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Detecting and Analysing Supply Chain Disruptions

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Abstract

There is mounting evidence of supply chains distress across different industrial ecosystems affecting the production capacity of firms and indirectly creating price pressures. At the same time, the need of policy makers to monitor and understand the underlying factors is also more pressing. This paper, therefore, proposes a methodology to detect and analyse supply chains disruptions. In a first step, it applies a new indicator based on business surveys to estimate at sectoral level the relative importance of supply constraints versus demand expansion in determining price pressures. This information is summarised in the form of an "alert system" that can be updated on a regular basis. In a second step, relying on two case studies on wood and magnesium, where price distress and shortages have been observed, an econometric model is built. This investigates the relation between the import price variation and several dependency indicators, as well as long-term demand variations in order to understand the likely determinants of price pressures associated with shortages. The results suggest that higher reliance on foreign imports combined with higher concentration in supply chains are the two key factors explaining price pressures at product level. In addition, we find that products where there is a strong structural demand increase are more likely to experience price pressures. These findings can shed light on the determinants of ongoing supply chains disrutpions and specific price pressures, thereby helping policy makers design appropriate responses.

JEL Classification: F13, F14, F60

Keywords: International supply chains, price pressures, shortages, disruptions, trade data

Acknowledgements: This paper has benefited greatly from comments and suggestions from Roman Arjona, Josefina Monteagudo, Outi Slotboom, and Frank Vandermeeren.

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1. Introduction

International supply chains are very efficient in containing costs, although several events throughout history have exposed limits in their resilience. While the EU gains resilience from world markets being open and integrated in global value chains (i.e. through cost reduction, economies of scale, risk reduction, access to foreign inputs),[1] disruptions can affect specific products and inputs that are particularly critical for society and the EU economy. In the past, such disruptions occurred because of a rapid unexpected increase in demand, a rapid unexpected decrease in supply or the implementation of (foreign) government restrictions.[2] Over the last two decades, there have been several international events leading to shortages that find their origin in one of these underlying factors.[3]

Recent events, which are linked to both demand and supply factors, are causing supply chain shortages. On the one hand, the pandemic and the progressive reopening of economic activities have caused an abrupt release of large pockets of global demand in some specific sectors. In parallel, structural shifts, such as the green and digital transitions, are also contributing to boosting demand in specific markets. On the other hand, these trends intertwine with some trade instruments restricting the international flows of certain goods,[4] the rise in energy prices, the ongoing labour shortages and the shipping crisis. In fact, the shipping crisis has affected the key waterway that linked Europe and Asia, having a significant impact on the price of transport (see Figure 1). All these factors impacted the production capacity of many EU companies,[5] affecting the availability of critical products in various supply chains.[6]

[1] For example, looking at the case of Estonia, Banh *et al.* (2020) show evidence that global value chains (GVC) have contributed to increasing productivity and long-term growth. Moreover, Baldwin and Freeman (2021) argue that GVCs have attenuated an important part of the effects of the COVID-19 pandemic.

[2] Various papers look into the causes of supply chain disruptions and their consequences. For instance, Werling (2014) discusses the case of supply chain disruptions and the resulting macro-economic damage that could be caused by the West Coast Port Stoppage, taking into account several variations in the duration of these disruptions. Todo *et al.* (2015) investigate how supply chain networks are affected by the occurrence of a natural disruption, such as the Great East Japan earthquake. Using a simulation analysis based on input-output tables, they find that diversified supply chains are more resilient compared to supply chains that are heavily concentrated in the same area. Armani *et al.* (2020) describe how the COVID crisis has led to shortages in medical equipment and discusse how they could have been solved more rapidly by relying on low cost emergent technologies.

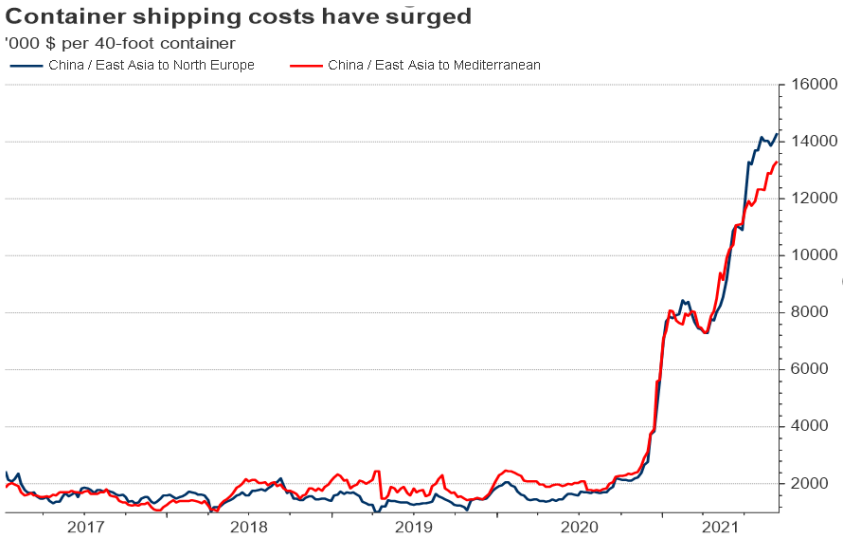
[3] Recent examples include the 2011 shortage in computers, electronics and automobiles originated by the Japan Tsunami, the 2014 shortages created by the bankruptcy of Hanjin - the seventh biggest shipping company in the world at the time - affecting various sectors given its horizontal nature, the toy shortage in 2014 or the current COVID-19 global pandemic.

[4] For instance, government actions in food and medical products are tracked in the following database: “COVID-19 Trade Policy Database: Food and Medical Products - Global Governance Programme (eui.eu)”

[5] See for instance “Longer Delivery Times Reflect Supply Chain Disruptions”, IMF Blog

[6] The Financial Times on (Sep. 7, 2021) “Supply chain squeeze: first cars, now chairs and cupboards | Financial Times (ft.com)”.

Figure 1: Cost of transport between Asia and Europe

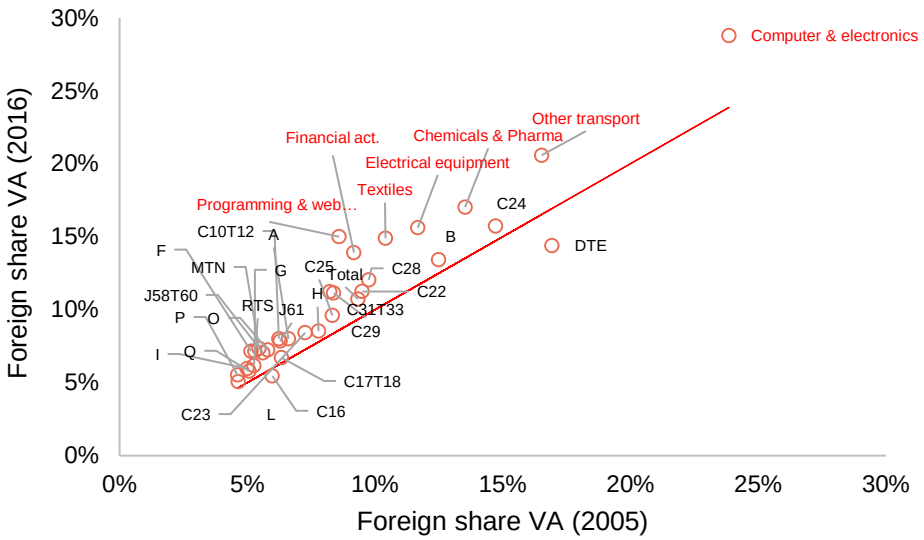


Source: Refinitiv Datastream, Freightos. The main observation is that cost of shipping has increased significantly in the last months.

The strategies of firms, which have proven to be efficient in normal times, might have exacerbated the problem of shortages in the context of an unexpected event, such as the COVID-19 pandemic.[7] First, as part of these strategies, supply chains have become increasingly complex as they span across a variety of geographical areas, in an attempt to maximise the comparative advantage at each stage of the production process (Figure 2 shows the increase in the foreign content of EU production between 2005 and 2016).[8] In fact, a large number of companies are involved in the various stages of delivering a finished good to final customers. While this model has proven highly efficient in normal times, it can be vulnerable in times of unexpected events. Any unexpected pressure on critical business nodes resulting from events such as closures of important firms or distress in logistic harbours can paralyse entire supply chains. Second, another business strategy likely to have contributed to the ongoing shortages refers to the just-in-time or lean inventory replenishment approach, which is a systematic approach to only produce goods when needed and thereby cutting waste of materials and the cost of inventory. Consequently, due to the lack of extra inventory or excess capacity to make up for production losses in case of disruptions, supply chains have become more vulnerable and less resilient to unexpected disruptions, as this strategy relies on a complex balance between production, shipping and demand.

[7] See Magableh (2021) who studies the impact of the COVID-19 pandemic on different supply chain stages and establishes a detailed and comprehensive framework on the factors that may affect supply chain performance, disruptions and resilience.
[8] Using input-output tables, Timmer *et al.* (2014) observe that international fragmentation, as measured by the foreign value-added content of production, has rapidly increased since the early 1990s.

Figure 2: Share of EU foreign value added (2016 vs 2005)



Source: Authors' calculations based on OECD MNE tables. Note that the sector codes refer to sectors based on a Nace rev.2 classification. The main observation is that as dots are above the 45 degree line, foreign share of EU sectoral production seems to be increasing with respect to 2005.The sectors where the foreign share has increased more than 4 percentage points are highlighted in red, which include "programming and web activities", "computer and electronics", "financial activities", "textiles", "other transport manufacturing" or "electrical equipment".

Understanding the aforementioned specific causes of supply chain disruptions is important to mitigate their potential negative effects in the short-, medium-, long-term. The EU economy is rebounding from the pandemic recession faster than expected. However, uncertainty and risks surrounding the growth outlook remain high, partly related to the disruptions in global value chains due to the ongoing supply constraints and bottlenecks.[9] The mechanism behind is that disruptions in global value chains affect the production capacity and competitiveness of businesses, and eventually consumers, as the availability of critical inputs and final products is reduced. This can directly impact the desired output and create indirect inflationary pressures, thereby hampering the economic recovery.[10] Consequently, it is important to understand the specific causes of these phenomena in order to limit, when possible, the potential permanent consequences of supply chain distress.

This paper contributes to the current need to identify, monitor, and support policy action with economic evidence so as to address supply chain distress. It is articulated in three parts. First, it analyses the evolution of prices at sectoral level, seeking to disentangle to what extent price pressures depend on supply and/or demand dynamics, and discuss possible avenues to regularly monitor sectoral price movements. Then, given the specific nature of the products experiencing price pressures (likely associated with shortages), two case studies on wood and magnesium explore potential factors determining the observed shortages. Second, based on these case studies, the paper tests the hypothesis that the likelihood of experiencing price pressures (likely associated with shortages) in the EU is higher for products where the EU is highly reliant on foreign imports and these foreign imports are highly concentrated. In parallel, this paper also test the potential role of structural demand increases in explaining price hikes. Finally, the last section presents the main conclusions of the paper and it explores possible avenues for further research.

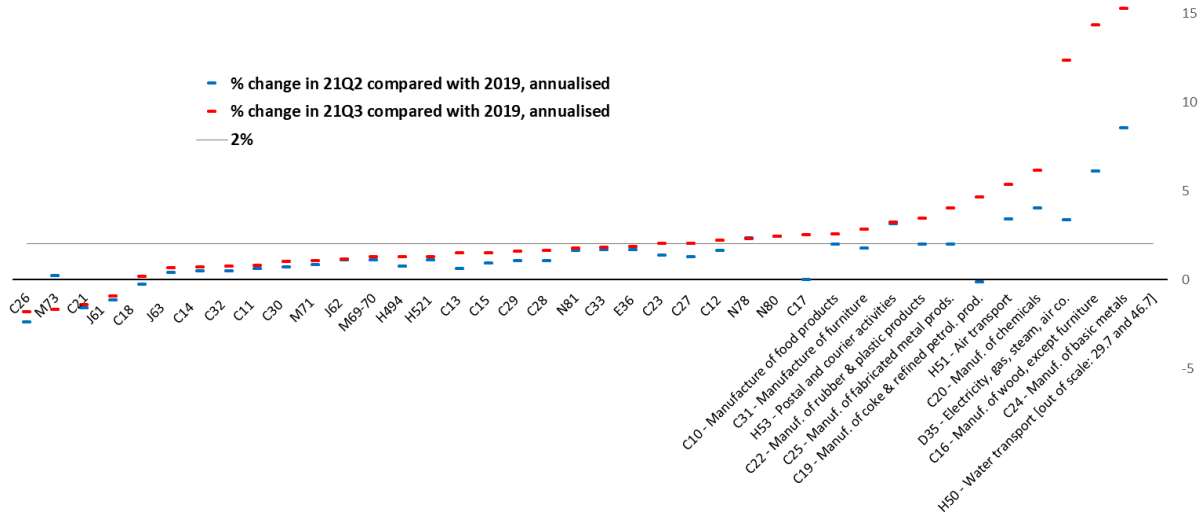
[9] European Commission (Autumn 2021 Economic Forecast).
[10] "Inflation may turn out higher than forecast if supply constraints are more persistent and price pressures are passed on to consumer prices more strongly."

2. Monitoring of supply chains disruptions

The pandemic and the progressive reopening of economic activities have highlighted the need for a better understanding of the current and potential risks that the EU is facing. Monitoring and addressing shortages in supply chains across different ecosystems is crucial given that supply disruptions could limit the economic recovery. Indeed, these disruptions translate into higher costs for businesses affecting their ability to produce and, eventually, into higher prices for consumers or directly into shortages of final products.[11] [12] This section uses sectoral economic indicators to identify supply chain distress and its potential drivers. More precisely, we rely on producer price pressures at a sectoral level in order to detect potential signals of distress. This section then deepens the analysis by looking at specific supply or demand factors leading to such price pressures.

Producer prices are on the rise (in particular in industry) after their extremely low levels of 2020. While the sectors most affected by the rise in producer prices are mainly the industry sectors, some services sectors such as those related with *Transport*, and *Postal and Courier Activities* have also seen important increases in their producer prices. Part of the standard inflation data in 2021 is affected by the so-called "base effect", given the stagnating or even decreasing level of prices in 2020. In order to filter out this effect, we calculate the annualised change in 2021 compared to 2019 levels. We observe that producer prices have risen considerably in *Transport*, in particular water transport; in *Manufacture of Basic Metals and Wood*, which are almost 15% higher on an annual basis, and also Chemicals, which are more than 6% higher on an annual basis (see Figure 3).

Figure 3: Annualised change in producer prices on 2019, sectors



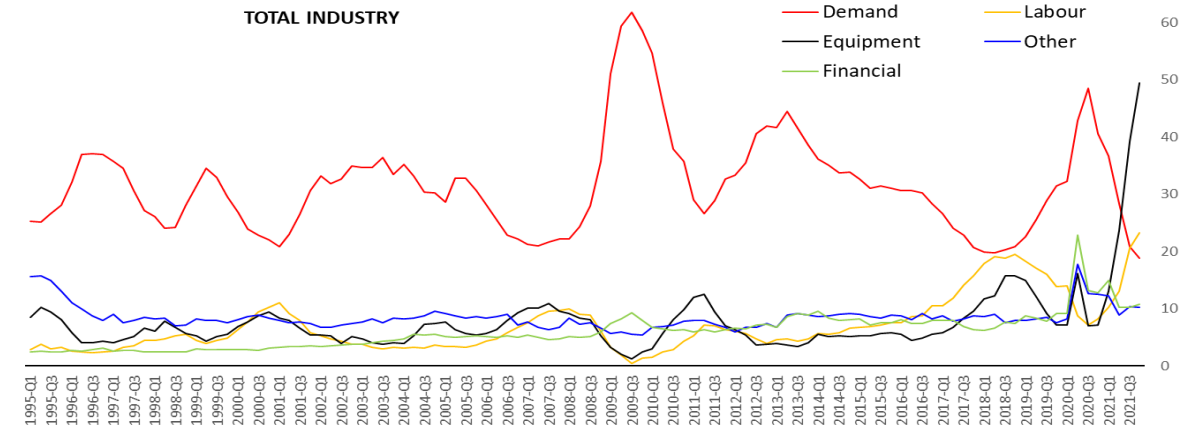
Source: Authors' calculations based on Eurostat data. Note: the indicator shows, for each sector, the annualised percentage change in producer prices in the second (blue) and third (red) quarter of 2021, with respect to the average of 2019. The values of sector H50 (Water transport) are out of scale, as the annualised increase in producer prices was 29.7% in the second quarter and 46.7% in the third one, i.e. by far the greatest increase across all sectors.

[11] Amiti *et al.* (2021) studied the pass-through of import prices to domestic prices in the US comparing time periods before and after the COVID-19 pandemic.

[12] In fact, the latest (11 November 2021) ECB Consumer Expectation Survey (CES) finds that on average, consumers are expecting inflation to be around 3% in the next year with important variations across Euro Area countries. For example, participants in Italy appear to have the highest expectations regarding inflation, with an expected inflation rate of 4%, whereas French participants expect inflation to be around 2% (ref. Expectations surveys: a tool for research and monetary policy (europa.eu)).

Among the supply factors creating price pressures, shortages of materials and equipment seem to be the most critical issue in industry.[13] A closer look at the factors limiting the production in industry, as reported by firms, shows that, for the first time, supply-side concerns about materials and equipment are the single most critical factor. In particular, in October 2021, half (49.4%) of EU firms operating in industrial sectors report shortages of materials and equipment, and the share of those reporting labour shortages (23.3%) is for the first time on records (since 1995) higher than those reporting scarcity of demand as a key problem (18.8%).[14] In other words, for the first time, demand is not the main concern for EU firms operating in industry (see Figure 4). Consequently, the assessment of businesses suggests a historical high in supply-side constraints, consistent with the concerns about supply bottlenecks presented above for several sectors.

Figure 4: Factors limiting the production in industry (% of firms reporting a constraint)



Source: Joint Harmonised EU Programme of Business and Consumer Surveys.

We build an indicator to evaluate the relative importance of supply and demand effects in determining the price pressures. This indicator signals to what extent the share of firms mentioning a demand expansion or a supply side constraint is different from the historical average of each sector. Such difference is measured in standard deviations and it provides a measure of the "impulse" coming from the two possible effects. While the increase in supply constraints of equipment and labour is directly reported in the surveys, the surge in demand is inferred from the decrease in the share of firms reporting a lack of demand. To show their relative importance, these two impulses are then weighted in percentage points. For example, in the manufacture of food products, the number of standard deviations on the supply side (labour and equipment combined) is around 6, whereas on the demand side is around 1. Consequently, Figure 5 shows that, during the last quarter of this year, 86% of the price pressure is likely due to supply constraints (in shades of blue) and the rest (14%) to demand expansion (in red). In a second step, we disentangle the relative importance of labour and equipment constraints, within the overall supply-side effect. In the example above, 22% of the price pressure seems to be due to labour constraints (light blue) and 64% to equipment constraints (dark blue).

Supply constraints seem the most important factor in explaining price pressures in most of the affected sectors.[15] Figure 5 shows that supply shortages are the main factor contributing to price pressures in the sectors previously identified, with the exception of

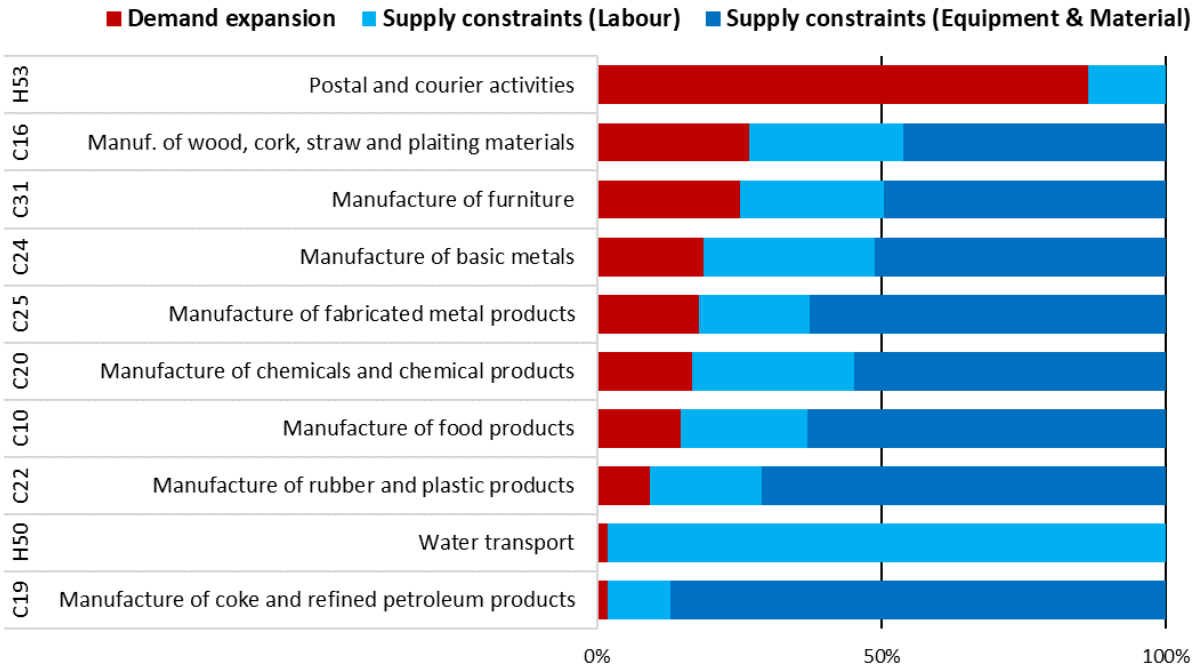
[13] The correlation coefficient is 0.55 for the whole series but it becomes 0.80 in the past three years.

[14] Note that labour shortages as reported by business surveys tend to be overestimated as suggested by Frohm (2021). This is important as shortages on the labour market have also inflationary pressures as there is a significant connection between tight labour markets and wage pressures.

[15] Guerrieri *et al.* (2020) argue that economic shocks associated to the COVID-19 pandemic –shutdowns, layoffs, and firms exits- may be characterised by supply shocks. They argue that these then trigger changes in aggregate demand larger than the shock themselves.

Postal and Courier Activities, where the very significant increase of demand seems to be the root cause of surging prices. For all these sectors, between 75% and 98% of the increase in prices seems due to supply constraints, of labour or equipment and material. Within the supply factors, labour constraints seem the main determinant of price pressures in *Water Transport*, while constraints of material and equipment explain price pressures in the other sectors (in particular, *Manufacture of Coke and Refined Petroleum Products*, *Manufacture of Rubber and Plastics*, and *Manufacture of Fabricated Metal Products*).

Figure 5: Relative importance of demand expansion vs supply constraints in determining price pressures (2021Q4)



Source: Authors calculations based on data by the Joint Harmonised EU Programme of Business and Consumer Surveys. Note: the indicator weights the number of standard deviations between the latest data point and the historical mean to capture the "impulse" coming from the different effects. Data refer to October 2021.

Given the importance of having a regular monitoring of price pressures that might signal shortages, we explore a shortages warning mechanism, which summarises the evolution of producer prices and possible underlying factors based on reported firm constraints. The problem faced when analysing the ongoing distress of supply chains is the lack of detailed product (consumer and producer) price data covering the whole economy. For this reason, we explore an alert system of potential shortages at sectoral level, which summarises the evolution of producer prices and its possible causes. In particular, it uses publically available data so as to periodically review a set of key indicators in industrial and service sectors, which allow to monitor the occurrence of potentially harmful supply chain shortages (see Box 1 at the end of the document).

Examples of distressed sectors in terms of producer price pressures include Manufacture of Basic Metals and Wood. The set of indicators under the shortages warning mechanism suggests that sectors such as *Electricity and Gas, Manufacture of Basic Metals, Wood Manufacture, Extraction of Crude Petroleum, Water Transport, Mining of Metal Ores* and *Manufacture of Chemicals* have seen a price increase of at least 10% when comparing data of July 2021 and the average of 2019.

Moreover, companies in these sectors systematically report constraints in their production coming from the unavailability of inputs and equipment.[16] For example, in *the Manufacture of Basic Metals* there is an increase in producer prices of around 27% and companies clearly report constraints on the input side. In the case of *Wood Manufacture*, a similar situation is observed, as producer prices increased by 25% and a larger share of companies reported constraints in inputs and equipment compared to before the pandemic. In order to better understand the forces at play, two important products within these sectors are more extensively analysed next so as to highlight potential causes behind the observed shortages.

Within the sector referring to the *Manufacture of Basic Metals*, magnesium is a product with significant industrial applications across various downstream sectors which is currently experiencing supply chain distress materialising in important price increases. Its end-users include the automotive industry (44% of the magnesium used in the EU), the packaging industry, aerospace, defence and consumer durables, as well as the primary steel production. Alternatives to magnesium are either non-existent or less green (already phased out several decades ago). China controls 89% of the world production of magnesium, and 93% of the magnesium consumed in the EU in 2018 came from China. The current shortages of magnesium experienced in EU supply chains seem to be partly explained by supply factors originated within China. In particular, these refer to Chinese electricity constraints given that electricity is commonly generated via coal, and this was affected by stricter environmental and safety rules, regional flooding and accidents in coal mines, and boycotts of Australian imports. All these factors contributed to raising the price of coal by over 100% during the first half of 2021 in China. Faced with this is situation, local decision-makers imposed cuts on large electricity consumers, which included magnesium and polysilicon manufacturers (see Box 2.1 at the end of the document).

When it comes to *Wood and Wood Products*, some factors explaining the price pressures and the ongoing shortages include a pronounced increase in global demand and supply bottlenecks. On the one hand, in the context of a rapid global economic recovery, the EU demand for wood has significantly increased, which is positively affected by European programmes supporting building renovations. This is supported by similar renovation programs in non-EU countries, which affect the ongoing trend in demand at a global level. On the other hand, supply bottlenecks (limited storage, labour shortages, limited capacity of European sawmills) have prevented the market from adjusting to the current demand spikes. While the EU is a producer of many wood related products, some of these products experience a high import concentration. For example, the EU relies on Russia for types of plywood (61% of EU imports) or fiberboards (50% of EU imports), Ukraine for wood wool (71% of EU imports) and China for assembled flooring panels (58% of EU imports) or blockboards (62% of EU imports). Consequently, international factors affecting important producers such as Russia, Ukraine or China can affect EU supply chains (see Box 2.2 at the end of the document).

In both of these examples the international dimension appears to play an important role in explaining the ongoing supply chain distress. For instance, the production of magnesium is highly concentrated in China and, consequently, distortions in its production due to unexpected events affect the EU industry directly due to a lack of alternative sources. On the other hand, in the case of wood, policies affecting global demand have created constraints in EU supply chains. Given the importance of the international dimension in the context of the current supply chain shortages, relying on trade flows, in the next section we

[16] A few sectors are not covered because of data unavailability.

evaluate how certain characteristics of international supply chains affect the ongoing price pressures observed in the EU market at a product level.[17]

3. Identifying common characteristics of disrupted supply chains

Based on the conclusions that emerge from the case studies on magnesium and wood, this section tests whether the primary hypothesis that concentrated global supply chains are an important driver of the ongoing price pressures observed at a product level can be generalized. An increase in import prices for specific products can be interpreted as a signal of distress, which is partly explained by ongoing shortages. The hypothesis of this section is that products likely to experience high price increases are characterised by being heavily imported by the EU and concentrated in a few foreign sources.[18] Confirming this hypothesis could be useful to guide policy actions for products experiencing distress.[19] An additional hypothesis that is going to be tested is whether long-term trends in EU demand can lead to price distress such as in the example of wood and the ongoing wave of renovations of buildings. This would suggest that the pandemic has just accelerated ongoing demand trends creating pressures.

A high import price increase is a good proxy for products experiencing shortages as identified by sectoral experts and evidence provided by industry. Sectoral experts and evidence provided by industry show that various products are experiencing shortages. In order to test that prices are a good proxy for shortages, we compare the list of products resulting from their assessment with the list of products experiencing the highest increases in terms of import price between 2021 and 2019. For this purpose, trade data is used to compute a measure of import price variation for more than 5,200 products (HS6 classification) in a systematic manner. The source of trade flows is the Eurostat-COMEXT database, which includes recent information on both the values and volumes of EU imports and exports.[20] This allows to compute import unit values (i.e. ratio between import values and volumes), which are widely used in the economic literature as a proxy for import prices.[21] The variation in the so defined import prices is then computed as a percentage change between 2021 and 2019, taking into account all import flows for the first three quarters of these two years. It is important to note that total imports (i.e. both EU and non-EU import flows) are considered to compute import prices for the whole list of products imported by the EU (more than 5200 goods). The top 20% products in terms of import price increases closely match those products experiencing shortages as reported by sectoral experts and industry.[22]

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[17] See Chad P. Bown (2021) for an in-depth analysis on the behaviour of international trade of Personal Protective Equipment (PPE) during the first first waves of the pandemic, which focuses on behaviour of China, the EU and the US.

[18] The European Commission document on strategic dependencies and capacities (2021) analysis EU's strategic dependencies so as to identify potential risks to supply chains. The concentration of foreign imports is one of the economic variables that are used to determine the level of foreign dependencies that could create risks. Other studies such as Korniyenko *et al.* (2017), Jaravel and Mejean (2020) use different indicators capturing levels of concentration so as to identify risks in supply chains.

[19] See for instance the Updating the 2020 New Industrial Strategy: Building a stronger Single Market for Europe's recovery "communication-industrial-strategy-update-2020_en.pdf (europa.eu)" where various possible actions are described. Examples include diversifying international supply chains and pursuing international partnerships to increase preparedness, pooling EU resources to build stronger and more diverse alternative supply chains with likeminded countries, creating industrial alliances so as to create know-how in the EU or the Important Projects of common European interest (IPCEIs) in areas where the market alone is not able to deliver breakthrough innovation.

[20] The latest data point considered refers to August 2021.

[21] Trade prices are an essential tool to empirical research in international economics. For a literature review see Berthou and Emlinger (2011)

[22] These include the following products among others,: agrifood (e.g. vegetable oils including palm and soya beans oil, buckwheat, poultry), energy intensive industry and construction (e.g. wood, magnesium, steel, platinum, copper, rubber, plastic,

Various economic indicators are used so as to test the main hypothesis that concentrated global supply chains are an important factor driving the import price variation. In this analysis, we test the hypothesis that while being connected to international markets is beneficial in terms of efficiency and risk reduction, in some cases, concentrated global supply chains could induce higher risks that could materialise in spikes in prices. To that end, we use a number of indicators measuring the level of foreign dependency of EU imports. More precisely, a product is considered as being highly foreign dependent if the levels of import diversification and potential substitutability with EU supply are low. Thus, to understand whether a low diversification is related to the increase in import price, the analysis uses the indicator corresponding to the concentration of EU imports from extra EU sources (i.e. Herfindahl-Hirschman Index). The underlying rationale is that a low diversification or a high concentration of imports confers more market power to suppliers and the associated risks in terms of supply chain tend to be higher, leading to an increase in prices. For example, as shown in the case study on magnesium, if this product is sourced mainly from China and an electricity crisis occurs, the risk in supply chains increases due to a lack of alternatives. In parallel, the indicator corresponding to the share of non-EU imports in total EU imports, which measures the importance of foreign imports for the EU, is also included in the analysis. Once we control for concentration levels, relying on a diversified portfolio of foreign sources could in principle reduce the product import price variation. However, our main hypothesis is tested by looking at the interplay of these two variables. In other words, we expect that import price increases are driven by a high reliance on foreign imports, which are at the same time highly concentrated.[23]

An empirical method is used to test whether concentrated global supply chains are associated with a variation in import prices for the products where the EU is a heavy importer. The estimation consists of a linear regression model of the import price variation on various dependency indicators and long-term demand variations, controlling for other confounding factors at a sectoral level. Formally, we estimate *Equation (1)* as follows:

$$\Delta\, imp\_price_{p,HS6}^{2021-2019} = \alpha_0 + \alpha_1 imp\_conc_{p,HS6}^{2019} + \alpha_2 shr\_foreign\_imp_{p,HS6}^{2019} + \alpha_3 shr\_foreign\_imp_{p,HS6}^{2019} \times imp\_conc_{p,HS6}^{2019} + \alpha_4 \Delta\, imp\_vol_{p,HS6}^{(2019/2014)} + FE_{HS2} + \varepsilon_{p,HS6} \quad (1)$$

where $\Delta\, \boldsymbol{imp\_price_{p,HS6}^{2021-2019}}$ is a binary variable set to 1 if the HS6 product *p* belongs to the top 20% products in terms of percentage change in import prices between 2021 and 2019 and 0 otherwise. The underlying rationale for using a binary variable is to ensure that the most distressed products are under scrutiny, given that, as previously mentioned, there is a significant overlap between the top 20% products in terms of price variation and the products identified by various sectoral experts and industry as experiencing shortages. $\boldsymbol{imp\_conc_{p,HS6}^{2019}}$ is the Herfindahl-Hirschman Index computed based on 2019 extra-EU import volumes for each HS6 product *p* and it is intended to capture the concentration of extra-EU imports. $\boldsymbol{shr\_foreign\_imp_{p,HS6}^{2019}}$ is the share of extra EU import volume in the total EU import volume for each HS6 product *p* in 2019 and it also captures indirectly the production capacity of the EU.[24] In order to test our main hypothesis, we rely on the interaction of these two variables as the main variable of interest. A positive sign would confirm our hypothesis that products where the EU heavily relies on concentrated foreign sources are the ones with a higher

paper, fertilizers, glass, turbines, dyestuff, sand), health (e.g. plastic gloves, resins), textile (e.g. benzene, fabrics, yarn), electronics (e.g. IT hardware including printing machinery, electrical capacitators and resistors, electric motors).

[23] This hypothesis is based on the SWD on strategic dependencies and capacities that accompanied the Industry Strategy update of 5 May 2021, which uses these indicators so as to identify products where the EU experiences a high level of foreign dependency.

[24] The variables $imp\_conc_{p,HS6}^{2019}$ and $shr\_foreign\_imp_{p,HS6}^{2019}$ are computed the same way the indicators CDI_1 and CDI_2 are computed in the SWD(2021) 352 final, with the only difference that in the current analysis trade volumes are used instead of values to avoid any endogeneity issues that might arise.

likelihood of experiencing import price increases. The last explanatory variable, $\Delta\, \boldsymbol{imp\_vol}_{p,HS6}^{(2019/2014)}$, is intended to capture the long-term variation in demand and it is computed as the change in import volume in 2019 compared to 2014. This is important as it gives an indication of the fact that the global industrial transformation, which might increase the demand for particular products, could also affect price variation. The regression takes into account any industry characteristics that might influence the price variation (e.g. rising average demand for a particular industry) by controlling for sectoral fixed effects $\boldsymbol{FE}_{HS2}$. Finally, the error term $\boldsymbol{\varepsilon}_{p,HS6}$ captures all the other factors that might explain the import price variation at the product level that have not been specifically included in the regression model (e.g. trade policy interventions for specific products, shipping costs).

Our main finding is that the most important price increases occur for those products where the EU is heavily reliant on foreign imports and with a high import concentration. The results from the estimation of *Equation (1)* are presented in *Column (1)* of Table 1. Results in Column (1) show that after controlling for specific industry characteristics, the coefficient on the indicator corresponding to the concentration of EU imports is positive but insignificant, while the coefficient corresponding to the share of extra EU import volume in the total EU import volume is negative and significant. More importantly, the interaction of these two variables is positive and significant, suggesting that relying on foreign imports has not necessarily increased the likelihood of experiencing high price increases, as long as the EU imports have a high degree of diversification. In other words, this confirms our hypothesis that products for which the EU is heavily reliant on foreign imports and with a high import concentration are the ones experiencing particularly high import price increases. Another factor observed to have increased the likelihood of experiencing a rise in import prices is the long-term demand trends that were already ongoing before the pandemic. This suggests that the pandemic has exacerbated already existing trends in international demand.

These results are robust to different specifications of the model, regardless of the way the various variables have been computed. The described findings using the *Baseline* empirical framework are robust to various alternative specifications. First, the results presented hold if we control for more disaggregated industry characteristics using HS4 codes (see *Column (2)*). Second, the main messages extracted using the *Baseline* specification are also confirmed when creating more restrictive binary independent variables (see *Column (3)*). In this regard, highly concentrated products are defined as those with a concentration indicator above 0.4, suggesting that imports are coming from less than 3 destinations. In parallel, a high importance of foreign imports in total EU imports is defined as products where the majority of imports come from extra-EU countries.[25] Third, the results are also robust when using a more restrictive definition of the dependent variable, where only the top 10% increases in prices are identified (see *Column (4))*. Fourth, *Column (5)* uses a continuous measure of price variation instead of a binary measure, confirming that the results are not driven by the particular threshold imposed in the baseline framework. This suggests that the main variables used in the analysis – concentration of foreign imports and share of foreign imports – not only explain the highest price increases but also smaller price movements. Finally, *Column (6)* uses changes in quantities as a dependent variable instead of changes in prices. This robustness check is motivated by the definition of shortage, which suggests an imbalance between supply and demand affecting not only prices but also quantities. Confirming our main hypothesis and consistently with the definition of shortages, the results suggest that products with a high import concentration where the EU is heavily reliant on foreign imports are also the ones experiencing decreases in import volumes.

[25] These thresholds follow the definition of strategic dependencies presented in the SWD on strategic dependencies and capacities that accompanied the Industry Strategy update of 5 May 2021.

Table 1 : Factors explaining the increase in import prices

	Baseline	Robustness				
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable:	**=1 if top 20% Δ import price**	=1 if top 20% Δ import price	=1 if top 20% Δ import price	=1 if top 10% Δ import price	Δ import price	=1 if top 20% Δ import volume
Concentration of non-EU imports	**0.0026**	-0.0083		0.0315	-0.5310	0.0958**
	(0.0454)	(0.0527)		(0.0374)	(0.3778)	(0.0472)
Importance of non-EU imports	**-0.0021*** **	-0.0025***		-0.0016***	-0.0156***	-0.0026***
	(0.0005)	(0.0007)		(0.0004)	(0.0041)	(0.0005)
Concentration X Importance of non-EU imports	**0.0023****	0.0020*		0.0018**	0.0257**	0.0024**
	(0.0010)	(0.0012)		(0.0008)	(0.0101)	(0.0011)
=1 if Concentration of non-EU imports > 0.4			0.0094			
			(0.0134)			
=1 if Importance of non-EU imports > 0.5			-0.0641***			
			(0.0205)			
=1 if Concentration of non-EU imports > 0.4 X =1 if Importance of non-EU imports > 0.5			0.0440*			
			(0.0254)			
Δ Long-term demand	**0.0004*****	0.0004***	0.0004***	0.0004***	0.0071***	0.0004***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0006)	(0.0001)
Observations	**5,175**	4,888	5,181	5,175	5,175	5,175
R-squared	**0.0715**	0.2912	0.0685	0.0787	0.0678	0.1221
HS2 FE	**YES**	NO	YES	YES	YES	YES
HS4 FE	**NO**	YES	NO	NO	NO	NO

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

4. Conclusions

The Covid-19 pandemic and other recent events have led to supply chain distress across countries and industrial ecosystems, which materialised in shortages, indirectly affecting the prices of certain goods. Given the implications of shortages and price pressures for the resilience of critical supply chains and the overall recovery, this paper aimed at shedding light on these recent developments and some of their potential causes. More precisely, in a first step, it has explored a shortages warning mechanism to regularly monitor the sectors affected by important price increases and to disentangle the relative importance of demand or supply. Then, the paper has focused on two sectors where important price increases are observed, namely basic metals and wood products. Within these sectors, two case studies have been analysed - magnesium and wood - to dig deeper into the potential causes of the observed supply chain distress. Finally, based on the findings from the the two case studies and using detailed trade data at product level, this paper has addressed the following questions: Is the likelihood of experiencing price distress (and potentially a shortage) in the EU higher for products where the EU is heavily reliant on foreign imports and where these foreign imports are highly concentrated? Is the likelihood of experiencing price distress (and potentially a shortage) in the EU higher for products where there is a strong global structural demand increase?

A main finding of this paper is that the likelihood of experiencing price increases (likely associated with shortages) in the EU is higher for products with a high import concentration and where the EU is heavily reliant on foreign sources. The quantitative evidence from the analysis carried out highlights the importance of tools to monitor shortages and finds evidence that external dependencies where potential for further diversification is limited are often at the root of observed shortages. In addition, it also finds evidence that products where there is a strong structural demand increase are more likely to experience price pressures.

While this analysis tests the hypothesis that concentrated global supply chains could be an important driver of the ongoing supply chain distress observed at a product level, other channels might also play an important role. Other factors likely to drive the import price variation include increases in energy prices, shipping costs and delays, as well as trade policy decisions, among others. Studying the determinants of price variations beyond the hypothesis tested in this paper could open avenues for further research in order to better understand the ongoing supply chain distress, as a first step to build more resilient supply chains.

Box 1 : A Shortages alert mechanism

A shortage is defined as an imbalance between supply and demand of goods or services. The shortages alert mechanism (SAM) among industrial and service sectors explored here **aims to detect potentially harmful supply chain shortages and map the disruptions in the supply of essential inputs,** which may threaten the recovery and risk creating inflationary pressures. **SAM sets a focus on industries, services and ecosystems to help:** (1) monitor distress across supply chains; (2) contribute to the detection of factors causing supply chain distress.[26]

What is included in SAM?
The SAM is based on ***official statistics*** (e.g. prices) and ***survey data*** (e.g. aggregate firms perceptions and economic analysts). This combined approach has the advantage of frequent (monthly and quarterly) updates based on a multilevel approach with different level of aggregation. Recent ***market intelligence*** (including examples) provided by different ecosystem units in DG GROW, based on experience by knowledgeable actors in the ecosystem, will be used to complement these two aspects.

Official statistics comprise price information from Eurostat for the identification and monitoring of large or abrupt changes, which could be an early indication of possible price imbalances. The **survey data** used exploit five indicators on the main constraints or factors that limit the production of goods: demand, labour, equipment, finance and other. These are retrieved from DG ECFIN's Joint Harmonised EU Programme of Business and Consumer Surveys. Both sources allow for regular monitoring and consistent reporting for multiple industrial and service sectors and ecosystems

How to read the SAM?
The SAM offers a comparison between the latest values and the pre-pandemic values (average of 2019) of the set of indicators considered. The first column presents the **NACE code** of the respective industry or service, while the second and third column respectively indicate the **sector** and the **ecosystem(s)** considered. The fourth column represents the **share of the industry or service within the total value added** (in 2018) that is used to rank indicators in SAM. The fifth and sixth columns display the **producer prices** with price index 2015 = 100. The 5 last columns reflect the share of firms that indicated a particular production constraint (demand, labour, equipment, finance and other) in the Joint Harmonised EU Programme of Business surveys.[27] SAM is to be complemented by product information relying on market intelligence, web scrapping or detailed trade data among other sources (see the case studies of wood and related products or magnesium).

While the *levels* of producer prices and constraints are also important, we chose to focus on the *evolution* of producer prices and constraints. Producer prices experiencing a price increase of at least 3% are indicated in yellow and increases of at least 10% are in red. For constraints, reported constraints experiencing an increase of at least 50% are in yellow and those experiencing a doubling (100% increase) are in red.

[26] Information at a country level can be obtained, depending on data availability.

[27] The Shortages Alert Mechanism refers to the following question: "What main factors are currently limiting your production?" Respondents are given the options: "(1) Insufficient demand, (2) Labour shortages, (3) Material and/or equipment shortages, (3) Financial constraints, (4) Uncertainty about economic policy (e.g. tax, government spending, regulation, central bank policy), (5) Uncertainty about economic policies impacting your sector, (6) Rental costs, (7) None (DNRO), (8) Other (please specify)". In the SAM, "Other" refers to option (4), (5), (6) and (8). Respondents were requested to either select one or several factors (yes/no answer).

A shortages alert mechanism

				Producers Prices (2015=100)		Survey Data on Constraints									
						Demand		Labor		Equipment		Financial		Other	
Nace	Sector	Ecosystem	Share of Total Value Added	Avg. 2019	2021 M07 /Q2 for services	Avg. 2019	2021 Q4	Avg. 2019	2021 Q4	Avg. 2019	2021 Q4	Avg. 2019	2021 Q4	Avg. 2019	2021 Q4
L68	Real Estate Activities	Social Proximity	10.8%	*NA*	*NA*	16.6	16.7	11.4	14.4	3.6	2.4	11.2	10.9	20.5	23.3
M69	Legal and Accounting Activities	Aerospace & Defense, Agrifood, Construction, Creative & Cultural,	3.4%	*NA*	*NA*	29.5	22.9	17.5	26.3	1.7	0.8	5.1	4.2	13.2	17.3
K64	Financial Service Activities (exc. Insurance and pension funding)	*NA*	2.9%	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	NA	*NA*	*NA*	*NA*	*NA*
J61	Telecommunictions	Aerospace & Defense and Digital	2.7%	97.03	94.9	41.6	31.9	6.9	10.5	0.5	1.7	22.7	23.1	18.7	27.1
J62	Computer Programming, Consultancy and related activities	Digital	2.7%	103.9	106.2	20.9	17.8	32.9	40	2.4	2.8	9.2	5.6	12.5	17
H49	Land Transport and Transport via pipelines	Tourism and Mobility-Automotive	2.3%	*NA*	*NA*	25.6	25.3	32	40.2	4.2	4.8	11.7	10.9	19.8	26.6
N80	Security and Investigation Activities	Aerospace & Defense	2.0%	107.7	112.9	20	31.4	28.3	30.4	0.8	-1.3	10.4	12.6	19.4	18.2
C28	Manufacture of Machinery and Equipment	Aerospace & Defense, Agrifood, Construction, Creative & Cultural,	1.9%	104.3	107.3	26.4	11.4	18.8	26.5	13.2	63.7	6.1	5.9	5.4	9
C29	Manufacture of Motor Vehicles, Trailers and Semi-Trailers	Aerospace & Defense and Mobility-Automotive	1.9%	101.5	104,5	24.1	18	15	22.7	13.8	82.7	7	10.7	7.1	10.3
D35	Electricity, Gas, Steam and Air Conditioning Supply	Renewable Energies	1.8%	105.2	123.1	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
H52	Warehousing and Support Activities for Transportation	Aerospace & Defense and Mobility-Automotive	1.8%	*NA*	*NA*	26.2	19.5	18.3	25.9	7.5	6.5	10	6.7	16.8	25.2
C10	Manufacture of Food	Agrifood	1.5%	104.0	108.9	26.5	28	16.1	23.9	8.8	25.5	9	11.7	8	9.6
C25	Manufacture of Fabricated Metal Products (exc. Machinery and Equipment)	Aerospace & Defense, Agrifood, Construction, Creative & Cultural,	1.5%	105.0	112.2	34.4	20.1	21.4	29.5	6.9	51.1	8.4	8.9	7.7	13.1
M71	Architectural and Engineering Activities; technical testing and analysis	Aerospace & Defense, Agrifood, Construction, Creative & Cultural,	1.4%	105.78	107.5	24.8	21	27.1	33.6	2.8	3.9	7.5	13.2	15.4	18.4
N77	Rental and Leasing Activities	Aerospace & Defense, Agrifood, Construction, Creative & Cultural,	1.2%	*NA*	*NA*	24.5	33.5	17.3	21	3.4	10.6	7.3	5.9	13.3	23.7
N78	Employment Activities	Aerospace & Defense, Agrifood, Construction, Creative & Cultural, Electronics, Energy Intensive	1.2%	109.65	114.9	24.1	8.8	41.6	57.7	1	0.8	4.3	1.7	18.5	18.9
J60	Programming and Broadcasting Activities	Creative & Cultural	1.1%	*NA*	*NA*	33.6	37.3	2.8	6.1	1.4	-1.5	18.4	16.3	31	44.3
C21	Manufacture of Basic Pharmaceutical Products and Pharmaceutical Preparations	Health	0.9%	99.7	96.9	6.8	10.8	11.3	7	15.3	33.2	17.4	7.4	10.7	6.5
M72	Scientific Research and Development	Aerospace & Defense, Agrifood, Construction, Creative & Cultural, Electronics, Energy Intensive	0.9%	*NA*	*NA*	32	NA	32	NA	10.3	NA	30.5	NA	9.2	*NA*
C22	Manufacture of Rubber and Plastic Products	Energy Intensive Industry	0.8%	101.5	107.8	33.6	27.1	6.3	25	6.3	67.1	6.6	8.1	7.4	8.9
C27	Manufacture of Electrical Equipment	Aerospace & Defense, Renewable Energies and Mobility-Automotive	0.8%	102.9	106.6	32.9	9.4	15.8	27.8	12.1	74.6	5	6.8	6.8	9.4
K65	Insurance, Reinsurance and Pension Funding (exc. Compulsory social security)	*NA*	0.8%	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	NA	*NA*	*NA*	*NA*	*NA*
S96	Other Personal Service Activies	Social Proximity	0.8%	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
C33	Repair and Installation of Machinery and Equipment	Aerospace & Defense, Agrifood, Construction, Creative & Cultural,	0.7%	106.5	110.2	23.8	16.2	31.2	32.2	6.1	44.3	9.7	10	12	13.3
K66	Activities Auxiliary to Financial Services and Insurance Activities	*NA*	0.7%	*NA*	*NA*	*NA*	*NA*	*NA*	NA	*NA*	NA	*NA*	*NA*	*NA*	*NA*
S94	Activities of Membership Organizations	Creative & Cultural	0.7%	*NA*	*NA*	*NA*	*NA*	*NA*	NA	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
C23	Manufacture of Other Non-Metallic Mineral Products	Energy Intensive Industry	0.6%	105.6	109.3	29.1	17.1	14.9	20.8	9.6	27.3	8.3	10	10.7	13.6
C24	Manufacture of Basic Metals	Energy Intensive Industry	0.6%	110.4	139.9	44.1	16.2	10.9	20.6	6.3	30.8	7.5	12	11.8	18.5
J58	Publishing Activities	Creative & Cultural and Digital	0.6%	*NA*	*NA*	35.7	41.4	9.1	12.7	0.6	2	9.7	9.8	23.5	27.1
R93	Sports Activities and Amusement and Recreation Activities	Tourism	0.6%	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
C30	Manufacture of Other Transport Equipment	Aerospace & Defense and Mobility-Automotive	0.5%	103.8	105.5	21.6	35	12.6	2.8	22.5	54.2	5	2.4	6.6	8.2
J59	Motion Picture, Video and TV Production	Creative & Cultural	0.5%	*NA*	*NA*	35.7	33.5	5.3	16.3	1.1	3.9	15.4	7.4	19.2	28.1
M74	Other Professional, Scientific and Technical Activities	Creative & Cultural	0.5%	*NA*	*NA*	31	35	10.7	24.4	3.4	5.1	11.9	11.2	23.9	20.3
C17	Manufacture of Paper and Paper Products	Energy Intensive Industry	0.4%	106.1	109.9	30.3	8.9	9.9	21.8	9.1	44.8	5.6	9.4	5.9	6.7
C32	Other Manufacturing	Creative & Cultural and Health	0.4%	101.9	103.2	17.9	18.6	21.7	15	9.5	34.3	4.7	5	8.1	7.1
H53	Postal and Courier activities	Retail	0.4%	110.6	117.5	33.3	*22.6*	19.3	14.3	13.9	4.4	17.1	2.7	13.1	16.8
M73	Advertising and Market Research	Creative & Cultural	0.4%	100.4	100.8	40.5	34.3	11.2	17	3.1	2.9	10.8	8.5	12.4	19.2
C11	Manufacture of Beverages	Agrifood	0.3%	104.3	105.9	19.2	25.4	5.7	11.3	8	24.5	6	12.5	9.5	12.3

				Producers Prices (2015=100)		Survey Data on Constraints									
						Demand		Labor		Equipment		Financial		Other	
Nace	Sector	Ecosystem	Share of Total Value Added	Avg. 2019	2021 M07 /Q2 for	Avg. 2019	2021 Q4	Avg. 2019	2021 Q4	Avg. 2019	2021 Q4	Avg. 2019	2021 Q4	Avg. 2019	2021 Q4
C16	Wood Manufacture (exc. Furniture)	Energy Intensive Industry	0.3%	105.4	131.4	29.4	15.6	17.8	25.5	10.5	36	11.2	11.3	8.3	8.7
C31	Manufacture of Furniture	Construction	0.3%	104.5	109.7	36.7	18	15.8	28.4	5.8	45.3	8	10.6	7.6	15.1
H51	Air Transport	Aerospace & Defense and Tourism	0.3%	102.7	109.7	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
B06	Extraction of Crude Petroleum and Natural Gas	*NA*	0.2%	84.6	119.7	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
C13	Manufacture of Textiles	Textile	0.2%	103.5	106.1	40.8	33.7	13.2	23.6	6.5	31.4	6	8.3	8.9	9.7
C14	Manufacture of Wearing Apparel	Textile	0.2%	102.5	103.6	31.6	33.5	7.1	8.4	0.8	13.7	5.8	10.8	7	13.6
C18	Printing and Reporduction of Recorded Media	Creative & Cultural	0.2%	100.2	100.2	41.7	35.5	15.9	26.7	4.1	32.4	9.8	8.4	9.3	6.7
C19	Manufacture of Coke and Refined Petroleum Products	Energy Intensive Industry	0.2%	116.8	126.2	16.8	16.7	1.4	2.3	5.6	32.4	9.6	9.9	20.5	6.9
E36	Water Collection, Treatment and Supply	*NA*	0.2%	104.9	108.7	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
H50	Water Transport	Tourism and Mobility-Automotive	0.2%	97.82	154.6	*NA*	29.2	*NA*	15.2	*NA*	1.4	*NA*	7.6	*NA*	19.9
N79	Travel Agency, Tour Operator Reservation Service and related activities	Tourism	0.2%	*NA*	*NA*	43.8	50.3	9	8.2	1.8	0.3	7.2	8.3	18.2	46.7
B05	Mining of Coal an Lignite	*NA*	0.1%	125.4	129.0	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
B08	Other Mining and Quarrying	*NA*	0.1%	104.7	110.0	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
C12	Manufacture of Tobacco Products	Agrifood	0.1%	108.3	112.9	*NA*	4.6	*NA*	60.4	*NA*	64.8	*NA*	71.8	*NA*	6.2
C15	Manufacture of Leather and Related Products	Textile	0.1%	103.2	105.6	27.5	32.8	6.1	14.6	2	8.4	3.7	5.3	8	18.6
S95	Repair of Computers and Personal and Household Goods	Creative & Cultural, Digital and Social Proximity	0.1%	*NA*	*NA*	33.2	30.9	13.9	6.5	1.8	2.4	18.2	8.6	31	40
B07	Mining of Metal Ores	*NA*	0.0%	129.4	193.8	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
B09	Mining Support Service Activities	Energy Intensive Industry	0.0%	108.4	111.5	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
C20	Manufacture of Chemicals and Chemical Products	Energy Intensive Industry	*NA*	103.2	114.3	23.8	11.5	7.7	12.7	10.8	47.9	6.2	5.7	6.7	8.9
C26	Manufacture of Computer, Electronic and Optical Products	Aerospace & Defense, Digital and Electronics	*NA*	94.5	91.3	30.1	15.3	20.9	28.3	11	61.9	7.3	14	7.1	10.9
I55	Accomodation	Tourism and Social Proximity	*NA*	109.07	*NA*	36	41.4	18.4	29.1	4	1.1	11.5	7.3	21.9	35.5
I56	Food and Beverage Service Activities	Tourism and Social Proximity	*NA*	107.08	*NA*	33.2	34.2	19.7	22	4.6	3.5	11.5	8.8	17.9	34.9
J63	Information Service Activities	Creative & Cultural and Digital	*NA*	102.58	103.6	27	27.6	17.3	21.4	1.3	3.2	8.4	4.4	18.8	16.4
M70	Activities of Head Offices	Aerospace & Defense, Agrifood, Construction, Creative & Cultural,	*NA*	*NA*	*NA*	25.5	21.5	15.6	22.9	3	3.3	8.4	6.4	11.6	19.9
M75	Veterinary Activities	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	NA	*NA*	NA	*NA*	*NA*	*NA*	*NA*
N81	Services to Buildings and Landscape Activities	Construction and Social Proximity	*NA*	*NA*	*NA*	21.6	17.5	25.4	37.8	2.7	2	7.9	6.6	20.1	21.2
N82	Office Administration, Office Support and Other Business Support Activities	Tourism and Social Proximity	*NA*	*NA*	*NA*	31.6	40.7	12.4	16.5	1.9	2.7	6.7	5.6	16.2	27
R90	Creative, Arts and Entertainment Activities	Creative & Cultural and Tourism	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	NA	*NA*	*NA*	*NA*	*NA*
R91	Libraries, Archives, Museums and other cultural activities	Creative & Cultural and Tourism	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	NA	*NA*	*NA*	*NA*	*NA*
R92	Gambling and Betting Activtiies	Tourism	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*	NA	*NA*	*NA*	*NA*	*NA*

Legenda Price Info	
	min. 3 %
	min. 10%

Legenda Survey Data	
	min. 50 %
	min. 100%

Box 2: Case-studies
2.1. Magnesium[28]

Magnesium is a metal with significant industrial applications across various downstream sectors. Its end-users include the automotive industry (44% of the magnesium used in the EU), the packaging industry, aerospace, defence and consumer durables, as well as the primary steel production. For instance, magnesium provides strength properties to the aluminium alloys and it constitutes up to 5% of the 179kg of aluminium used in a vehicle, on average. It is important to highlight that in most cases, there are very few viable alternatives that could replace magnesium as an input.

Magnesium is considered as a critical raw material for the EU due to its strategic applications and the dependency on supply from limited foreign sources. Magnesium is one of the 137 products identified by the EU Commission as experiencing foreign dependencies.[29] Indeed, the production of magnesium is heavily concentrated, with China controlling 89% of the world production. In 2018, 93% of the 184 thousand tons consumed in the EU originated from China, with other countries like Russia, Israel, Serbia, the UK or Turkey represented by small shares. Since September 2021, aluminium and steel producers in the EU have been experiencing shortages of magnesium, possibly explained by various cancellation of orders originating from China. This was triggered by the energy crisis in China - including coal shortages - combined with the attempt to reach lower emission targets, which led to the abrupt closure of some plants. For example, in the main magnesium production hubs in the world, which are located in Shaanxi and its provinces, 25 magnesium plants had to shut down, which led to a global disruption, implicitly affecting EU's supply chains. This global disruption in supply led to a substantial increase in the magnesium price.[30] The Chinese press reported that, at the end of October 2021, in the Fugu county (the north of Shaanxi province), where half of the magnesium production in China is located, magnesium smelters had recovered about half of their lost capacity, mainly due to a recent decrease of coal price. The production of magnesium is expected to reach 85% of its 2020 level during the last quarter of 2021. However, even if the production resumes, the supply disruption and/or the higher costs will continue to be felt by the EU industry in the near future. This is partly explained by the relatively low stocks of magnesium (usually enough to maintain production for 4 to 8 weeks) and the relatively long lead times (around 3 months) for the shipments arriving from China. Consequently, in the short-run, the production of downstream sectors might be negatively affected.

2.2. Wood and wood products shortages[31]

Wood is an essential input in the construction sector with important implications for the green objectives of the EU. While wood and wood products represent on average only around 8.5 % of material inputs used in the construction sector, they are often essential components (e.g. joinery, roof structure, engineered boards). Moreover, wood has a high significance for specific construction companies specialised in wooden constructions, or in some Member States where wood is used more extensively (e.g. Lithuania, Finland, Sweden or Austria). These market developments cause various risks for EU's policy objectives such as the

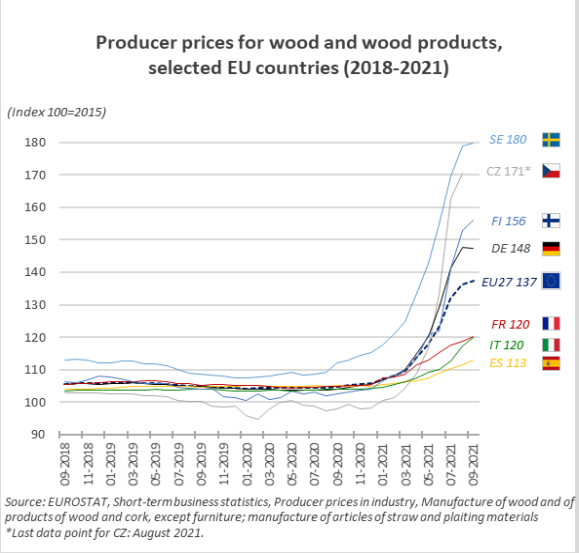
[28] Authors thank Salvatore Berger (DG GROW) for his contribution.
[29] Commission Staff Working Document on strategic dependencies and capacities ("swd-strategic-dependencies-capacities_en.pdf (europa.eu)").
[30] Magnesium | 2021 Data | 2022 Forecast | 2012-2020 Historical | Price | Quote | Chart (tradingeconomics.com)
[31] Authors thank Pieter Staelens and Etienne Pasteau (DG GROW) for their contribution.

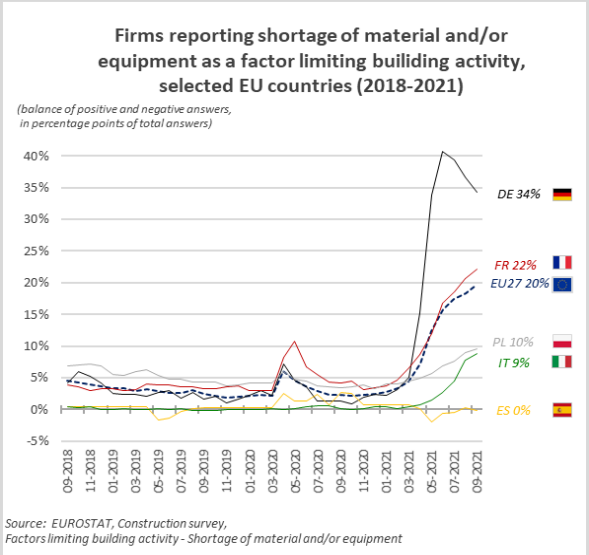
National Recovery and Resilience Plans, the renovation wave and the promotion of sustainable construction.

Shortages of wood and wood products make the EU construction ecosystem vulnerable. Shortages in wood and wood products can lead to the postponement of new projects due to increased uncertainty among developers about total price and delivery date, delays in projects with penalties, and problems with public tendering because of a lack of indexation agreements in contracts. This market situation can also induce a risk of failures and permanent loss of skilled workers, an investment slowdown (R&D, digitalization, green technologies), as well as a negative impact on the implementation of the renovation wave and a lower affordability of housing.

Shortages in wood and wood products have already been felt in terms of price increases, having a negative impact on the sectoral output. The construction ecosystem in the EU has faced shortages of wood products and corresponding significant price increases for wood and wood products since spring 2021. In September 2021, average producer prices for wood and wood products in the EU27 were +31% higher than a year before. The acuteness of the situation varies across Member states and types of wood products, as there are different markets for raw materials (roundwood), intermediate materials (timber) and end products. As a matter of fact, these shortages appear to be negatively correlated with construction output. The most recent figures indicate a -1.8% drop at the EU level between July and August 2021, with a more pronounced decrease in Sweden (-10.5%), Germany (-3.1%) and Hungary (-5.9%), countries particularly affected by the price spikes and shortages.

Price evolution of wood and wood products and share of firms reporting material shortages





The increase in demand is the main explanatory factor for these market developments. Demand for European raw wood coming from China and the US has increased in a context of rapid recovery, as well as an additional domestic demand implied by domestic national and European programmes supporting renovation. More structurally, wooden products are increasingly used in the construction sector to meet climate-related objectives. Finally, rising energy prices are driving up demand for wood pellets, which compete with wood use in panels and particle board. In the medium term, while demand from outside the EU will

possibly subside, domestic demand for wood construction products will continue to increase, in part due to EU policies supporting the green transition.

In parallel, supply bottlenecks have prevented the market from adjusting to the current demand spikes. In the short term, the lack of adjustment is explained by the limited storage and felling capacities due to the pandemic, labour shortages in the wood sector and the limited capacity of European sawmills to cope with the surging global demand. Supply is further reduced by the impact of bark beetle damages, especially in Central Europe as regards spruce, and regulations on the use of damaged wood from sanitary feelings, in combination with transport bottlenecks.

There is limited supply of wood and wood products also coming from international partners. Apart from the domestic factors, the international developments are also affecting the EU supply. First, there is a limited supply of raw materials and products from outside the EU, partly due to observed supply bottlenecks for softwood in Canada and the wood export ban from Ukraine. Second, expectations of a forthcoming export ban from Russia increase the pressure on EU supply mainly exerted by buyers from China. Third, there are difficulties with imports of wood products from China, with delays or no-deliveries reported. Finally, higher price increases are observed for wood products, especially for Oriented Strand Board (OSB) and plywood made from softwood, which suggests supply chain issues at the intermediate level (sawmills, production, transport).

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