

# Backward integration raises value chain vulnerabilities

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## Summary

- The Covid pandemic and the war between Russia and Ukraine create major shocks to global value chains. Among the problems experienced are that firms find it difficult to source inputs necessary for the production process. We use survey data on material, equipment and space shortages experienced by businesses to investigate whether shortages are related to the degree of integration in global value chains.
- We exploit sectoral differences to show that sectors with a high degree of integration in the global value chain tend to suffer more from input shortages. The results are most convincing after allowing for country-specific characteristics, such as economic size and trade openness.
- Industrial sectors, such as machinery & equipment and motor vehicles, which have a relatively high integration in the global value chain, are more affected by shortages than services, such as legal & accounting activities and postal & courier activities, which have a lower integration.

## Introduction

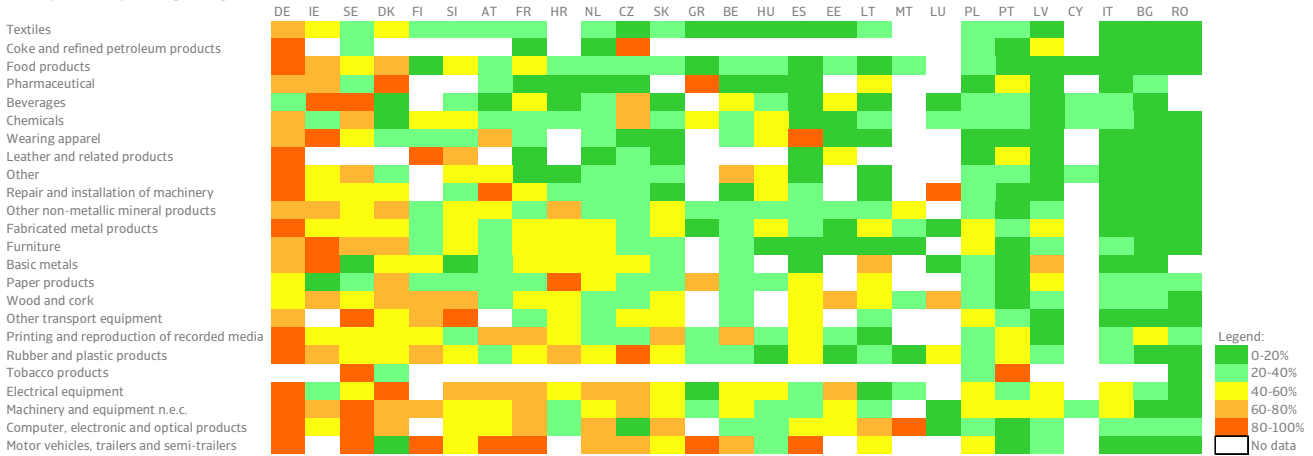
Global value chains have undergone major shocks in recent years, as we explained in an earlier research note.<sup>1</sup> The Covid-19 pandemic has upended the normal functioning of value chains. This is visible in many ways such as a shortage of semiconductors, high container shipping rates, and elevated commodities prices. Many businesses have been struggling to source inputs used in their production process or can only source them at high prices. This outbreak of the Russia-Ukraine war has only aggravated the situation. The impact is for instance being felt in the car industry, as Ukraine is a key producer of various scarce metals such as palladium (used in catalytic converters, used in cars) and neon (used in lasers for the manufacture of microchips).

We investigate the relationship between global value chain participation and input shortages experienced by businesses Europe. The participation of a country or sector in the global value chain (GVC) is measured by looking at backward GVC participation. Backward participation is measured as foreign content embodied in a country's exports, as a percentage of total exports of the exporting country. For example, a German car manufacturer may use components that are produced in Slovakia. These components are foreign content that increase the degree of backward participation of this manufacturer and by extension of the whole manufacturing sector.

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<sup>1</sup> 'Pandemic and security shocks shake but won't destroy global value chains', Atradius Economic Research Note,

**Figure 2: Equipment and material shortages in industrial sectors**  
% of respondents experiencing shortages, 2022 Q2



We take data on the degree of backward participation from the OECD Trade in Value Added (TiVA) database. The latest data are from 2018.<sup>2</sup>

Input shortages are measured using survey data from the European Commission on reported shortages by firms in “material, equipment and/or space”. The survey data are taken from European Commission’s 2022 Q2 industry and services surveys. We chose 2022 Q2 as a reference period as input shortages on the EU level peaked during this quarter. Both the industry and services survey contain a question on “factors that are limiting production”. In the industry survey, one of the possible answers (multiple can be selected) is “shortage of material and/or equipment”. In the services survey, the corresponding answer is “shortage of space and/or equipment”. We use the percentage of positive answers to these questions. The higher the percentage, the more shortages that are experienced.

We collected data on 30 sectors (both industry and services) and 26 EU countries (there was no data available for Greece). The total dataset has 406 observations.

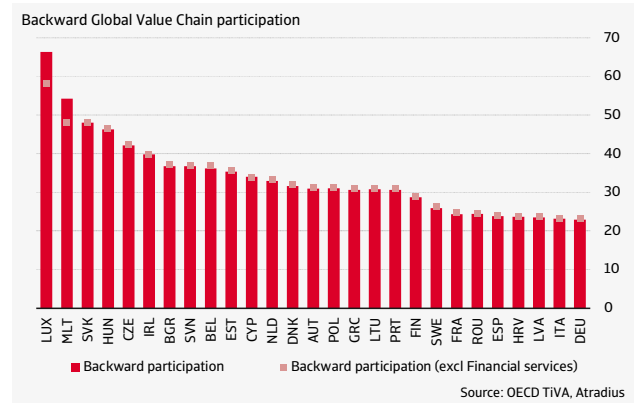
### Integration in value chains

Figure 1 shows the degree of backward GVC participation of EU countries (total economy). There is quite some variation across countries. Countries with a high degree of backward participation are Luxembourg, Malta, Slovakia, and Hungary. In Luxembourg and Malta, the figures are inflated by the financial services sector, which uses a lot of foreign content in its exports. In Slovakia and Hungary, there is a large automobile industry and a large computer & electronics sector. These sectors, which are both industrial sectors, typically have a high dependency on global value chains.

Examples of countries with weak backward linkages are Germany, Italy, Croatia and Sweden. Germany and Italy both have a considerable manufacturing sector, but they still rank relatively low on global value chain participation due to their economy size. Large economies

source more inputs locally instead of importing them from other countries. Croatia and Sweden both have a strong representation in services sectors, which tend to have a stronger domestic orientation. In Croatia, the trade, transport & accommodation sector is relatively large. In Sweden, the information & communication and business services sectors take an important place in the economy.

**Figure 1: High backward participation in a number of EU countries**



### Shortages

Shortages experienced by firms have increased in the past two years. This most likely has to do with the coronapandemic and the disruptions to supply and demand it caused. In 2022 Q2, 50.9% of EU industrial producers experienced material and/or equipment shortages. Just before the coronapandemic, this was only 8.5%. In the services sector, we also see an increase in reported equipment shortages, but a much smaller one: from 3.2% just before the pandemic to 3.6% in the 2022 Q2. This is not a real surprise as many services sectors were closed during the pandemic. Personnel shortages are a much bigger problem in the services sectors (29% of firms reported labour as a factor limiting the business in 2022 Q2, versus 19% before the pandemic).

as this does not change considerably from year to year.

<sup>2</sup> Despite lagging a few years behind, we believe the OECD TiVA data still accurately reflects the degree of backward participation,

In the **industrial** sector, there are large differences across countries and subsectors in reported material and/or equipment shortages (Figure 2). Countries that experience the highest shortages across all industrial sectors are Germany, Ireland, Sweden, Denmark, Finland and Slovenia. Among the less affected countries are Latvia, Italy, Bulgaria and Romania.

Among the sectors most affected are motor vehicles, computer, machinery & equipment, electrical equipment, tobacco products, and rubber & plastic products. Relatively less affected are textiles, coke & refined petroleum products, food products, pharmaceutical and beverages.

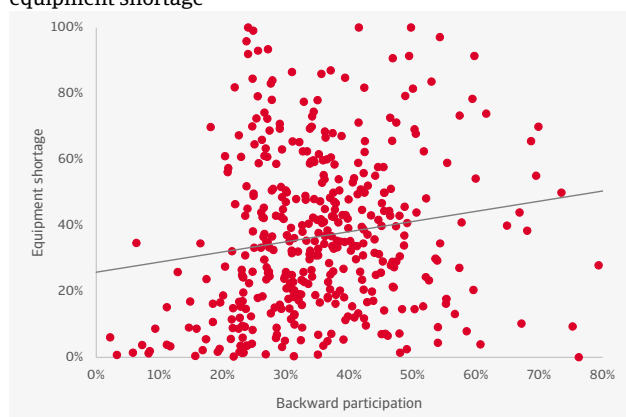
In the **services** sector, the differences in reported shortages between sectors are much smaller, but they are still noticeable. Countries that are most hit by shortages in space and/or equipment are Austria, Ireland and the Netherlands. By contrast, Italy, Czech Republic, Bulgaria and Cyprus are barely experiencing equipment and space shortages.

Services sectors that are more affected by the shortages are air transport, warehousing & support activities for transportation, and rental & leasing activities. Less affected sectors are legal & accounting activities, postal & courier activities, and programming & broadcasting activities.

### Relation between GVC participation and value chain disruptions

Looking at a scatter plot of GVC participation and material, equipment and space shortages, we see a positive relationship between the two variables. (Figure 3). If we plot the data by country (not shown here), the positive relationship becomes more pronounced in some cases (e.g. Czech Republic and Finland), whereas in other cases the relationship is not strong or even negative (e.g. Sweden and Bulgaria).

Figure 3: Relation between backward participation and equipment shortage



<sup>3</sup> The variables capacity utilisation and order/demand are taken from the same European Commission surveys as the variable on shortages. Capacity utilisation measures the operation capacity of a firm as a percentage of full capacity (answers can range from 0 to 100 percent). Order/demand development measures the “order

This suggests that country-specific characteristics, such as economic size and trade openness, play an important role. To investigate the relationship between backward participation and shortages further, we conducted various cross section regression analyses (see Box 1 for the basic model specification).

#### Box 1: Model specification

We estimated a cross section regression with country dummies for the relationship between equipment shortages ( $Y_{ij}$ ) and a vector of explanatory variables ( $X_{ij}$ ), where  $i$  refers to one of the 30 ISIC rev. 4 sectors and  $j$  refers to one of the 26 EU member states (there was no data for Greece). The model specification, which allows for country dummies ( $D$ ), representing the country specific characteristics, is:  $Y_{ij} = a_0 + a_1 * X_{ij} + D_j + u_{ij}$ , where  $u_{ij}$  stands for the disturbance term. We obtained results using standard errors that are robust for heteroskedasticity.

First, we conducted a regression without country specific characteristics. This yields a significant and positive coefficient on the variable backward participation (see Table 1, model 1). This means we find evidence of a positive relationship between the degree of backward participation in global value chains and shortages experienced by businesses. Second, we conducted a regression with country dummies to capture country-specific characteristics effects such as differences in economic size and trade openness. This again shows a positive, significant coefficient on backward participation (model 2). Importantly, the coefficient of model 2 is larger than that of model 1. This means that the relationship between backward participation and shortages becomes stronger once correcting for country-specific effects. Third, we conduct a regression with country dummies and two control variables: capacity utilisation and order/demand development<sup>3</sup> (model 3). The idea is that sectors with a high capacity utilisation and a strong demand development, more likely need production inputs such as materials and equipment, and are more likely to run into issues importing these inputs. We therefore expect the sign of the coefficients of these variables to be positive. In the regression output, capacity utilisation shows up significant only at the 10% level, but with a ‘wrong’ sign (it suggests equipment shortages decline as capacity utilisation increases, which is counterintuitive). The coefficient on backward participation in model 3 remains quite stable compared to model 2. This implies that the control variables hardly add any value to the model. The explanatory variables in model 3 have a weak correlation among each other. Hence, the risk of a biased estimate if the control variables are left out, is negligible.

In our preferred model (model 2), a one percentage point higher backward participation is associated on average with a 0.53 percentage point higher reported equipment, material and space shortages. The conclusion is that

development in the past three months” for industry and the “demand (turnover) development in the past three months” for services (It is measured as the percentage of positive answers minus the percentage of negative answers. Theoretically, it can range from -100 to 100.)

sectors that depend more on foreign inputs (high backward participation), report significantly higher input shortages.

Table 1: Different model specifications

	Model (1)	Model (2)	Model (3)
backward participation	0.306** (2.82)	0.528*** (4.07)	0.490*** (3.74)
capacity utilisation			-0.320* (-1.82)
orders			0.00969 (0.18)
constant	0.259*** (6.51)	0.232*** (3.95)	0.527** (2.89)
country dummies	no	yes	yes
N	406	406	403

*t* statistics in parentheses

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

## No easy policy solution

The policy implication of the above analysis could be that firms have to try to reduce their dependence on international trade networks. Firms have several options to improve value chain resilience, including reshoring production, diversifying suppliers and holding more inventory. However, as we argued in our previous research note, all these options come with significant downsides and costs. There could be some strategic reorientation in critical sectors like energy, sensitive technology, food supplies and medical equipment. But we do not expect to see a major step back on the globalisation ladder as the key economic rationale behind global value chains – the opportunity to exploit differences in labour costs – still holds.

To a certain extent producers have to live with distortions during unusual times such as the coronapandemic. Recent data shows an easing of value chain bottlenecks. Chip shortages are declining as chip manufacturers ramp up production, whereas logistical bottlenecks are also easing (declining shipping rates). Despite the improving situation, it may take well into 2023 for value chain distortions to resolve.

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