figures on the bars show the share of exports to and imports from Germany in each sector.

Brexit

15. **If the UK leaves the customs union without any further agreements (a so-called "hard Brexit" scenario), tariff rates will be set to the statutory ceiling that the EU has committed to in the World Trade Organization** (WTO). The following figure shows the most favored nation (MFN) average import tariff rates on intra-EU trade estimated by Dhingra et al. (2017)[8]. As a result of a hard Brexit, non-tariff trade barriers are also expected to increase. The non-tariff trade cost estimates in the hard Brexit scenario (in tariff equivalent terms) are illustrated below.[9] We assume that the total trade costs increase by the sum of tariff and non-tariff costs.
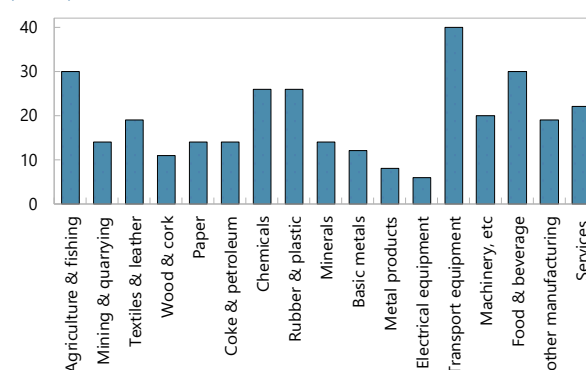
The UK MFN Tariffs with Non-EU Countries
(Percent)
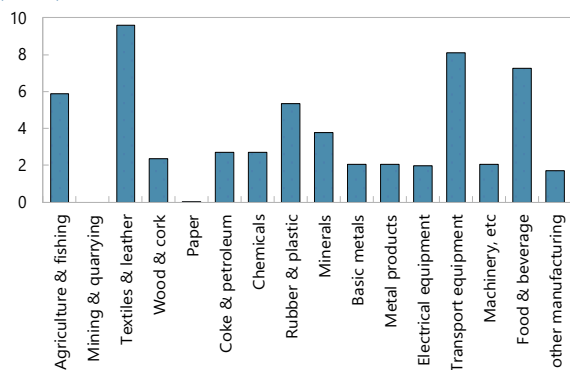
Source: Euro Area Policies, Selected Issues, 2018, SM/18/180.

Non-tariff Trade Costs in Tariff Equivalent Terms
(Percent)

Source: Euro Area Policies, Selected Issues, 2018, SM/18/180.

16. **While the UK is the fourth export destination for the Czech Republic, it is not a main source of the Czech imports.** The UK accounts for 3 percent of Czech's imports in goods and 6 percent of its imports in services and it is the destination of 5 percent and 6 percent of Czech's exports in goods and services, respectively. The share of trade with the UK has been stable over the past few years.

Trade with the UK and RoW
(Billion USD)
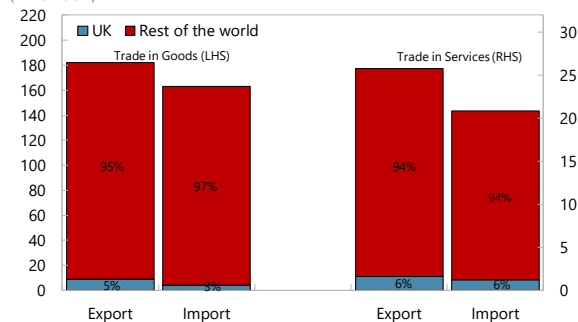
Source: Eurostat; and Comtrade Database, 2018.

17. **The direct exposure of the Czech Republic's economy to the UK is limited at the sectoral level.** The two following figures indicate that the sectors with the highest share of trade with the UK do not make large contributions to the overall trade flows of the Czech Republic. Electrical machinery, vehicles, travel, and transport account for a sizable share of Czech's international trade, but the UK is not a main trading partner of these sectors.

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[8] Dhingra, Huang, Ottaviano, Pessoa, Sampson, and Van Reenen (2017).

[9] Euro Area Policies, Selected Issues, 2018, SM/18/180.

Direct Exposure to the UK through Goods Market at Sectoral Level (Percent of total trade)

Share of Exports to UK / Share of Imports from UK

Mineral Products (2%, 6%): 1%, 0%
Vegetable Products (1%, 2%): 1%, 1%
Textiles (3%, 4%): 3%, 2%
Wood & Wood Products (3%, 3%): 2%, 2%
Stone & Glass (2%, 2%): 4%, 2%
Chemicals & Allied Industries (4%, 7%): 3%, 5%
Plastics & Rubbers (6%, 7%): 3%, 2%
Metals (9%, 11%): 3%, 2%
Food (2%, 3%): 4%, 3%
Miscellaneous (8%, 6%): 5%, 2%
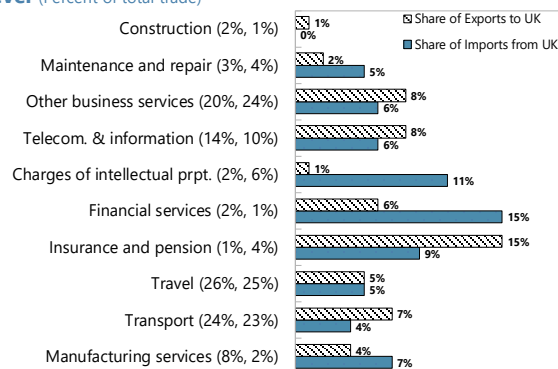Electrical Machinery (36%, 36%): 5%, 4%
Vehicles (22%, 11%): 7%, 2%
Footwear (1%, 1%): 12%, 1%
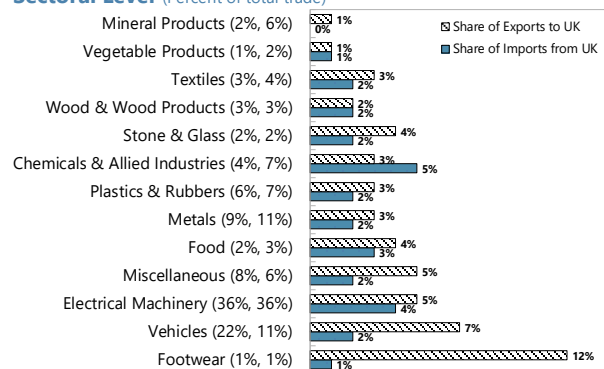
Source: Comtrade Database, 2017.

Direct Exposure to the UK through Services at Sectoral Level (Percent of total trade)

Share of Exports to UK / Share of Imports from UK

Construction (2%, 1%): 1%, 0%
Maintenance and repair (3%, 4%): 2%, 5%
Other business services (20%, 24%): 8%, 6%
Telecom. & information (14%, 10%): 8%, 6%
Charges of intellectual prpt. (2%, 6%): 1%, 11%
Financial services (2%, 1%): 6%, 15%
Insurance and pension (1%, 4%): 15%, 9%
Travel (26%, 25%): 5%, 5%
Transport (24%, 23%): 7%, 4%
Manufacturing services (8%, 2%): 4%, 7%

Source: Comtrade Database, 2017.

18.   We estimate that the Czech Republic's gross output and gross value-added would drop by 0.84 percent and 0.63 percent, respectively, in a hard Brexit scenario. Using our framework, we decompose the drop in the gross output and find that 0.55 percentage point is due to the direct effect, 0.19 percentage point to the second-round effect, and 0.10 percentage point to indirect effects. Similarly, 0.38 percentage point, 0.18 percentage point, and 0.07 percentage point of the decrease in the gross value-added are from direct, second-round, and indirect channels, respectively.

19.   Manufacturing of motor vehicles, machinery and equipment, rubber and plastic, and electronics and computers are the sectors with the highest losses from a hard Brexit scenario. This is both due to their *ex ante* high exports volume to the UK and the high trade costs imposed to these sectors after a hard Brexit.

20.   Our results are close to the previous IMF estimates, but sizably smaller than those of the Czech National Bank.[10] IMF staff evaluate the long-term effects of a hard Brexit on the EU countries using a Computable General Equilibrium model. They find that GDP in the Czech Republic drops by nearly 0.77 percent. The CNB exercise estimates a 1.5 percent drop in GDP in a hard Brexit scenario. This drop is the result of lower trade, higher tariffs, and lower demand in the EU. Our framework, on the other hand, assumes that a hard Brexit scenario results only in higher tariffs and the drop in the trade flows and demand in the EU area are the *consequences* of the rise in tariffs.

US and China Trade Disputes

21.   While the US is not a major trading partner for the Czech Republic, China is the second source of Czech imports after Germany. In 2017, China was the source of 13 percent of Czech imports (although the destination for only 1 percent of its exports). The US accounted for 2 percent of Czech imports and exports. While in gross terms the US might not trade much with the Czech

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[10] United Kingdom, Selected Issues, 2018, IMF Country Report No. 18/317.

Republic, it can still be the destination for a high share of Czech products that are initially exported to other countries, such as Germany.

22.   US-China trade disputes would affect the Czech Republic mainly through Germany.[11] As demand for American and Chinese goods declines in China and the US, demand for Czech intermediate goods that are utilized in the production of those exported goods declines. Given the 13 percentage point and 8 percentage point increase in tariffs faced by US products in China and Chinese products in the US, respectively, we find 7 million USD loss in gross value-added and 23 million USD loss in gross output of the Czech Republic. Moreover, due to these tariff hikes, demand in these two countries for German intermediates decreases. This might result in lower demand in Germany for Czech intermediates. We find that through this channel gross output and gross value-added in the Czech Republic drop by 377 and 102 million USD, respectively. Overall, the gross output of the Czech Republic falls by nearly 0.1 percent.

23.   While the impact of the US-China trade disputes on the Czech Republic would likely be limited, a hard Brexit scenario or lower demand in Germany could have sizable effects. We show that a hypothetical 1 percent fall in German demand could result in 0.15 percent and 0.11 percent falls in gross output and gross value-added. We find that, in a hard Brexit scenario, the gross output and gross value-added of the Czech Republic would decrease by 0.84 percent and 0.63 percent, respectively, mostly due to direct exposure to the UK. By contrast, US-China trade disputes would affect the Czech economy mainly through German demand.

24.   We use input-output tables and network analysis to quantify the effects and study the channels through which the external shocks propagate to Czech economy. Trade costs have dropped over the last few decades, mainly due to advances in transportation and information technologies. This has allowed firms to increasingly organize their production around global value chains (GVCs), spreading production across many different countries. The Czech Republic is a small open economy with a high rate of participation in GVCs. Thus, to measure the impacts of external shocks, we take supply chain linkages into account. Utilizing the input-output tables and network analysis, we show that external shocks propagate through different channels to the Czech Republic. In particular, a hard Brexit or a slowdown in Germany mostly affects Czech economy through the direct channel. However, the US-China trade disputes would have a sizably larger effect through Germany (although the overall effect is not very large).

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[11] By the end of 2018, US had imposed 25 percent tariff on $50 bn and 10 percent tariff on $200 bn of imports from China. China retaliated by imposing 25 percent tariff on $50 bn and 5-10 percent tariff on $60 bn of imports from the US. We find that the average tariff equivalent is around a 13 percentage point increase on tariffs that US products face in China and an 8 percentage point increase on tariffs that Chinese products face entering the US.