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Belgium's import and export dependence on non-EU countries

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Michel Dumont, dm@plan.be
Bernhard Michel, bm@plan.be
Glenn Rayp (Ghent University), glenn.rayp@ugent.be

Abstract - Various crises as well as ongoing geopolitical tensions have reduced trust in the international supply of goods. To inform policy in this context, we propose a methodology to determine for which goods Belgium's imports and exports are highly concentrated among a limited number of non-EU countries, whether these goods are strategic and whether the dependence is persistent. We also look at indirect dependence within global supply chains and estimate the impact of potential disruptions on the Belgian economy. Belgium's import and export dependence on non-EU countries has remained fairly constant during the years 2014-2023. We find that the importance of the United States as a trading partner has decreased while that of China has increased. In addition, Belgium's indirect dependence on non-EU countries turns out to be substantial, for both imports and exports. According to our results, the loss in activity due to a disruption in the imports of strategic goods with strong and persistent dependence on non-EU countries would amount to 2% of Belgian manufacturing value added. For disruption in exports, this would be 0.5%.

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Keywords - imports and exports, global supply chains, non-EU dependence, strategic goods

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Executive summary

Trust in the international supply of goods has suffered in recent years due to various events such as natural disasters, the Covid-19 pandemic, problems with shipping, and the Russian invasion of Ukraine, as well as ongoing geopolitical tensions like the increasing trade disputes between the United States and China. The global supply of goods used to be assessed mainly from the perspective of economic efficiency and making the most of each country's strengths but is now increasingly seen as a potential risk for countries, that of being too dependent and vulnerable, in particular for technologies considered to be strategic. A growing number of countries are trying to reduce their dependence on trading partners that they consider as 'problematic'. This may take the form of bringing production back home (reshoring), moving it to nearby countries (nearshoring), moving it to friendly countries (friendshoring), or generally of reducing risks, for example by diversifying suppliers (de-risking). In response to China's state support for various strategic technologies, and its dominance in key parts of the global production chain, the US and the EU are developing strategic plans with specific goals and actions to support their own industries. Some of these measures are clearly protectionist such as favouring domestic manufacturing under the 'Inflation Reduction Act of 2022' and the 'CHIPS and Science Act of 2022' in the US. With its Open Strategic Autonomy, the EU seeks to shield its internal market from unfair or abusive trade practices by establishing mutually beneficial bilateral relationships, by diversifying global supply chains and by monitoring strategic dependencies.

The European Commission has developed a methodology to determine to what extent the EU is dependent on goods imported from outside the EU. This methodology is applied, among other things, for establishing a list of critical raw materials for the EU. In this paper, we identify Belgium's dependence on non-EU countries starting from the European Commission's method. However, our methodology differs from the one of the European Commission in several respects. In addition to imports, we also consider exports. Recent examples such as the export restrictions imposed by the EU following the invasion of Ukraine, and the ban imposed by the United States on exports by the Dutch company ASML of lithography machines – needed to produce computer chips – to China, show that strong export dependence may also be an issue.

To identify goods that are strategic, we have used and extended the list developed by Mignon (2023). This list is originally based on the US International Trade Administration's 'Draft List of Critical Supply Chains', which reflects the US policy view on how to improve the resilience of supply chains in critical industries, and it has been supplemented by Mignon (2023) with goods considered strategic by the EU.

Unlike most other studies, we work with data on international trade at the most detailed goods level. We show that an analysis based on less detailed data results in a biased assessment of trade dependence. By working with data for 10 years (2014-2023), rather than for just one year as in most studies, we find that when, for a given good, Belgium is highly dependent on non-EU countries for imports or exports, this dependence is usually temporary. There is only a limited number of goods for which Belgian import and export dependence is persistent.

Belgium's dependence on countries outside the EU is greater for imports than for exports. During the period 2014-2023, the number of goods for which Belgium relies heavily on non-EU countries for imports remains relatively stable. The share of goods with high dependence in Belgium's total import value increases slightly, for all goods as well as for strategic goods. For exports, the number of goods for which Belgium is dependent is on the rise. However, the share of goods with high dependence in Belgium's total export value decreases except for strategic goods for which the share increases slightly. At the lowest threshold that we consider in defining dependence[1], we find that that Belgium is highly dependent for 14 to 17% of the more than 9 000 goods that it imports. For strategic goods, this share is only 3 to 4%. At the highest threshold that we consider, it amounts to 5 to 6% for all goods, and 1 to 2% for strategic goods. At the lowest threshold, goods with high import dependence represent on average 12% of the total import value, for strategic goods it is on average just over 4%. At the highest threshold, this average is just 4% for all goods and just under 2% for strategic goods. In terms of exports, Belgium is highly dependent at the lowest threshold level for 13 to 14% of all goods it exports and for 3% of strategic goods. At the highest threshold level, this amounts to 5 to 6% for all goods and 1% for strategic goods. At the lowest threshold, goods with high export dependence represent on average 10% of the total export value, for strategic goods it is on average just over 2%. At the highest threshold, this average is 2% for all goods and barely 0.4% for strategic goods.

The largest number of goods for which Belgium has a high import dependence come from China, followed by the United States and the United Kingdom. When it comes to imports of strategic goods, Belgium is more dependent on the United States than on China. However, dependence on China is increasing for strategic goods while dependence on the United States is decreasing. During the period under review, there are 81 strategic goods for which Belgium's import dependence is persistent (see Table 5 on page 34). For 39 of these goods, the United States is the main supplier to Belgium, for 11 goods it is China, and for 6 goods it is the United Kingdom. In terms of exports, the United Kingdom and the United States share the first place with the highest number of goods for which Belgium is highly dependent, followed by China. For strategic goods, the United States is the main buyer from Belgium, followed by the United Kingdom and China. There are 25 strategic goods for which Belgium's export dependence is persistent (see Table 6 on page 38). For 11 of these goods, the United States is the main destination, for three goods Switzerland and only for two goods China.

While bilateral trade data allow to estimate Belgium's import and export dependence at a very detailed level of disaggregation, they do not allow to identify indirect dependence due to upstream or downstream links within global supply chains. Hence, as a complement, we calculate Belgium's total (direct and indirect) dependence on non-EU countries both on the import and export side. These calculations are based on global multi-country input-output data, which map how production and trade are organized across different industries and countries worldwide. We find that Belgium's indirect dependence on non-EU countries is substantial, for both imports and exports.

From a country perspective, the results on total dependence are in line with the findings for direct dependence based on bilateral trade data. They reveal that, among non-EU countries, Belgium is most dependent on China for imports, followed by the United States and Russia. Belgium's import

[1] For the geographical concentration of Belgian imports and exports, calculated with the Herfindahl-Hirschman Index, 0.25 is the lowest threshold that we consider and 0.5 is the highest threshold (see section 2.1 for more details).

dependence on China is particularly high in 'computer, electronic and optical products', 'electrical equipment', 'motor vehicles, trailers and semi-trailers' and 'machinery, apparatus and tools' and its import dependence on the United States is highest for 'basic pharmaceutical products and pharmaceutical preparations' and 'chemical products'. Although Belgium's total import dependence on non-EU countries has remained stable between 2010 and 2021, its dependence on China has increased and its dependence on the United States has decreased. Nevertheless, Belgium's import dependence on the United States has grown substantially for 'basic pharmaceutical products and pharmaceutical preparations' over this period. Regarding total export dependence, our results show that, among non-EU countries, Belgium is most dependent on China, followed by the United States and India. While Belgium's total export dependence on all non-EU countries hardly changed between 2010 and 2021, the country's total export dependence on China increased, for all industries. Finally, Belgium's total export dependence on the United States also increased on average over this period but this increase was mainly due to the very strong increase in dependence in the pharmaceutical industry.

We also look at potential negative effects for Belgium due to high import or export dependence on non-EU countries. For this purpose, we assume a full disruption in exports or imports of strategic goods for which Belgium is highly and persistently dependent on non-EU countries during the period 2014-2023. We estimate the impact of such a shock on the Belgian economy in an input-output model. Hence, our results are not restricted to the direct impact of the shock on the industries that import or export goods for which Belgium is highly dependent, but also includes indirect effects due to domestic inter-industry links. According to our results for the year 2019, the impact of a full disruption in exports or imports of strategic goods for which Belgium is highly dependent on non-EU countries amounts to respectively 0.5% and 2% of Belgium's total manufacturing value added.

Synthese

Verschillende gebeurtenissen, zoals natuurrampen, de Covid-19 pandemie, problemen met de scheepvaart en de Russische invasie in Oekraïne, evenals aanhoudende geopolitieke spanningen, zoals de toenemende handelsgeschillen tussen de Verenigde Staten en China, hebben het vertrouwen in het internationale aanbod van goederen verminderd. Terwijl het wereldwijde aanbod van goederen vroeger vooral werd beoordeeld vanuit het oogpunt van economische efficiëntie en het optimaal benutten van de sterke punten van elk land, wordt het nu steeds meer gezien als een mogelijk probleem van te grote afhankelijkheid en kwetsbaarheid, vooral voor technologieën die als strategisch worden beschouwd. Steeds meer landen proberen hun afhankelijkheid van 'problematische' handelspartners te verminderen door de productie terug naar eigen land te halen (reshoring), naar nabijgelegen landen te verplaatsen (nearshoring), naar bevriende landen te verplaatsen (friendshoring) of in het algemeen de risico's te verminderen, bijvoorbeeld door diversificatie van leveranciers (de-risking). Als reactie op China's steun voor verschillende strategische technologieën en zijn dominantie in belangrijke schakels van de mondiale productie, ontwikkelen de VS en de EU strategische plannen, met specifieke doelen en acties, om hun eigen industrieën te ondersteunen. Sommige van deze maatregelen zijn duidelijk protectionistisch, zoals het bevoordelen van de binnenlandse productie in het kader van de "Inflation Reduction Act of 2022" en de "CHIPS and Science Act of 2022" van de VS. Met haar Open Strategische Autonomie probeert de EU de markt te beschermen tegen oneerlijke of onrechtmatige handelspraktijken, door wederzijds voordelige bilaterale relaties aan te gaan, de wereldwijde toeleveringsketen te diversifiëren en het monitoren van strategische afhankelijkheden.

De Europese Commissie heeft een methode uitgewerkt voor het bepalen van sterke afhankelijkheid, van de EU, voor de invoer van goederen uit niet-EU landen. Deze methode wordt onder andere toegepast bij het samenstellen van de Europese lijst van kritieke grondstoffen. In deze paper vertrekken we van deze methode om de Belgische afhankelijkheid van niet-EU landen in kaart te brengen. Hierbij wijken we wel op een aantal punten af van de werkwijze van de Europese Commissie. Zo beschouwen wij naast invoer ook de uitvoer. Recente voorbeelden, zoals de door de EU opgelegde uitvoerbeperkingen naar aanleiding van de invasie van Oekraïne en het door de Verenigde Staten aan het Nederlandse ASML opgelegde verbod om haar lithografiemachines - nodig voor de productie van computerchips - naar China uit te voeren, tonen aan dat ook sterke uitvoerafhankelijkheid een probleem kan zijn.

Voor het bepalen van strategische goederen vertrekken we van de 'Draft List of Critical Supply Chains' van de US International Trade Administration, die de beleidsvisie reflecteert van de VS om de veerkracht van de toeleveringsketens van kritieke sectoren te verbeteren. Deze lijst werd door Mignon (2023), op basis van verschillende documenten van de Europese Commissie, aangevuld met goederen die door de EU als strategisch worden beschouwd.

In tegenstelling tot de meeste andere studies over afhankelijkheid, werken wij met gegevens over internationale handel op het meest gedetailleerd goederenniveau. We tonen aan dat een analyse op basis van meer geaggregeerde gegevens leidt tot een vertekende inschatting van afhankelijkheid. Door te werken met gegevens voor 10 jaar (2014-2023), in plaats van maar één jaar zoals in de meeste studies, stellen we vast dat wanneer België, voor de in- of uitvoer, voor een bepaald goed sterk afhankelijk is

van niet-EU landen, deze afhankelijkheid meestal slechts tijdelijk is. Er is maar een beperkt aantal goederen waarvoor de Belgische in- en uitvoerafhankelijkheid persistent is.

België is voor de invoer meer afhankelijk van niet-EU landen, dan voor de uitvoer. Tijdens de periode 2014-2023 is er geen duidelijke trend in het aantal goederen waarvoor België voor de invoer sterk afhankelijk is van niet-EU landen. Het aandeel, in de totale Belgische invoerwaarde, van goederen met sterke afhankelijkheid vertoont wel een lichte stijging, voor zowel alle goederen als voor strategische goederen. Voor de uitvoer is er een duidelijke stijgende trend van het aantal goederen met afhankelijkheid. Het aandeel, in de totale Belgische uitvoerwaarde, van goederen met sterke afhankelijkheid vertoont echter een daling, behalve voor strategische goederen waarvoor het aandeel licht toeneemt. Bij de laagst beschouwde drempel, voor het bepalen van afhankelijkheid[2], is er voor 14 tot 17%, van de in totaal meer dan 9 000 verschillende door België ingevoerde goederen, sprake van een sterke afhankelijkheid. Voor strategische goederen is dit slechts 3 tot 4%. Bij de hoogste drempel die we beschouwen, gaat het om 5 tot 6% voor alle goederen, en 1 tot 2% voor strategische goederen. Bij de laagst beschouwde drempel zijn goederen met sterke invoerafhankelijkheid gemiddeld goed voor 12% van de totale invoerwaarde, voor strategische goederen is dit gemiddeld iets meer dan 4%. Bij de hoogst beschouwde drempel is dit gemiddeld 4% voor alle goederen en iets minder dan 2% voor strategische goederen. Voor de uitvoer is er bij de laagste drempelwaarde een sterke Belgische afhankelijkheid voor 13 tot 14% van de België uitgevoerde goederen en 3% voor strategische goederen. Bij de hoogste drempelwaarde is dit respectievelijk 5 tot 6% voor alle goederen, en 1% voor strategische goederen. Bij de laagst beschouwde drempel zijn goederen met sterke uitvoerafhankelijkheid gemiddeld goed voor 10% van de totale uitvoerwaarde, voor strategische goederen is dit gemiddeld iets meer dan 2%. Bij de hoogst beschouwde drempel is dit gemiddeld 2% voor alle goederen en amper 0,4% voor strategische goederen.

Het hoogste aantal goederen met een sterke Belgische invoerafhankelijkheid komt uit China, gevolgd door de Verenigde Staten en het Verenigd Koninkrijk. Wat de invoer van strategische goederen betreft is België wel duidelijk meer afhankelijk van de Verenigde Staten dan van China. De afhankelijkheid voor strategische goederen van de Verenigde Staten neemt echter af en die van China toe. Tijdens de beschouwde periode zijn er 81 strategische goederen waarvoor de Belgische invoerafhankelijkheid persistent is (zie tabel 5 op p. 34). Voor 39 van die goederen zijn de Verenigde Staten de voornaamste uitvoerder naar België, voor 11 goederen is dit China, en voor 6 goederen het Verenigd Koninkrijk. Wat de uitvoer betreft, delen het Verenigd Koninkrijk en de Verenigde Staten de eerste plaats met het hoogste aantal goederen waarvoor België sterk afhankelijk is, gevolgd door China. Voor strategische goederen zijn de Verenigde Staten de voornaamste invoerder vanuit België, gevolgd door het Verenigd Koninkrijk en China. Er zijn 25 strategische goederen waarvoor de Belgische uitvoerafhankelijkheid persistent is (zie tabel 6 op p. 38). Voor 11 van deze goederen was de Verenigde Staten de belangrijkste bestemming, voor drie goederen is dit Zwitserland en slechts voor twee goederen China.

Met internationale handelsgegevens kunnen we de Belgische in- en uitvoerafhankelijkheid inschatten op een zeer gedetailleerd goederenniveau. Deze gegevens laten echter niet toe om ook de indirecte afhankelijkheid van andere landen, als gevolg van transacties stroomopwaarts, of stroomafwaarts, in de

[2] Voor de geografische concentratie van de Belgische in- en uitvoer, berekend met de Herfindahl-Hirschman Index, is 0.25 de laagste drempel die we beschouwen en 0,5 de hoogste drempel (zie sectie 2.1 voor meer uitleg).

mondiale toeleveringsketen, vast te stellen. Om een idee te hebben van de totale (directe en indirecte) Belgische afhankelijkheid van niet-EU landen, werken we met wereldwijde meerlanden-input-output-gegevens, die de productie- en handelsstructuur, per bedrijfstak en per land, op wereldschaal weergeven. We vinden dat de indirecte Belgische afhankelijkheid van niet-EU landen aanzienlijk is.

De resultaten liggen grotendeels in dezelfde lijn als de resultaten over directe afhankelijkheid, gebaseerd op bilaterale handelsgegevens. België blijkt, van alle niet-EU landen, voor invoer het meest afhankelijk te zijn van China, gevolgd door de Verenigde Staten en Rusland. Wat China betreft, is er een sterke Belgische invoerafhankelijkheid in de bedrijfstakken 'informaticaproducten, elektronische en optische producten', 'elektrische apparatuur', 'motorvoertuigen, aanhangwagens en opleggers' en 'machines, apparaten en werktuigen'. Voor de Verenigde Staten is er een sterke Belgische afhankelijkheid voor 'farmaceutische basisproducten en farmaceutische bereidingen' en 'chemische producten'. Hoewel de totale Belgische invoerafhankelijkheid van niet-EU landen constant is gebleven tussen 2010 en 2021, is de afhankelijkheid ten opzichte van China toegenomen en die van de Verenigde Staten afgenomen. Daar waar de totale Belgische invoerafhankelijkheid van China in alle bedrijfstakken, in 2021 hoger is dan in 2010, is dit voor de Verenigde Staten enkel het geval in de bedrijfstak 'farmaceutische basisproducten en farmaceutische bereidingen'. De Belgische afhankelijkheid van de Verenigde Staten nam wel sterk toe voor 'farmaceutische basisproducten en farmaceutische bereidingen'. Wat de totale uitvoerafhankelijkheid, blijkt uit onze resultaten dat België, wat niet-EU landen betreft, het meest afhankelijk is van China, gevolgd door de Verenigde Staten en Indië. De totale uitvoerafhankelijkheid, ten opzichte van niet-EU-landen, in de Belgische verwerkende nijverheid, wijzigde nauwelijks tussen 2010 en 2021. De totale uitvoerafhankelijkheid van België ten opzichte van China nam wel toe, voor alle bedrijfstakken. Ook de totale Belgische uitvoerafhankelijkheid van de Verenigde Staten is gemiddeld toegenomen maar deze toename is vooral het gevolg van de zeer strek toegenomen afhankelijkheid in de farmaceutische industrie.

We proberen ook na te gaan wat de negatieve gevolgen kunnen zijn van een sterke Belgische afhankelijkheid van niet-EU landen. Hiervoor veronderstellen we een schok waarbij de vraag naar uitgevoerde, of het aanbod van ingevoerde, strategische goederen, waarvoor België, tijdens de periode 2014-2023, persistent sterk afhankelijkheid was van niet-EU landen, volledig wegvalt. Door het gebruik van Belgische input-outputgegevens kunnen we de impact schatten, van een dergelijke schok, op de Belgische economie. Hierbij wordt niet enkel gekeken naar de directe impact van de schok op de getroffen bedrijfstakken, maar ook naar de indirecte impact vanwege de afhankelijkheid tussen bedrijfstakken, stroomopwaarts en stroomafwaarts in de Belgische productieketen. De schokken op de uitvoer en invoer hebben, berekend voor 2019, een impact, in verhouding tot de toegevoegde waarde van de Belgische verwerkende nijverheid, van respectievelijk 0,5% en 2%.

Synthèse

La confiance dans l'approvisionnement international en marchandises a été érodée au cours des dernières années par plusieurs événements, dont des catastrophes naturelles, la pandémie de COVID-19, les problèmes de transport maritime et l'invasion de l'Ukraine par la Russie, ainsi que par les croissantes tensions géopolitiques, notamment les différends commerciaux entre les États-Unis et la Chine. Auparavant, l'approvisionnement de biens en provenance du monde entier était considéré principalement sous l'angle de l'efficacité économique et de l'exploitation des avantages comparatifs des pays. Mais aujourd'hui cet approvisionnement est de plus en plus vu comme un problème potentiel de dépendance excessive et de vulnérabilité, en particulier pour les technologies considérées comme stratégiques. De plus en plus de pays tentent de réduire leur dépendance à l'égard de partenaires commerciaux qu'ils considèrent comme « problématiques », en rapatriant la production (reshoring), en la déplaçant vers des pays proches (nearshoring), en la déplaçant vers des pays alliés (friendshoring) ou encore en réduisant les risques de manière générale, par exemple en diversifiant les fournisseurs (de-risking). En réponse aux aides d'état données par la Chine pour diverses technologies stratégiques et à la domination chinoise de maillons clés des chaînes de production mondiales, les États-Unis et l'Union européenne ont commencé à élaborer des plans stratégiques, assortis d'objectifs et d'actions spécifiques, pour soutenir leurs propres industries. Certains de ces plans sont clairement protectionnistes et favorisent la production nationale comme le « Inflation Reduction Act » et le « CHIPS and Science Act » aux États-Unis. Avec son plan d'« Autonomie stratégique ouverte », l'UE cherche à protéger son marché intérieur contre les pratiques commerciales déloyales ou abusives en établissant des relations bilatérales mutuellement bénéfiques, en diversifiant les chaînes d'approvisionnement mondiales et en surveillant les dépendances stratégiques.

La Commission européenne a développé une méthodologie pour déterminer dans quelle mesure l'UE est dépendante de biens importés en provenance de pays non-membres. Cette méthodologie est notamment utilisée pour établir une liste de matières premières critiques pour l'UE. Dans ce document, nous nous inspirons de cette méthodologie pour identifier la dépendance de la Belgique à l'égard de pays non-membres de l'UE. Cependant, notre méthodologie s'écarte de celle de la Commission européenne sur un certain nombre de points importants. En plus des importations, nous prenons également en compte les exportations. Des exemples récents, tels que les restrictions à l'exportation imposées par l'UE suite à l'invasion de l'Ukraine par la Russie, et l'interdiction imposée par les États-Unis à la société néerlandaise ASML d'exporter ses machines de lithographie – nécessaires à la production de puces électroniques – vers la Chine, montrent qu'une forte dépendance en termes d'exportations peut également poser problème.

Pour déterminer quels sont les biens stratégiques, nous avons utilisé et étendu la liste établie par Mignon (2023). A l'origine, cette liste est basée sur la « Draft List of Critical Supply Chains » de l'Administration américaine du commerce international, qui reflète la vision politique américaine en matière de résilience des chaînes d'approvisionnement de secteurs critiques, et elle a été complétée par Mignon (2023) en ajoutant des biens considérés comme stratégiques par l'UE.

Contrairement à la plupart des autres études sur la dépendance, nous utilisons des données sur le commerce international au niveau le plus détaillé. Cela permet de montrer qu'une analyse basée sur des données plus agrégées conduirait à des estimations biaisées de la dépendance. En travaillant avec des données sur 10 ans (2014-2023), plutôt que pour une seule année comme dans la plupart des études, nous constatons que lorsque la Belgique est fortement dépendante des pays non-membres de l'UE pour les importations ou les exportations d'un bien donné, cette dépendance n'est généralement que temporaire. Il n'y a qu'un nombre limité de biens pour lesquels la dépendance de la Belgique en termes d'importations et d'exportations est persistante.

La Belgique dépend davantage des pays non-membres de l'UE pour ses importations que pour ses exportations. Au cours de la période 2014-2023, le nombre de biens pour lesquels la Belgique dépend fortement des pays non-membres de l'UE pour ses importations est restée relativement stable. La part des biens pour lesquels la Belgique est dépendante dans la valeur totale des importations belges est en légère augmentation, pour tous les biens et pour les biens stratégiques. Pour les exportations, il y a une nette tendance à la hausse du nombre de biens pour lesquels la Belgique est dépendante. Toutefois, la part de ces biens dans la valeur totale des exportations belges est en baisse, sauf pour les biens stratégiques pour lesquels elle augmente légèrement. Au seuil le plus bas considéré pour déterminer la dépendance[3], la Belgique est fortement dépendante pour 14 à 17% de l'ensemble des plus de 9 000 biens qu'elle importe. Pour les biens stratégiques, ce pourcentage n'est que de 3 à 4%. Au seuil le plus élevé que nous considérons, il est de 5 à 6% pour tous les biens, et de 1 à 2% pour les biens stratégiques. Au seuil le plus bas, les biens pour lesquels la Belgique est fortement dépendante en termes d'importations représentent en moyenne 12% de la valeur totale des importations, contre un peu plus de 4% pour les biens stratégiques. Au seuil le plus élevé, cette proportion est en moyenne de 4% pour l'ensemble des biens et d'un peu moins de 2% pour les biens stratégiques. Pour les exportations, au seuil le plus bas, la dépendance est forte pour 13 à 14% des biens exportés par la Belgique et pour 3% des biens stratégiques. Au seuil le plus élevé, elle est forte pour 5 à 6% de tous les biens et 1% des biens stratégiques. Au seuil le plus bas, les biens pour lesquels la Belgique est fortement dépendante en termes d'exportations représentent en moyenne 10 % de la valeur totale des exportations, contre un peu plus de 2% pour les biens stratégiques. Au seuil le plus élevé, cette proportion est en moyenne d'un peu moins de 2% pour l'ensemble des biens et d'à peine 0,4% pour les biens stratégiques.

Le plus grand nombre de biens pour lesquels la Belgique est fortement dépendante en termes d'importations provient de la Chine, suivie des États-Unis et du Royaume-Uni. Pour les importations de biens stratégiques, la Belgique est nettement plus dépendante des États-Unis que de la Chine. Toutefois, la dépendance à l'égard des États-Unis pour les biens stratégiques diminue tandis que celle à l'égard de la Chine augmente. Au cours de la période examinée, il y a 81 biens stratégiques pour lesquels la dépendance de la Belgique en termes d'importations est persistante (voir tableau 5 à la page 34). Pour 39 de ces biens, les États-Unis sont le principal exportateur vers la Belgique, pour 11 biens c'est la Chine et pour 6 biens c'est le Royaume-Uni. En termes d'exportations, le Royaume-Uni et les États-Unis se partagent la première place comme pays de destination avec le plus grand nombre de biens pour lesquels la dépendance de la Belgique est persistante, suivis par la Chine. Pour les biens stratégiques, les États-

[3] Pour la concentration géographique des importations et des exportations de la Belgique, mesurée avec l'indice de Herfindahl Hirschman, le seuil le plus bas que nous considérons est 0,25 et le seuil le plus élevé est 0,5 (voir section 2.1 pour plus d'explications).

Unis sont le principal importateur de la Belgique, suivis du Royaume-Uni et de la Chine. Il y a 25 biens stratégiques pour lesquels la dépendance de la Belgique en termes d'exportations est persistante (voir tableau 6 à la page 38). Pour 11 de ces biens, les États-Unis sont la principale destination, pour trois, c'est la Suisse et pour seulement deux, c'est la Chine.

Alors que les données sur le commerce bilatéral permettent d'estimer la dépendance de la Belgique en termes d'importations et d'exportations à un niveau très détaillé, elles ne permettent pas d'identifier la dépendance indirecte à travers des liens en amont ou en aval dans les chaînes d'approvisionnement mondiales. Dès lors, nous avons calculé la dépendance totale (directe et indirecte) de la Belgique vis-à-vis des pays non-membres de l'UE en termes d'importations et d'exportations. Ces calculs ont été effectués avec des données entrées-sorties multi-pays qui montrent la structure de la production et du commerce, par industrie et par pays, à l'échelle mondiale. Selon les résultats, la dépendance indirecte de la Belgique vis-à-vis de pays non-membres de l'UE est importante, aussi bien en termes d'importations qu'en termes d'exportations.

Si l'on regarde les pays partenaires, les résultats sur la dépendance totale confirment ceux obtenus pour la dépendance directe avec les données sur le commerce bilatéral. On constate que, parmi les pays non-membres de l'UE, la dépendance de la Belgique est la plus élevée vis-à-vis de la Chine, suivie par les États-Unis et la Russie. La dépendance la Belgique est particulièrement importante à l'égard de la Chine dans les branches d'activité « produits informatiques, électroniques et optiques », « matériel électrique », « véhicules automobiles, remorques et semi-remorques » et « machines, appareils et outils », et à l'égard des États-Unis dans les branches d'activité « produits pharmaceutiques de base et préparations pharmaceutiques » et « produits chimiques ». Même si la dépendance totale de la Belgique vis-à-vis des pays non-membres de l'UE est restée relativement stable entre 2010 et 2021, la dépendance à l'égard de la Chine s'est accrue et celle à l'égard des États-Unis s'est réduite. Nonobstant cette évolution globale, la dépendance de la branche « produits pharmaceutiques de base et préparations pharmaceutiques » vis-à-vis des États-Unis a augmenté considérablement. En ce qui concerne la dépendance totale en termes d'exportations, les résultats indiquent que, parmi les pays non-membres de l'UE, la Belgique est le plus dépendant de la Chine, suivie des États-Unis et de l'Inde. Alors que la dépendance totale de la Belgique en termes d'exportations à l'égard de pays non-membres de l'UE n'a pratiquement pas changé entre 2010 et 2021, elle a augmenté vis-à-vis de la Chine, dans toutes les branches d'activité, et vis-à-vis des États-Unis, principalement dans l'industrie pharmaceutique.

Nous avons également examiné les possibles conséquences négatives pour la Belgique d'une forte dépendance en termes d'importations et d'exportations à l'égard des pays non-membres de l'UE. Dans ce contexte, nous avons fait l'hypothèse d'une rupture complète des exportations ou des importations de biens stratégiques pour lesquels la Belgique a été fortement dépendante des pays non-membres de l'UE de manière persistante au cours de la période 2014-2023. L'impact d'un tel choc sur l'économie belge est estimé avec un modèle entrées-sorties. Dans le cadre d'un tel modèle, l'impact n'est pas restreint à l'effet direct du choc sur les branches d'activité qui exportent ou importent les biens visés, mais tient aussi compte des effets indirects à travers les liens entre les branches d'activité en Belgique. Selon les résultats pour l'année 2019, l'impact d'une rupture complète des exportations et des importations de biens stratégiques pour lesquels la Belgique est fortement dépendante des pays non-membres de l'UE s'élève à respectivement 0,5% et 2% de la valeur ajoutée totale de l'industrie manufacturière belge.

1. Introduction

Due to the reduction in trade barriers and falling transport costs, international trade increased sharply after World War II. This growth was related to the 'first unbundling' - the decoupling of the location of production from the location of consumption – that allowed to exploit economies of scale and comparative cost advantages. With advances in information and communication technology, global trade networks became increasingly complex, resulting in the 'second unbundling', the fragmentation of production processes f due to which the different parts and components of final goods are produced in different locations (Baldwin, 2006). Regional and global supply chains emerged in which, besides production, foreign direct investment and knowledge-intensive services such as research and development, design and marketing, logistics, distribution and after-sales services play an important role (Grossman and Rossi-Hansberg, 2006). In search of low wages for labour-intensive standardised assembly, much of the manufacturing of final products was shifted from the most industrialised countries to a relatively limited group of emerging economies (mainly in Asia). As a result, the G7 countries' share of global industrial production fell from two-thirds to half (Baldwin, 2017).

Recently, various shocks and geopolitical tensions have reduced public trust in global supply chains. These include natural disasters (the earthquake and subsequent tsunami in Japan in 2011: Ye and Masato, 2012), pandemics (Covid-19: OECD, 2022), war (the invasion of Ukraine: OECD, 2023), the disruption of maritime transport (Berthou, Haramboure and Samek, 2024), increasing geopolitical tensions (Brexit: Vandenbussche, Connell and Simons, 2022) and geo-economic fragmentation (Aiyar et al., 2023).

Within the European Union, concern is rising that for certain strategic technologies – for example, those needed for the digital and green transformation – the dependence on imports from countries outside the EU becomes too big, in particular with respect to China (European Commission, 2022). A growing number of countries are taking measures to reduce dependence on trading partners that are perceived as unreliable, and to redesign global supply chains through 'reshoring', 'nearshoring', 'friendshoring or 'de-risking'. In response to China's strategic support for various technologies, and its dominance in key parts of the global supply chain, the US and the EU are outlining industrial policies to support domestic industries. Some of the proposed measures are clearly protectionist, such as those favour domestic investment in the 'Inflation Reduction Act' and the 'CHIPS and Science Act' in the US.

The EU seeks to shield its internal market from unfair competition and abusive trade practices through its Open Strategic Autonomy, a policy instrument that aims to establish mutually beneficial bilateral relationships and diversify global supply chains, and to monitor strategic dependencies.

In this paper, we examine the potential vulnerability of the Belgian economy due to its dependence on non-EU countries, for both imports and exports of goods. Based on trade data at the most detailed product level, we investigate to what extent Belgian imports and exports are concentrated and depend on one or only a few non-EU countries. The resulting list of goods with high import and export dependence is then linked to a list of strategic goods. To determine whether the dependence is persistent or transitory, we look at the period 2014-2023. Beyond direct bilateral trade flows, we also analyse Belgium's indirect dependence, using global multi-country input-output data. Finally, we estimate the economy-

wide impact of a possible disruption in imports and exports of goods with strong dependence on non-EU countries based on Belgian input-output data.

In recent years, the European Commission has published several studies on the EU's import dependence on non-EU countries (European Commission 2017, 2021, 2022). Arjona, Connell and Herghelegiu (2023) reveal large differences between countries in the composition of their international trade in goods. In view of these findings, a specific study for Belgium seems justified. Previous studies for Belgium on this topic are Jaucot, De Lange and Van Herreweghe (2022), Mignon (2023) and Buysse, Essers and Marchand (2024). Unlike these studies, we work with data at the most detailed goods level. To define strategic goods, we use the list compiled by Mignon (2023).

Unlike most other studies, we look not only at imports but also at exports.[4] This is warranted as export restrictions have become more common in recent years. Most notably, the EU imposed several restrictions on trade with Russia in response to Russia's invasion of Ukraine. Recent evidence also shows that the United States impose export restrictions on trading partners to prevent China's access to strategic technologies. For instance, the US has effectively prevented the Dutch company ASML, which is the global market leader in the lithography technology needed to make the most advanced computer chips, from selling this technology to China. By the same token, China is trying to reduce its dependence on other countries for strategic technologies.

Sections two and three describe the methodology and data used for determining Belgium's import and export dependence vis-à-vis non-EU countries, as well as to estimate the impact on the Belgian economy of a potential breakdown in this trade. In the fourth section, we present the results of our analysis. Section five concludes with some reflections on possible policy measures. However, the reader should keep in mind that our main purpose is not to make policy recommendations but rather to provide a tool to identify the potential vulnerability of the Belgian economy due to strong dependence on imports and exports from countries outside the European Union.

[4] In their study of Belgian strategic trade dependencies with China, for the years 2017-2022, Buysse, Essers and Marchand (2024) also consider exports.

2. Method

For analyses of trade dependence, the European Commission uses the following definitions (European Commission 2021):

- **Dependencies**: reliance on a limited number of actors for the supply of goods, services, data, infrastructures, skills and technologies combined with a limited capacity for internal production to substitute imports.
- **Strategic dependencies**: dependencies that are considered of critical importance to the EU and its Member States' strategic interests such as security, safety, health and the green and digital transformation.

The definition of strategic dependencies does nor only consider economic objectives. A footnote in the definition of dependencies states that it may include exports. Unlike most other studies, we also consider exports in our analysis.

Arriola et al. (2024) provide a recent overview of the different methods used to determine countries' dependence on international trade. Our analysis of the dependence of Belgian imports and exports is in line with Berthou, Samek and Haramboure (2023) and Berthou, Haramboure and Samek (2024) who combine Inter-Country Input-Output (ICIO) tables with trade data. ICIO tables allow mapping dependence over the entire global supply chain. The drawback of these data is the low level of product detail, which, as Berthou, Haramboure and Samek (2024) show, results in the underestimation of dependencies. Trade data offer greater product detail but do not allow to capture indirect dependence within global supply chains. Combining these two types of data allows for a comprehensive as well as detailed assessment of trade dependence.

2.1. Measuring direct dependence

The criterion used in almost all studies of dependence is a measure of the geographical concentration of imports based on the Herfindahl-Hirschman Index (HHI):

$$\text{HHI} = \sum_{i=1}^{n} (\text{Import share}_n)^2 \quad (\text{countries} : 1 \dots n) \qquad 0 \leq \text{HHI} \leq 1 \ (1)$$

For each imported good, the value of the HHI is calculated as the sum of the square of the shares of countries in Belgian imports (expressed as a fraction of 1). In the most extreme case, a good is only imported from one country (n=1) and the HHI is equal to 1. The more concentrated the imports are, the closer the HHI will be to 1, which is an indication of strong dependence on a limited number of countries. When import concentration is low, the HHI will be close to 0. The choice of a threshold for the HHI, above which geographic concentration of imports is considered to be strong, is arbitrary. Several values have been used in prior work: 0.25 (Guinea and Sharma, 2022, Research Institute for Global Value Chains et al., 2023), 0.33 (Baur and Fach, 2022), 0.40 (European Commission, 2021) or 0.50 (Bonneau and Nakaa, 2020, Jaravel and Méjean, 2021, Berthou, Samek and Haramboure, 2023). We retain three alternative thresholds: 0.25, 0.40 and 0.50. In the academic literature, the most common threshold for considering a market as imperfectly competitive is 0.25. This is the lowest threshold we use to identify high

geographic concentration. An HHI of 0.5 is taken as an indication of substantial concentration and is the highest threshold that we consider.

For export dependence, we adopt an analogous approach and calculate the HHI based on Belgian exports for each good.[5]

In some studies, the HHI is weighted by an indicator that reflects the country risk. For example, the European Commission uses the World Bank's World Governance Indicators (European Commission, 2017). For the analysis of Belgium's import dependence in 2020, Mignon (2023) relies on Credendo's[6] country risk indicators. For our analysis, we only impose EU membership as selection criterion. A share of imports or exports from non-EU countries exceeding 50% is taken as an indication of high geopolitical dependence. This is in line with work by European Commission (2021), where geographic concentration (HHI) and the share of non-EU countries are the two first criteria for determining dependence.[7] In principle, we could also adopt alternative selections of countries, or weigh by country risk. However, we have chosen not to do so because this implies an arbitrary choice, and because such risk indicators are not always relevant for determining import dependence. Moreover, the current political volatility makes the assessment of the strategic risk more difficult for some key countries (e.g., the US). In our analysis, the UK, which left the European Union in 2021, is taken to be a non-EU country for the whole period.

Unlike most other studies which focus on a single year, or a limited number of years, our analysis covers a relatively long period (2014-2023). This allows us to examine to what extent Belgium's import and export dependence is persistent. To the best of our knowledge, the only prior study on import dependence with a long-term perspective is Vicard and Wibaux (2023). In their analysis of the EU-27 over the period 1996-2019, they find no clear trend in the number of goods with strong import dependence despite an increasing dependence on China. For a large share of goods, dependence is only temporary.

The European Commission's definition of dependence (see above) also refers to domestic production capacities. European Commission (2017) defines a measure that includes domestic production, in addition to imports and exports, as an indicator of the capacity of domestic (EU) production to replace imports from non-EU countries, whereas in later studies, the European Commission works with a simplified measure that does not include domestic production. European Commission (2021) mentions that it would be best to include information on domestic production. However, data on domestic production in EU countries are not collected at a sufficiently detailed product level. There are thus too many missing values at the desired product level even when working with the most detailed data on industrial production. Mejean and Rousseaux (2024) also highlight the problem of missing data in their attempt to use PRODCOM data for their analysis of European trade dependence.

In terms of additional criteria, there is wide variation between studies. Some studies include indicators of the potential for import differentiation or substitution (see Mignon, 2023, for an overview). In

5 This also holds for all the other criteria discussed below, which we apply to both imports and exports, unless otherwise stated.
6 Credendo is the Belgian Export Credit Agency.
7 The European Commission also considers a third criterion, which measures the EU's capacity to replace imports from non-EU countries through domestic production.

addition, the European Commission uses the criterion of strategic goods. In our analysis, we use the list of strategic goods defined by Mignon (2023), which starts from the US International Trade Administration's 'Draft List of Critical Supply Chains'. This list reflects the US policy view on how to improve the resilience of international supply in critical sectors (International Trade Administration, 2022). Mignon (2023) extends this list with goods considered as strategic by the EU (including 16 strategic raw materials) based on several European Commission documents. We have further extended this list to consider changes in product codes in the years 2021, 2022 and 2023, for goods that can be considered strategic, based on their product description. This is the case for single photovoltaic cells and photovoltaic cells assembled in modules or made up into (solar) panels, for which new product codes were introduced in 2022 (see section 3.1.2 on product code changes).

2.2. Measuring total dependence within global supply chains

In the previous subsection, we discussed how we define import and export dependence based on bilateral trade data. This allows to assess the direct dependence on other countries but not to identify indirect dependence due to upstream and downstream links within global supply chains. Such indirect dependence can be estimated based on input-output data. Here, we propose an analysis of total foreign dependence, direct and indirect, starting from the indicators of foreign exposure defined by Baldwin, Freeman and Theodorakopoulos (2022, 2023), which we modify as discussed below.

The indicators defined in Baldwin, Freeman and Theodorakopoulos (2022) cover supply chain exposure in terms of purchases/imports, and in terms of deliveries/exports. In line with Baldwin, Freeman and Theodorakopoulos (2023), we first focus on the purchases/import side. For the calculation of the indicators, they rely on a global multi-country input-output table (GMCIO). Such a table describes structures of production and trade by industry and country at the global scale. It contains a square matrix Z of intermediate consumption – deliveries of intermediate inputs by industry *i* in country *m* to industry *j* in country *n* – and a rectangular final demand matrix F – deliveries by industry *i* in country m to final demand in country *n*. Total final demand f is a column vector that is derived by summing F over all final demand categories and purchasing countries. The sum of deliveries to intermediate consumption and final demand yields total (gross) output or production for each industry *i* in country *m* – column vector $x = Z * e + f$, where e is a (summation) column vector of 1's. We can transform the matrix Z, which reveals purchases by industry *j* in country *n* of intermediates from suppliers – other industries – at home and abroad, into a matrix of technical coefficients A by dividing by the (gross) output vector x: $A = Z * \hat{x}^{-1}$.

In input-output terms, technical coefficients in matrix A measure additional direct intermediate input requirements by the purchasing industry, due to a one-euro increase in its (gross) production, prompted by a final demand shock. Beyond direct input requirements, the shock also generates extra indirect input requirements further down the supply chain as the suppliers of the direct inputs also require inputs for their additional production. This is measured by A*A. In turn, the suppliers of the suppliers require extra inputs, and so on, adding further terms (A*A*A…) to the indirect requirements. As example, take a consumer buying a new car in France. This is final demand that entails extra output, say of the local automobile industry. Along the supply chain, there will be direct demand for intermediate inputs from

direct suppliers, for example, from a steel producer in Belgium, as well as indirect demand for intermediate inputs, for example, coal sourced from Poland by the Belgian steel producer.

Summing the effects of the final demand shock over the entire supply chain results in an infinite series: $I + A + A * A + A * A * A + \cdots$, which comprises the initial shock (I), the direct input requirements (A) and all the indirect input requirements (the higher order terms). The series converges to $(I - A)^{-1}$. The latter expression corresponds to the Leontief inverse matrix L that can also be derived from the basic identity $x = A * x + f$ of the Leontief input-output model. Any element of L represents all output by industry *i* in country *m* (in the row) generated (directly or indirectly) by a one-euro final demand shock for output of industry *j* in country *n* (in the column). In other words, the Leontief inverse matrix L traces total input requirements along the supply chain of all industries in the GMCIO table. Following up on our example, we can read from L the total value of steel produced in Belgium that is supplied, directly or indirectly, for the assembly of a motor vehicle in France. Moreover, computing the column sums of the Leontief inverse matrix L yields the output multipliers for all industries in all countries. They measure how much extra output is generated worldwide by a one-euro shock to the final demand for any industry's output.

Baldwin, Freeman and Theodorakopoulos (2023) use the GMCIO framework to define three measures of supply chain exposure. Their first one is 'face value exposure' (FVE), which determines the "proximate origin of intermediate inputs" (Baldwin, Freeman and Theodorakopoulos, 2023, p.7). The underlying idea is that this measure "takes the origin of purchased intermediates at face value" (Baldwin, Freeman and Theodorakopoulos, 2023: p.7) without investigating further down the supply chain. The authors express face value exposure mathematically as $I + A$. The second measure of supply chain exposure is what they refer to as 'look through exposure' (LTE). This determines the origin of intermediates purchased all along the supply chain, i.e. it is not restricted to the proximate origin of the purchased intermediates but rather 'looks through' the entire supply chain. Mathematically, this corresponds to L in the set-up of Baldwin, Freeman and Theodorakopoulos (2023). The third measure is then 'hidden exposure' (HE), which is the difference between LTE and FVE and reveals the origin of purchased intermediates all along the supply chain. Mathematically, this corresponds to the expression $A * A + A * A * A + \cdots$.

With respect to the input-output terminology exposed above, FVE is the sum of the initial shock and the direct input requirements, and HE corresponds to the indirect input requirements. We believe that in the spirit of the concept of supply chain exposure, it is preferable to exclude the initial shock from both FVE and LTE because the shock does not really express supply chain exposure, it inflates the share of FVE in LTE, and it drives up the domestic share of supply chain exposure as the initial shock is considered to be domestic. When excluding the initial shock, FVE corresponds to direct input requirements only and LTE is the sum of direct and indirect input requirements. HE remains as defined in Baldwin, Freeman and Theodorakopoulos (2023) and corresponds to the difference between LTE and FVE, in effect, the identity $LTE = FVE + HE$ still holds true. Table 1 compares the mathematical expression of the indicators proposed by Baldwin, Freeman and Theodorakopoulos (2023), in column 2, to the proposed alternative mathematical expression, in column 3, of the indicators of supply chain exposure, excluding the shock to final demand. This is in line with prior contributions to input-output economics which advocate multipliers that do not include the initial stimulus (Miller and Blair, 2009).

Table 1 Supply chain exposure indicators

Indicator	Baldwin, Freeman and Theodorakopoulos (2023)	Proposed alternative
Face Value Exposure	FVE=I+A	FVE=A
Look-through Exposure	LTE=L	LTE=L-I
Hidden Exposure	HE=A*A+A*A+⋯	HE=A*A+A*A+⋯

Alternatively, the matrix Z can also be transformed into the allocation coefficient matrix B. Mathematically, the matrix B is obtained by dividing Z by the diagonalized (gross) output vector x in the following way: $B = \hat{x}^{-1} * Z$. For any industry, this operation comes down to a division of the elements of its row in the Z-matrix by its total (gross) output. Thus, B is obtained through a normalization of Z by the output of the delivering (row) industry – a pre-multiplication by $\hat{x}^{-1}$. This makes it different from the technical coefficients matrix A, which is obtained by normalizing elements of Z by the output of purchasing (column) industry – a post-multiplication by $\hat{x}^{-1}$.

Any element of the matrix B corresponds to the deliveries by industry *i* in country m to industry *j* in country *n* as a share of the total output of industry *i* in country *m*. Hence, the elements of B represent the allocation of an industry's output over purchasing industries. In the Ghosh input-output model[8], this is used to measure the propagation of a shock to primary inputs. The idea is that a one euro increase in the primary inputs (value added) of an industry prompts an increase in that industry's output delivered to purchasing industries. This is the direct effect of the shock that corresponds to the elements in the industry's row in B. According to the Ghosh model, the increase also generates further indirect effects along the supply chain that correspond to higher order powers of the allocation coefficient matrix B: $B * B$, $B * B * B$ and so on. In the same way as for the Leontief inverse matrix, summing the initial shock and the direct and indirect effects yields an infinite series $I + B + B * B + B * B * B + \cdots$ that converges to $(I - B)^{-1}$. This is the Ghosh inverse matrix G, that can easily be derived from the basic identity $x' = x' * B + v'$ of the Ghosh input-output model. Any element of G represents all output by industry *j* in country *n* (in the column) generated (directly and indirectly) by a one-euro shock to primary inputs of industry *i* in country *m* (in the row). Thus, the Ghosh inverse matrix G traces the total output allocation along the supply chain of all industries in the GMCIO table.

We rely on matrices B and G for measuring supply chain exposure on the deliveries/export side. In doing so, we differ from Baldwin, Freeman and Theodorakopoulos (2022), who use the Leontief and Ghosh models for defining exposure indicators both on the purchases/import side and on the deliveries/export side.[9] We take the values in the allocation coefficient matrix B as indicators of 'face value exposure' (FVE) in terms of deliveries and exports. They indicate the proximate destination of output, disregarding what happens with this output further down the supply chain. We exclude the initial shock (I) from the FVE measure for the same reasons as put forward earlier on the purchases/import side. The deliveries/export side measure of 'look-through exposure' (LTE) reveals the exposure of output all the way through the supply chain. Mathematically, it corresponds to G minus the initial shock I.

8 The Ghosh input-output model focuses on the supply side whereas the Leontief model focuses on the demand side.

9 Our use of the Leontief and Ghosh inverse matrices is closely related to their use for the calculation of backward and forward linkage indicators.

Finally, the measure of hidden exposure (HE) is again the difference between LTE and FVE, which, amounts to $B * B + B * B * B + \cdots$ on the deliveries/export side.

Table 2 Supply chain indicators of exposure on the purchases/import side and on the deliveries/export side

Indicator	Purchases/import side	Deliveries/export side
Face Value Exposure	$\mathrm{FVE} = \mathrm{A}$	$\mathrm{FVE} = \mathrm{B}$
Look-through Exposure	$\mathrm{LTE} = \mathrm{L} - \mathrm{I}$	$\mathrm{LTE} = \mathrm{G} - \mathrm{I}$
Hidden Exposure	$\mathrm{HE} = \mathrm{A} * \mathrm{A} + \mathrm{A} * \mathrm{A} * \mathrm{A} + \cdots$	$\mathrm{HE} = \mathrm{B} * \mathrm{B} + \mathrm{B} * \mathrm{B} * \mathrm{B} + \cdots$

2.3. Estimating the potential impact of dependence on the Belgian economy

In this subsection, we discuss the methodology for estimating the total effect for the Belgian economy of a disruption in import supply or export demand of goods for which Belgium relies heavily on non-EU countries. These are the goods identified from trade data at the most detailed product level as discussed in section 2.1. The methodology consists in combining the results obtained from detailed trade data with more aggregate supply chain information from a single-country input-output table for Belgium.

For the estimation of the effects of strategic dependencies in the input-output model, we rely on the 'hypothetical extraction method' (HEM), which was first developed in the 1960s and is conceptually reviewed in detail in Miller and Lahr (2001). In its original form, this method consists in extracting an industry from the input-output model calculations, to determine its economy-wide importance. It may also be applied partially, to extract certain specific transactions or parts of an industry's activity (Miller and Lahr, 2001; Dietzenbacher and Lahr, 2013). This makes the method suitable to obtain input-output based estimations of the effects of a potential breakdown of a trading relationship that involves strategic goods for which Belgium depends strongly on non-EU countries.

Calculations based on a single-country input-output table, i.e. not a multi-country input-output table as discussed in the previous section, determine the output generated in the economy by final demand for domestically produced goods and services (f), both directly and indirectly, through purchases of intermediate inputs. They are based on the Leontief inverse matrix (L) that incorporates these effects for all domestic industries. Cells of the industry-by-industry matrix L*f indicate how much output in the row industry *i* is generated by final demand for products of the column industry *j*. Extracting an industry along the lines of the original HEM implies setting to zero all transactions of that industry, i.e. its deliveries to intermediate and final demand and its purchases of intermediate inputs from other industries. Thereby, a new hypothetical final demand f^h and a new hypothetical Leontief inverse matrix L^h are obtained, both with zeros in the rows and columns for the extracted industry. The difference between L*f and L^h*f^h yields a measure of the importance of the extracted industry in terms of output, economy-wide and by industry, which can be expressed in terms of value added by multiplying by a vector of value added per unit of output (v). But extractions must not necessarily set to zero all transactions of one industry. An extraction may consist in reducing the activity of an industry by a certain percentage, for example, in case of capacity constraints, or set to zero or reduce only certain transactions, for

example, trade with the UK in a global input-output model for estimating the effect of Brexit (Chen et al., 2019).

For our calculations, we consider a possible disruption of imports, or exports, of strategic goods for which Belgium depends strongly and persistently on non-EU countries. This shock (disruption) determines which transactions should be extracted when applying the 'hypothetical extraction method'. Ideally, we would want to single out all firms that may be directly affected by product-level strategic dependencies, that is, the exporters and importers of the relevant strategic goods. The transactions to be extracted could then be identified through the industry classification of the affected firms. However, information on the exporting or importing firms and their industry classification is not included in the trade data that we use to identify strategic goods with persistent dependence. Therefore, when estimating the export and import shocks, we must make assumptions to determine which industries export and import the relevant strategic goods. These assumptions differ between exports and imports, as we describe below.

We first discuss a shock to exports, as this is less complicated than a shock to imports. The export shock covers all export transactions to be extracted from the input-output calculations for measuring the effects of strategic export dependencies. Since our input-output tables (IOT) are industry-by-industry tables, we need to determine which industries in the SUT[10]-industry classification export these strategic goods and would thus face the shock of a breakdown in their demand. As mentioned earlier, we do not have information on exporters of these goods, and particularly not on their industry classification. Therefore, we assume that exports of these goods are produced by industries in the same proportions as total output of the SUT-product categories to which the goods belong. These proportions can be derived from the supply table, which cross-tabulates output over SUT-industries and SUT-product categories. This proportional distribution yields the total value of exports of the strategic goods, for all industries. These are the values to be extracted in the application of the 'hypothetical extraction method' by subtracting them from final demand by industry.

The matter is more complicated on the import side, where product-level strategic dependencies relate to possible disruption in supply from abroad. It is therefore necessary to identify the users of the relevant imports, as they will be affected by these disruptions, and to decide on how to model the way they will be affected. We consider that disruptions in the supply of the relevant strategic goods entail a complete disruption in the production of firms using these goods as inputs, that is, we take these products to be essential inputs in their production process. Unfortunately, just like for exports, we do not know which firms are importing the strategic goods and must therefore make assumptions on the use of imports of these products. These assumptions are based on the information on the use of imports that is available to us from the use table of imports, which is part of the SUT. This table shows the value of the imports of SUT-industries by SUT-product category.

Differences in the level of aggregation matter in this context. Imports with strong and persistent dependence, identified at the 8-digit goods level are spread over 26 SUT-product categories (see discussion

[10] Supply and Use Tables (SUT) link products to industries. From this, an input-output table can be derived, linking products to products or industries to industries. For more details, see Federal Planning Bureau and Institute for National Accounts (2023).

of results in section 4.3). Of course, these aggregated product categories of the SUT comprise not only strategic goods but also many other products. Imports of the relevant strategic goods represent up to 16% of Belgium's total imports in these 26 SUT-product categories.

We determine to what extent industries use the relevant strategic goods as intermediate inputs by assuming that the imports of these goods are distributed over the using industries in the same proportions as the entire SUT-product category to which they belong. These proportions are available from the use table of imports. As a result, we obtain an estimation of the use of strategically dependent imports for the 137 SUT-industries in the input-output table. Next, we model how the disruption in the imported supply of the relevant strategic goods affects the production of the using industries. At this level of industry breakdown, not the entire industry production would come to a halt due to a supply disruption because it is likely that only some of the firms in the industry use the relevant goods. With knowledge of the importers of these goods, it would be possible to identify the production exposed to such disruptions. Since we do not have this information, we assume that the share of production of an industry that is affected by the relevant strategic goods corresponds to the share of these goods in the industry's total purchases of intermediate inputs. Hence, we extract this share of the industries' production and apply the 'hypothetical extraction method' to measure the effects of the disruption. Given that imported products are exclusively goods, we restrict the shock to output of manufacturing industries. To sum up our approach on the import side, we transform the exposure to strategic goods with persistent dependence into a shock to gross production in the using industries.

From a methodological point of view, it would be interesting to work with data that allow to identify exporters and importers of specific strategic goods, for a more precise calibration of the shock from demand or supply disruptions. Such data are available but confidential.

3. Data

This section provides a detailed overview of the data used in the calculations of Belgium's import and export dependence on non-EU countries. In subsection 3.1, we discuss the bilateral trade data used to determine direct dependence. In subsection 3.2, we describe the international input-output data that allow to measure Belgium's direct and indirect dependence within global supply chains, and in subsection 3.3, we present the Belgian input-output data that are needed to estimate the impact on the Belgian economy, of a disruption in demand from non-EU countries for goods exported by Belgium and a disruption in supply from non-EU countries of goods imported by Belgium.

3.1. Trade data

To analyse Belgian imports and exports, we use bilateral trade data for Belgium according to the national concept, made available by the National Bank of Belgium (Source: Institute for National accounts (INA), 'Foreign Trade' database).

3.1.1. National concept versus Community concept

EU member states report data on foreign trade in goods either in the national concept or in the community concept. European statistics are presented according to the community concept because it is harmonised and therefore makes comparisons between countries possible. Trade data in the community concept cover almost all imports and exports of goods. Pure transit is excluded but imports of goods that are re-exported after only very little processing (quasi-transit) are included. Trade flows in the national concept exclude such re-exports. There is, however, a problem of comparability across countries because this is done differently by each country.[11]

For our analysis of Belgian imports and exports, we have chosen to work with trade data according to the national concept. International comparability matter less for this type of analysis for a single country and using data in the national concept reduces the bias due to re-exports. An analysis based on import data in the community concept would risk underestimating Belgium's trade dependence on non-EU countries since quasi-transit through other EU member states artificially increases the EU share in these data. Export data in the national concept also exclude such quasi-transit. Arjona, Connell and Herghelegiu (2023) emphasize the advantage of using data from FIGARO[12] because it allows distinguishing between goods that are imported for domestic production and goods that undergo little processing after being imported and are then re-exported and which therefore contribute less to the national economy. The growing magnitude of re-exports is illustrated in a study by the Netherlands Bureau for Economic Policy Analysis (CPB). The share of re-exports in the total value of exports for the Netherlands increased strongly in the period 1995-2022 so that in the most recent years re-exports even accounted for more than 50% of the total value of exports (van der Wal, Ligthart and Wache 2023). In the same vein, Eurostat

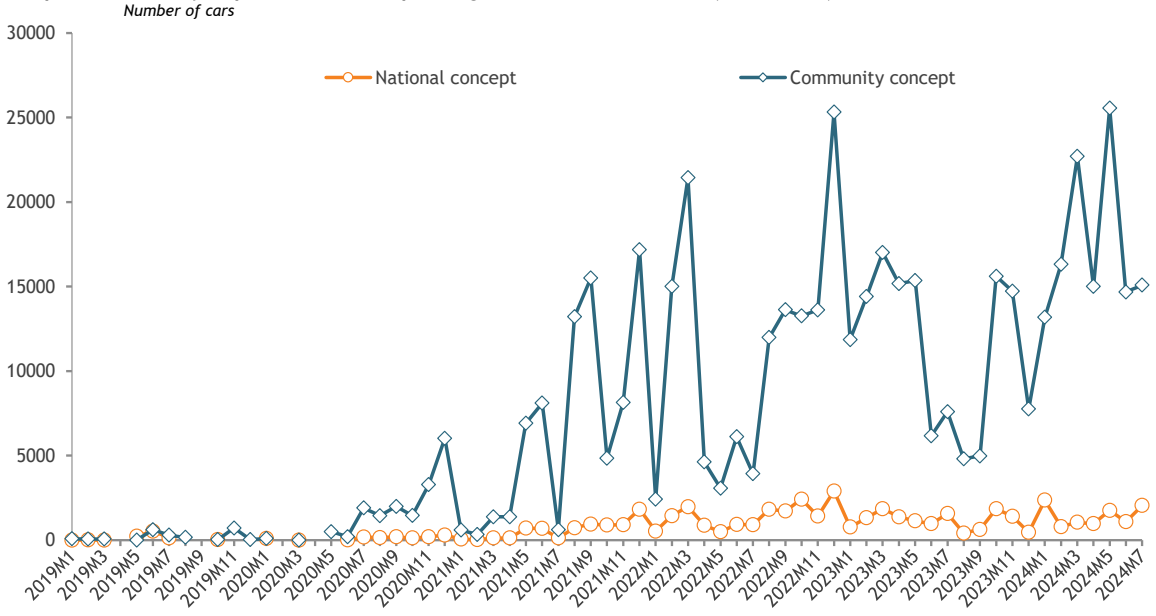
[11] For data on imports and exports of goods according to the national concept, at least one party in the trade transaction must be a Belgian resident. This is not the case for data according to the community concept, which contain a significant amount of trade flows that do not involve Belgian residents.

[12] FIGARO: Full International and Global Accounts for Research in Input-Output Analysis.

discusses the 'Rotterdam effect' according to which goods destined for other EU countries are imported through the port of Rotterdam. These are recorded as imports by the Netherlands although they are re-exported to other EU countries without any significant processing. This results in an overestimation of imports and exports of the Netherlands (for analyses that aim to identify goods destined for domestic consumption or production). Eurostat notes that this is also true, but to a lesser extent, for Belgian trade data due to transit through Belgian ports. Some researchers therefore refer to the Rotterdam-Antwerp effect. The analysis by Arjona, Connell and Herghelegiu (2023) shows that the EU's import dependence is underestimated if re-exports are not excluded from the data. We therefore prefer to use trade data in the national concept.

Graph 1 illustrates that the difference between the national concept and the community concept can be considerable, based on the example of the number of electric passenger cars imported monthly into Belgium from China from January 2019 to July 2024. According to the data in the community concept, imports of electric passenger cars from China into Belgium rise sharply from mid-2020 onwards with large monthly fluctuations. By contrast, according to the data in the national concept, the increase is much more limited and starts later (from mid-2021 onwards). The difference is substantial, both in terms of numbers and trend. Apparently, most of the electric passenger vehicles imported from China into Belgium are not destined for the Belgian market. Such import flows that are included in the data in the community concept should not be considered when determining import dependence.

Graph 1 **Monthly imports of electric passenger vehicles from China (2019-2024)**
Number of cars



The graph shows the number of electric passenger vehicles imported monthly into Belgium from China, according to the national concept and to the community concept, from January 2019 to July 2024. The CN8 code considered is 87038010 (Automobiles and other motor vehicles principally designed for the transport of fewer than 10 persons, including motor vehicles of the ""station wagon"" or ""break"" type and racing cars, with only an electric motor for propulsion, new (except vehicles specially designed for moving on snow and other special vehicles of subheading 8703.10).
Source: INA, 'Foreign trade' database.

3.1.2. The importance of product detail

Trade data in the national concept are available at the most detailed product level of the Combined Nomenclature (CN), i.e. 8-digit codes. The CN is a product nomenclature that is used by the EU for its

common customs tariffs and other EU policies, and for statistics on international trade involving EU countries. The 8-digit product codes of the CN are a breakdown of the Harmonised System (HS), which is the nomenclature developed by the World Customs Organisation as a common basis for international trade of all countries. The most detailed level of product breakdown in the HS is 6 digits.

Table 3 shows, as an example, the product description for Electronic Integrated Circuits (computer chips) at different levels of aggregation of the Harmonised System (2-digit, 4-digit and 6-digit) and the Combined Nomenclature (8-digit). The 2-digit level codes of the Harmonised System are referred to as chapters.

Table 3 Example of a product description at different levels of aggregation

Product code		Product description
85	(Harmonised System)	Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles
8542	(Harmonised System)	Electronic integrated circuits; parts thereof
854231	(Harmonised System)	Electronic integrated circuits as processors and controllers, whether or not combined with memories, converters, logic circuits, amplifiers, clock and timing circuits, or other circuits
85423119	(Combined Nomenclature)	Electronic integrated circuits as processors and controllers, whether or not combined with memories, converters, logic circuits, amplifiers, clock and timing circuits, or other circuits in the form of multichip integrated circuits consisting of two or more interconnected monolithic integrated circuits as specified in note 12 (b) (3) to chapter 85)

Most prior studies use trade data at the 6-digit level such as BACI[13] and FIGARO. However, for an analysis of foreign trade dependence, it is essential to work at the most detailed product level because 8-digit goods with different levels of import or export dependence may be aggregated into the same category at the 6-digit level.

Most studies of import dependence cover only one year, or a small number of years. A recent exception is Vicard and Wibaux (2023) who analyse EU-27 import dependence for the period 1996-2019 and find no clear increase in overall dependence, but an increase in the dependence on China, although most of this increase occurred before 2010. Arjona, Connell and Herghelegiu (2023) point out several factors that can explain why the situation is specific in a given year (temporary trade measures, domestic subsidies or supply disruptions). We consider a 10-year period (2014-2023) for a more structural analysis of import and export dependence. This allows us to identify for which imported and exported goods Belgium's dependence on non-EU countries is persistent rather than the result of temporary factors. However, when determining dependence for more than one year, the fact that there are changes in the CN8 codes every year must be taken into account. Sometimes new codes are created. For example, in 2021, following the Covid-19 pandemic, two new CN8 codes were introduced for face masks: codes 63079093 and 63079095 (see Table 3 for the full product description). Until 2020, both these goods were reported as part of the CN8 code 63079098. This code remains in the nomenclature after 2020, but the goods it covered up to 2020 are now subdivided into several codes.

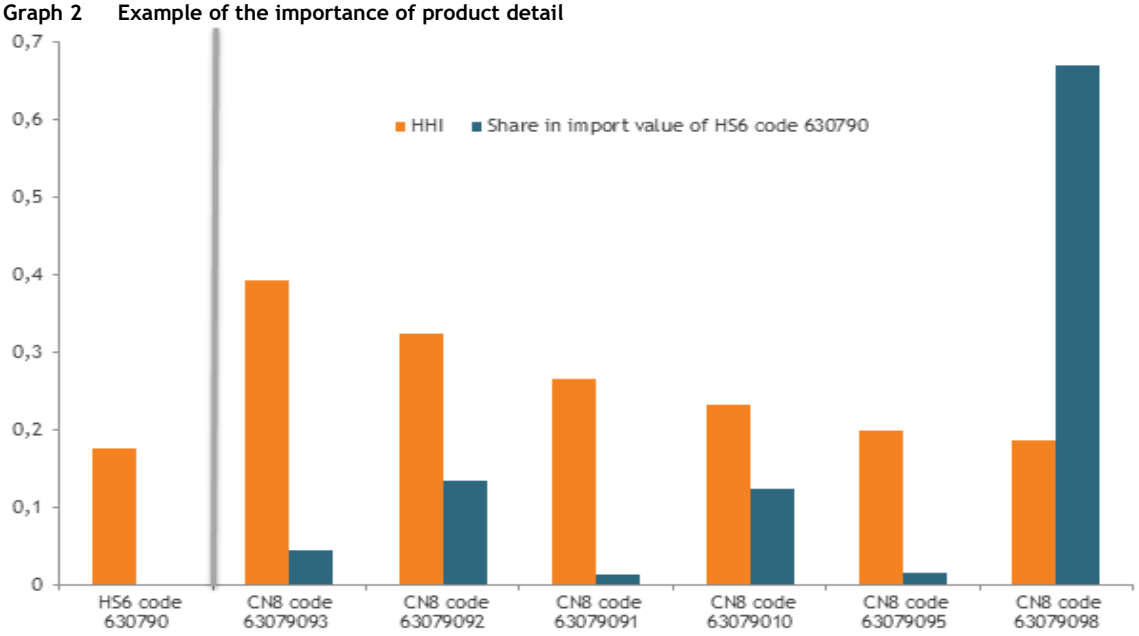
[13] BACI: Base pour l'Analyse du Commerce International.

We use Belgian imports of face masks as an example to clarify some aspects of the trade data. Table 4 shows the full product description of the six CN8 codes that are part of the HS6 code 630790. The description of this HS6 code is 'Made-up articles of textile materials, incl. dress patterns, not elsewhere specified', which is rather general.

Table 4 Description for the six CN8 product codes that are covered by HS6 code 630790

CN8 code	Product description
63079010	Made-up articles of textile materials, incl. dress patterns, knitted or crocheted, not elsewhere specified
63079091	Made-up articles of felt, incl. dress patterns, not elsewhere specified
63079092	Single-use drapes used during surgical procedures made up of nonwovens
63079093	Filtering facepieces (FFP) according to EN149, and other masks conforming to a similar standard for masks as respiratory protective devices to protect against particles
63079095	Protective face masks (excl. filtering facepieces FFP according to EN149, and other masks conforming to a similar standard for masks as respiratory protective devices to protect against particles)
63079098	Made-up articles of textile materials, incl. dress patterns, n.e.s. (excl. of felt, knitted or crocheted, single-use drapes used during surgical procedures made up of nonwovens, and protective face masks)

Graph 2 Example of the importance of product detail



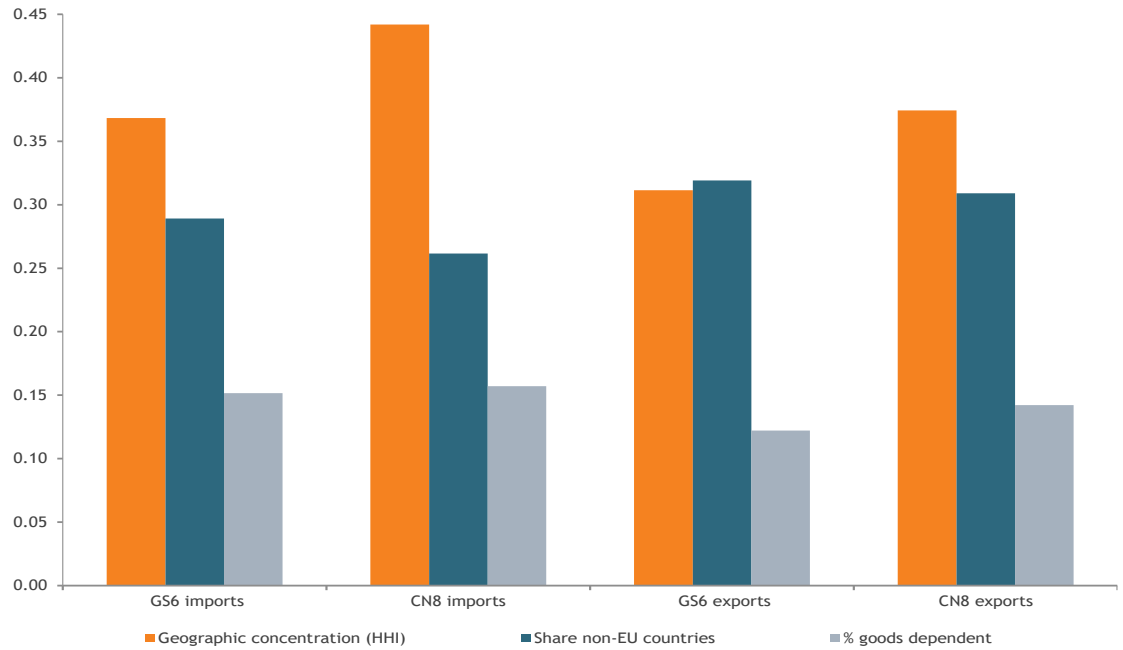
The graph shows the concentration (HHI, see text for definition) of Belgian imports in 2023 of the six CN8 product codes covered by HS6 code 630790 (see table 3 for the full product description of these codes). The graph also shows the HHI for HS6 product 630790 (calculated at the HS6 level) as well as the shares of the six CN8 products in the total imports of HS6 product 630790.
Source: Authors' calculations based on INA, 'Foreign Trade' database.

Graph 2 shows the concentration (HHI) of Belgian imports in 2023, for HS6 code 630790 and for the six CN8 codes covered by this HS6 code. It reveals major differences in the HHI, between the six CN8 codes: they range from 0.19 for code 63079098 to 0.39 for code 63079093. The HHI for HS6 code 630790 is 0.17. This result is mainly influenced by CN8 code 63079098, which accounted for 67% of total Belgian imports of HS6 code 630790 in 2023. By contrast, the share of CN8 code 63079093 – FFP face masks – in

total imports of HS6 code 630790 was only 5%. This illustrates that trade dependence can best be identified at the most detailed product level.

Graph 3 demonstrates the importance of working with data at the most detailed product level in more general terms.

Graph 3 Dependence on non-EU countries by level of aggregation of the trade data



The graph illustrates differences in results obtained with trade data at the HS6 level and at the CN8 level for (i) the geographic concentration (HHI, see text for definition) of Belgian imports and exports, (ii) the share of non-EU countries in total Belgian imports and exports, and (iii) the percentage of goods that are considered as highly dependent based on the criteria of a HHI >= 0.25 and of a share of non-EU greater than 50%.
Source: authors' calculations based on INA, 'Foreign Trade' database.

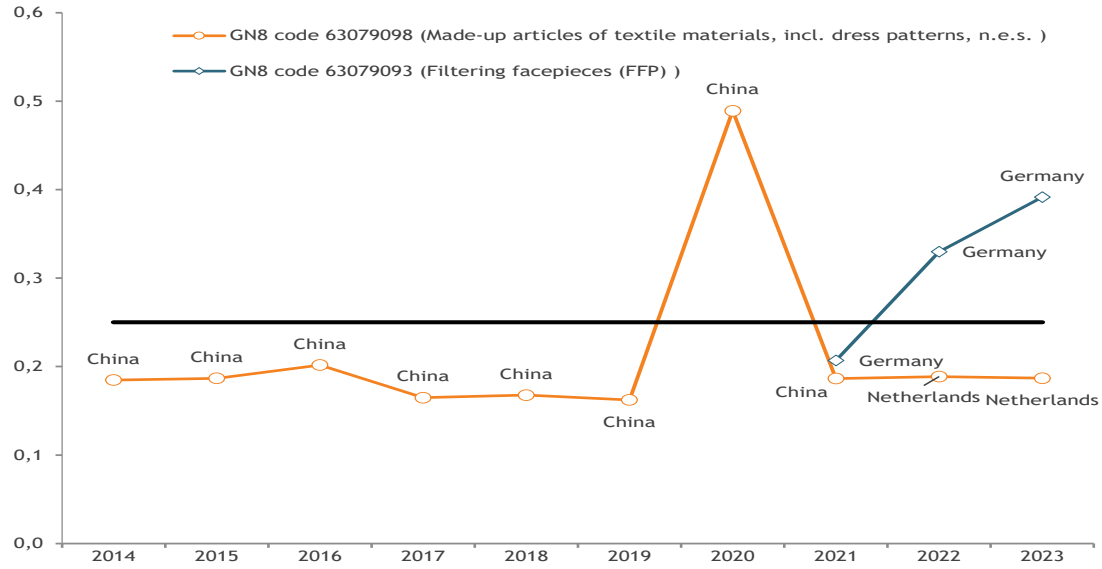
Graph 3 reports the HHI, the share of non-EU countries and the percentage of goods considered as highly dependent (HHI >= 0.25 and the share of non-EU countries >= 0.50) for imports and exports at the HS6 level and at the CN8 level. This shows that the geographic concentration of Belgian imports and exports is underestimated when using HS6-level data. By contrast, the share of non-EU countries in imports and exports is overestimated with HS6-level data. A slightly higher percentage of goods is identified as dependent when using CN8 trade data, especially for exports. But the difference is relatively small because the bias in the concentration (HHI) and the bias in the share of non-EU countries go in opposite directions.

There is, however, a significant difference in terms of the specific goods that are identified as dependent. For imports, 26% of the goods that are assessed as highly dependent at CN8 level are not picked up at the HS6 level. For exports, this share amounts to 31%. By contrast, all goods that are assessed as dependent when using data at the HS6 level, are equally identified as dependent, at the 6-digit level, when working with data at CN8 level.

3.1.3. The persistence of dependence

Pursuing with the example from the previous subsection, Graph 4 shows the concentration (HHI) of Belgian imports of face masks for the period 2014-2023. This illustrates the importance of an analysis for a sufficiently long period.

Graph 4 Concentration of Belgian imports of face masks (2014-2023)



The graph shows the geographic concentration (HHI, see text for definition) of Belgian imports of face masks over 2014-2023, (see table 3 for details). For each year, the country from which Belgium imported most of the good is also reported.
Source: authors' calculations based on INA, 'Foreign Trade' database.

As mentioned earlier, the CN8 code 63079093 was split off from CN8 code 63079098 in 2021, in the wake of the Covid-19 pandemic. Hence, no data are available for code 63079093 (FFP face masks) before 2021 so that for these years the less specific code 63079098 must be used. Graph 2 shows that this is problematic for interpreting dependence. For the CN8 code 63079098, China was the largest exporter to Belgium until 2021, after which the Netherlands became the largest exporter.[14] In the years before the Covid-19 outbreak, the concentration of imports was relatively low (below the threshold of 0.25). The HHI rose above 0.50 in 2020, and then fell again below 0.25 in 2021 and 2022. This is a clear example of high but temporary dependence. Moreover, the graph illustrates that in 2020 China was the only country able to scale up production of face masks, to meet the sharp increase in demand. In that year, Belgium imported face masks from 55 different countries, up from 44 countries in 2019. Nonetheless, China's share in Belgian imports of face masks increased from 25% in 2019 to 69% in 2020, before falling back to 29% in 2021. The concentration of imports for the new code 63079093 was slightly higher than the concentration for code 63079098 in 2021. But the HHI for the former code rose sharply to 0.39 in 2023. Finally, from 2021 onwards, Germany is the largest exporter FFP face masks to Belgium.

[14] For imports from the Netherlands, the 'Rotterdam effect' may influence findings. Indeed, the port of Rotterdam plays a major role as transit port into the EU for goods that come originally from countries all over the world. It would be possible to calculate the indirect dependence through the Netherlands, by using, for example, COMEXT data from EUROSTAT. However, we have not done so because data from COMEXT are in the community concept and thus not compatible with our Belgian trade data in the national concept. An alternative would have been to use trade data from FIGARO, which corrects for re-exports. But here, the problem is that these data are only available at the more aggregated HS6 level.

The CN8 code 63079093, created in 2021, groups together three categories of FFP face masks (FFP1, FFP2 and FFP3), which differ in the protection they provide against particles. A similar code change took place in 2022 for another product considered as strategic by the EU, namely photovoltaic cells, that are used in the assembly of solar panels. Until 2021, the CN8 code 85414090 covered photosensitive semiconductor devices, including photovoltaic cells. In 2022, this code was split into CN8 code 85414200 (Photovoltaic cells, not assembled into modules or into panels), CN8 code 85414300 (Photovoltaic cells assembled in modules or made up into panels) and the CN8 code 85414900 (Photosensitive semiconductor devices, excl. photovoltaic generators and cells).

Overall, possibilities of CN8 code changes include changes in the code without a change in the product description as well as product codes that are disaggregated or merged into new codes. For calculations of dependence, it is possible to keep track of code changes over time, for example based on the correspondence proposed by Baumgartner, Srhoj and Walde (2023). However, this correspondence has turned out to be incomplete and some code changes, such as code splits, require certain assumptions that are clearly not ideal. Regarding our calculations, the difference between results with, and without, considering the CN8 product code changes are limited.

3.1.4. Data problems due to Brexit

In 2021, the United Kingdom left the European Union. The problems with data on trade between Belgium and the UK, due to the Brexit, are discussed in Box 1. In our analysis, the country is considered a non-EU country for the entire period 2014-2023. For the years from 2021 onwards, the UK excluding Northern Ireland and Northern Ireland – for which, as explained in Box 1, trade data are reported separately – are considered as a single entity.

Box 1 Problems with international trade data due to Brexit

The UK poses a problem for our analysis of non-EU dependence, as the UK left the European Union in January 2021. As a result, data on trade between the UK and EU countries are collected, since 2021, through customs declarations and no longer through declarations on intra-EU trade transactions. Intra-EU trade flows are subject to certain reporting thresholds, which differ between EU countries. These thresholds do not apply to trade flows between EU countries and non-EU countries. Hence, beyond real trade effects due to the Brexit, there is a break in data on trade between the UK and EU countries (for an analysis of the real effects and data problems resulting from Brexit, see European Union, 2022, Buigut and Kapar, 2023, and Ward and Webb, 2023). As a further consequence of the change in data collection, trade flows between the UK and EU countries cover more goods. Moreover, the situation of Northern Ireland poses an additional problem since Northern Ireland is considered an EU member state for goods transactions under the Ireland/Northern Ireland Protocol. Since 2021, a distinction is made between the United Kingdom (excluding Northern Ireland) and the United Kingdom (Northern Ireland) in data on trade flows between Belgium and the UK. These data issues should be kept in mind when interpreting the results of our analysis relating to the UK.

Finally, we impose a threshold to exclude trade flows of limited value. Imports and exports of goods with a total value below €10 000 are not considered. On average, 5% of import flows and 8.5% of export

flows are excluded due to this threshold. For obvious reasons, the share of these flows in the total value of Belgian imports and exports is negligible.

3.2. Multi-country input-output data

For the calculation of indicators on supply chain exposure, we use industry-by-industry GMCIO tables (see section 2.2) from Eurostat's FIGARO project (European Commission and Eurostat, 2019), which are freely available on the institution's website.[15] These tables cover 45 countries (27 EU member states and 18 non-EU countries) plus the rest of the world and 64 industries according to the NACE Rev. 2 classification, for the years 2010-2021.[16] They are similar to the OECD's inter-country input-output (ICIO) tables used by Baldwin, Freeman and Theodorakopoulos (2023), with FIGARO tables covering less countries and years but giving a slightly more detailed industry breakdown. The advantage of the FIGARO tables is that they closely respect national data for Belgium (see Géal and Michel, 2023).

3.3. Belgian input-output data

To estimate the impact on the Belgian economy of a possible disruption in trade of strategic goods with a persistently high dependence, we use two types of national Belgian tables for the year 2019, at the most detailed level: the standard industry-by-industry input-output table (IOT), and the product-by-industry supply-and-use tables (SUT) from which the IOT is derived and which contain a more detailed breakdown at the product level. In these tables, the industry breakdown is based on the NACE Rev.2 classification and covers 137 industries (between the 2-digit and 3-digit levels of the underlying NACE classification). The product breakdown in the SUT is based on the CPA2008 classification[17] and covers 350 product categories (between the 2-digit and 3-digit levels of the underlying CPA classification). To match the level of aggregation of the input-output data, we convert and aggregate the strategically dependent exports and imports from the 8-digit CN level to the SUT-product classification of the Belgian SUT. The conversion is based on specific annual correspondence tables between CN and CPA2008.

15 https://ec.europa.eu/eurostat/web/esa-supply-use-input-tables/database#figarotables.

16 Nomenclature statistique des Activités économiques dans la Communauté Européenne (NACE) is the statistical classification of economic activities in the European Union.

17 Classification of Products by Activity (CPA) is the statistical classification of goods and services in the European Union.

4. Results

This section comprises three subsections. In subsection 4.1, we discuss the results of the analysis, based on bilateral trade data, of Belgium's import and export dependence on non-EU countries. In subsection 4.2, we describe Belgium's total dependence within global supply chains, calculated using a global multi-country input-output table (GMCIO). Finally, in subsection 4.3, we report results of the estimation of the economy-wide impact of a possible disruption in Belgium's imports and exports of strategic goods with a persistently high dependence on non-EU countries.

4.1. Belgium's import and export dependence on non-EU countries (2014-2023)

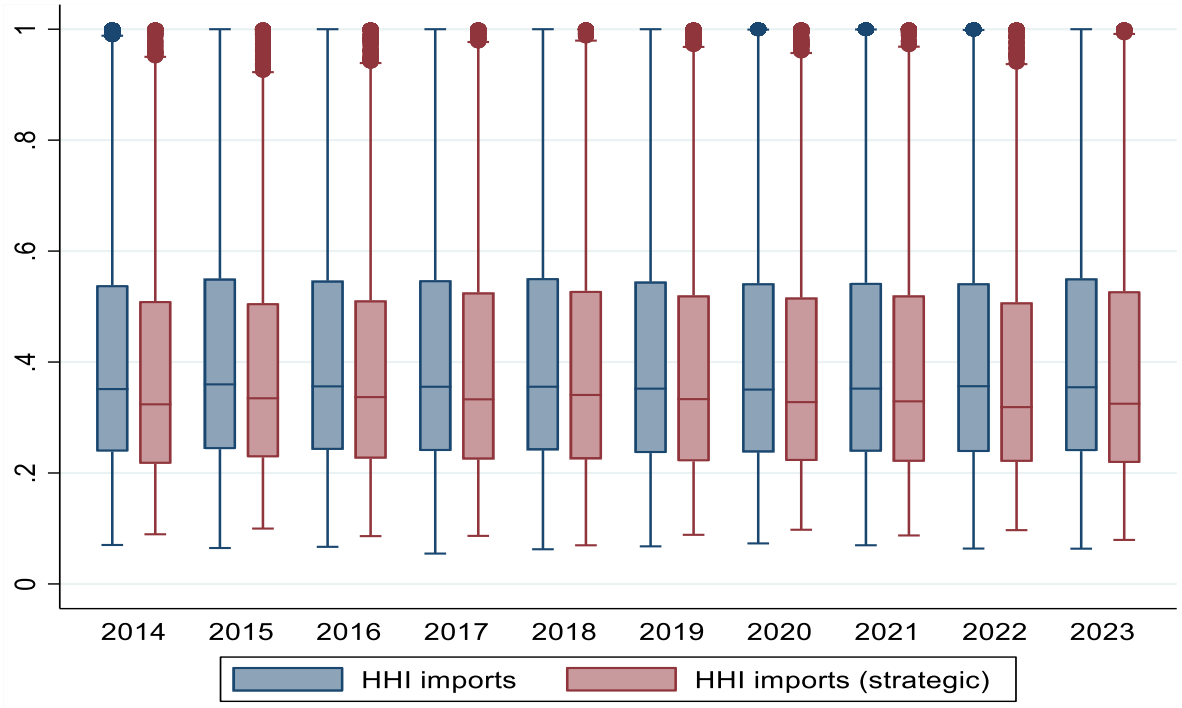
This subsection shows the results of the analysis of the dependence of Belgian imports and exports on non-EU countries, for the period 2014-2023, which are based on the methodology explained in 2.1 and the data outlined in 3.1.

4.1.1. The concentration of Belgian imports and exports

The boxplots in Graph 5 show the distribution of the Herfindahl-Hirschman Index (HHI) of Belgian imports of goods. On average, over the period 2014-2023, 9 170 different goods (CN8 level) were imported annually into Belgium. As mentioned earlier, a higher HHI indicates greater import (or export) dependence on one country, or on a limited number of countries. The graph also shows the distribution of the HHI for the subsample of strategic goods (see definition above). The origin of the imports – EU or non-EU – is not yet considered. The HHI is stable over the entire period. The median HHI is 0.37 (mean 0.44) for all goods and 0.34 (mean 0.42) for strategic goods. Based on this distribution, 50% of all imported goods are considered as concentrated for an HHI threshold of 0.25. For a threshold of 0.40 this share amounts to 45%, and for a threshold of 0.50 to 33%.

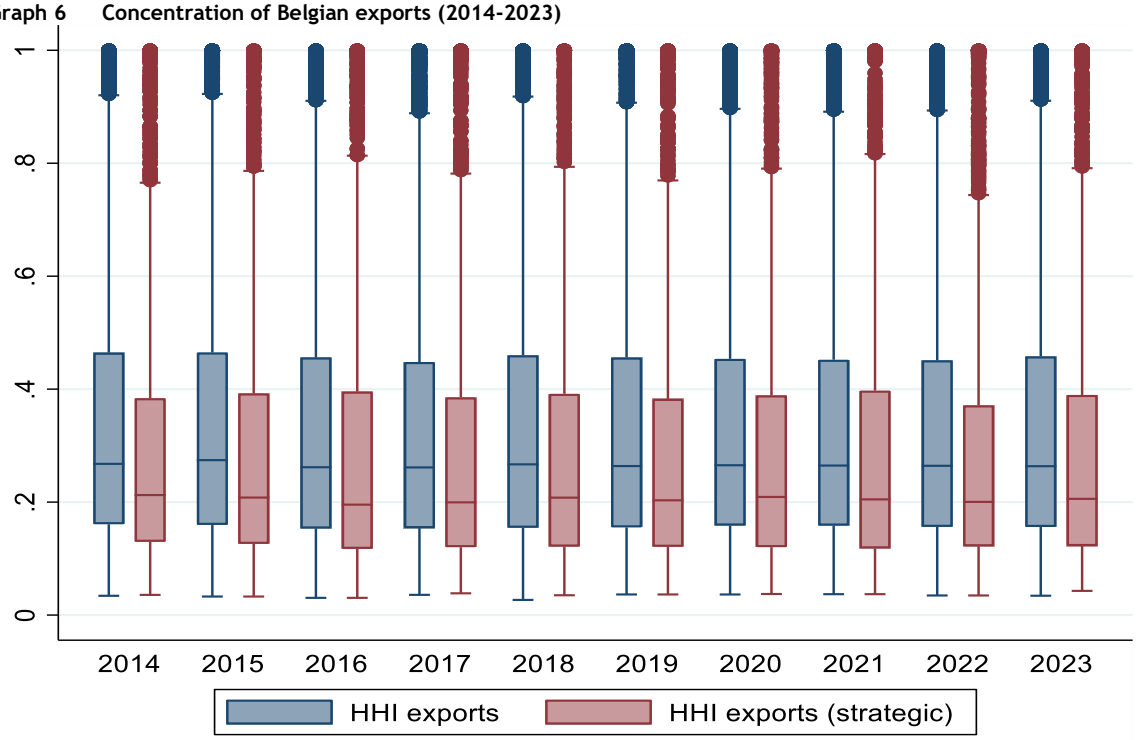
Graph 6 shows the same type of distributional boxplots for the geographic concentration of Belgian exports of goods. On average, over the period 2014-2023, Belgium exported annually 8 880 different goods (CN8 level). As for imports, the graph reports boxplots for all goods, as well as for strategic goods. The concentration of Belgian exports is lower than that of Belgian imports. With a value of 0.29, the median concentration of exports for all goods (mean 0.37) is nonetheless above the threshold value of 0.25. For strategic goods, the median is 0.22 (mean 0.32). The difference between the HHI for all goods and the HHI for strategic goods is even slightly higher for exports than for imports. These results confirm findings from previous studies (Arriola et al., 2024), in particular the fact that the concentration is lower for exports than for imports, and that the concentration is higher for all goods than for strategic goods.

Graph 5 Concentration of Belgian imports (2014-2023)



The graph displays boxplots of the concentration (HHI, see text for definition) of Belgian *imports* for the years 2014-2023. The boxplots show the distribution of the HHI for all goods and for strategic goods (CN8 product codes) based on the median (horizontal bar) and the interquartile range (box) with the first quartile (bottom of the box) and the third quartile (top of the box). The upper and lower dashes are maximum and minimum values calculated as the first (third) quartile - (+) 1.5 times interquartile range. The bulbs indicate outliers.
Source: authors' calculations based on INA, Foreign Trade database.

Graph 6 Concentration of Belgian exports (2014-2023)



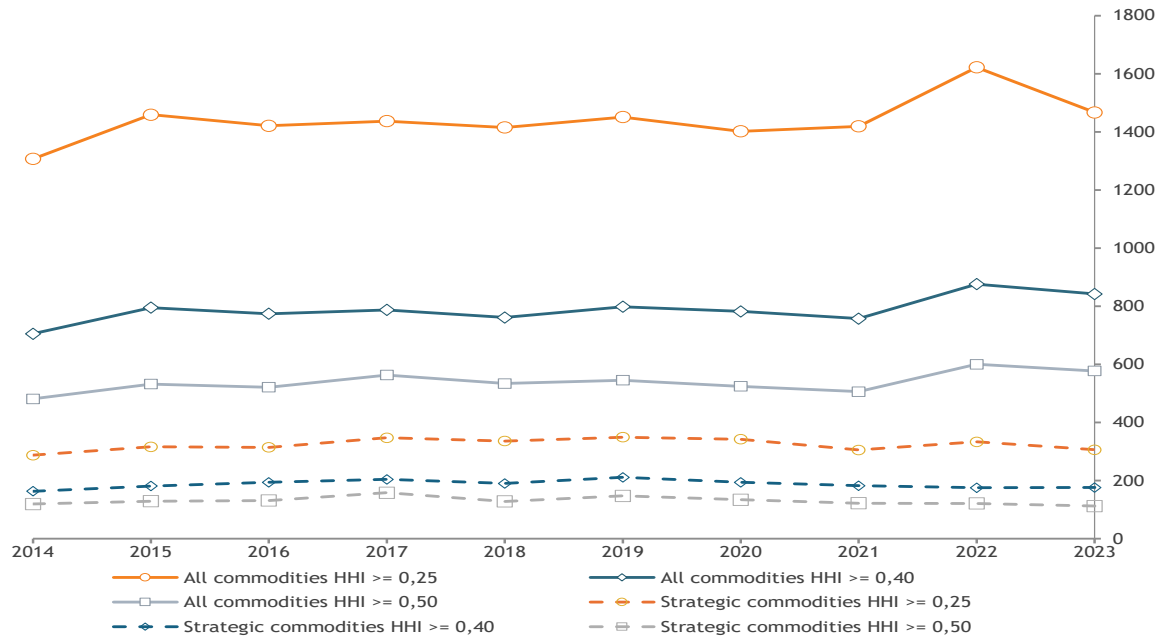
The graph displays boxplots of the concentration (HHI, see text for definition) of Belgian *exports* for the years 2014-2023. The boxplots show the distribution of the HHI for all goods and for strategic goods (CN8 product codes) based on the median (horizontal bar) and the interquartile range (box) with the first quartile (bottom of the box) and the third quartile (top of the box). The upper and lower dashes are maximum and minimum values calculated as the first (third) quartile - (+) 1.5 times interquartile range. The bulbs indicate outliers.
Source: authors' calculations based on INA, Foreign Trade database.

4.1.2. Non-EU dependence of Belgian imports and exports

We consider Belgium to be dependent on non-EU countries for imports, if the geographic concentration of imports exceeds the chosen HHI threshold and more than 50% of imports come from non-EU countries. This corresponds to the conditions for non-EU dependence considered by the European Commission (European Commission, 2021; Arjona, Connell and Herghelegiu, 2023).

The scatterplot in Graph A.1 in the Appendix provides a graphical identification of the goods for which Belgian imports are highly concentrated and for which Belgium mainly depends on imports from non-EU countries. Each point in the scatterplot corresponds to a good that was imported by Belgium in at least one year between 2014 and 2023. For those goods, the average HHI can be read on the horizontal axis, and the average share of non-EU countries in imports on the vertical axis. We distinguish between strategic goods (orange dots) and non-strategic goods (empty squares). The vertical lines indicate the 0.25 and 0.50 HHI thresholds and the horizontal line indicates the non-EU import share threshold of 50%. The graph reveals that the non-EU import share is rather low for many goods. It is lower than 50% for almost 82% of all goods imported into Belgium. This is the case for 76% of strategic goods. This reflects Belgium's well-known strong dependence on imports from other EU countries, especially from neighbouring countries.

Graph 7 Numbers of goods for which Belgian imports are highly dependent on non-EU countries



The graph shows the number of goods for which Belgian imports are highly concentrated (HHI, see text for definition) according to three alternative thresholds (0.25, 0.40 or 0.50), and for which more than 50% of imports come from non-EU countries.
Source: Authors' calculations based on INA, 'Foreign Trade' database.

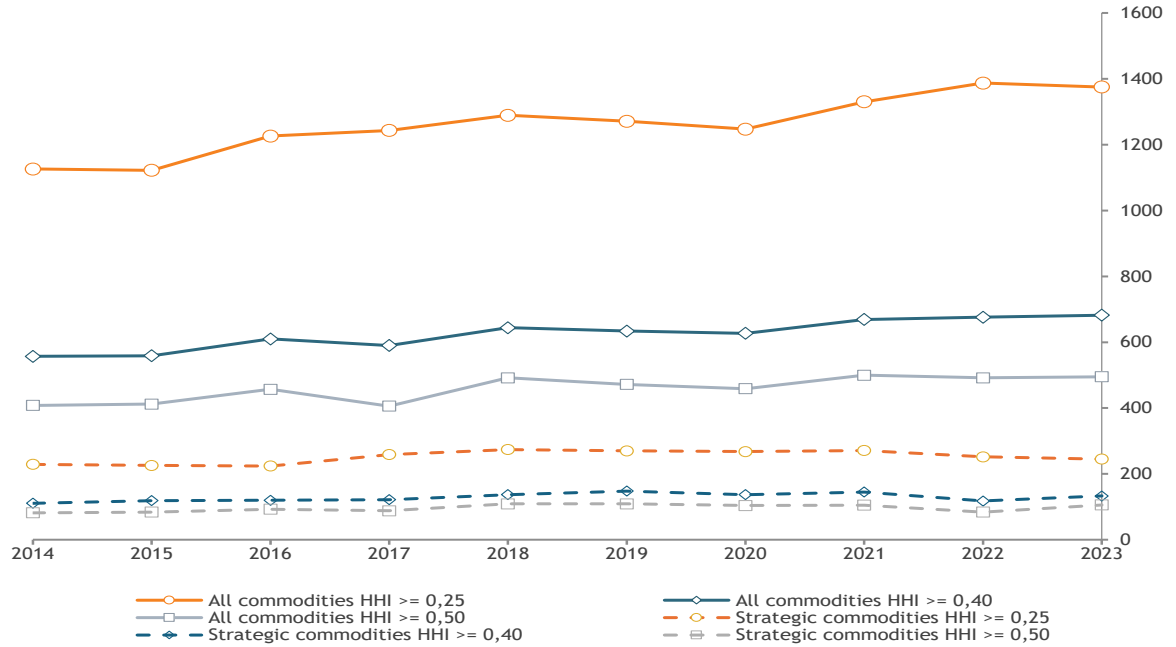
Graph 7 shows the number of goods for which Belgium is highly dependent on non-EU countries, for three alternative HHI thresholds (0.25; 0.40; 0.50). Solid lines stand for the total number of goods and dotted lines for the number of strategic goods. The graph illustrates that the number of goods for which Belgian imports are identified as dependent is higher, the lower the chosen threshold of concentration. For the HHI threshold of 0.25, we find a high dependence for 14-17% of all imported goods. For strategic goods, this share amounts to only 3-4%. For the HHI threshold of 0.50, these percentages are respectively

5-6% and 1-2%. The trend in the percentage of goods which are considered dependent is similar for the three HHI thresholds. But the trend is not statistically significant for five of the six categories in Graph 7. Only the slightly increasing trend for the HHI threshold value of 0.40 for all goods is statistically significant, and even then, only at 9%. The number of strategic goods with strong Belgian import dependence has remained very stable over the period 2014-2023. This result is in line with Vicard and Wibaux (2023) who find no clear (increasing) trend in the number of goods for which the EU-27 was highly dependent on non-EU countries for imports during the period 1996-2019.

The share of goods with high dependence in Belgium's total import value is increasing, for all goods as well as for strategic goods. This holds true for all HHI threshold values that we use. For an HHI threshold value of 0.25, goods with high import dependence represent on average 12% of the total import value, for strategic goods it is on average just over 4%. For an HHI threshold value of 0.50, the average share of goods with high import dependence in the total import value is just over 4% for all goods and just under 2% for strategic goods.

On the export side, we consider Belgium as dependent on non-EU countries for an individual good if the geographic concentration of exports exceeds the chosen HHI threshold and more than 50% of Belgian exports of that good go to non-EU countries. Graph A.2 in the Appendix shows a scatterplot for exported goods that is analogous to the one in Graph A.1. The average share of non-EU countries in exports is lower than 50% for approximately 77% of all goods exported from Belgium. This is the case for about 71% of the strategic goods. Belgium's export dependence on non-EU countries is higher than its import dependence. But the results also highlight that Belgium's exports mostly go to other EU member states.

Graph 8 Numbers of goods for which Belgian exports are highly dependent on non-EU countries



The graph shows the number of goods for which Belgian exports are highly concentrated (HHI, see text for definition) according to three alternative thresholds (0.25, 0.40 or 0.50), and for which more than 50% of exports go to non-EU countries.
Source: Authors' calculations based on INA, 'Foreign Trade' database.

Graph 8 reports the number of goods for which Belgium's exports are highly dependent on non-EU countries, for three alternative HHI thresholds (0.25; 0.40; 0.50). With an HHI threshold of 0.25, the dependence of Belgian exports on non-EU countries is high for 13-14% of all exported goods, while this is 3% for strategic goods. For an HHI threshold of 0.50, these percentages are respectively 5-6% and 1%. The lower geographical concentration of Belgian exports compared to its imports explains why the shares of exported goods with a high dependence on non-EU countries is lower than the share of imported goods with such a high dependence. Just like for imports, the trend in the number of goods for which Belgian exports are highly dependent on non-EU countries is similar for the three HHI threshold values. The trends in the share of all goods are significant regardless of the HHI threshold. By contrast, the trends are not statistically significant for strategic goods.

The share of goods with high dependence in Belgium's total export value is decreasing for all goods and slightly increasing for strategic goods. For an HHI threshold value of 0.25, goods with high export dependence represent on average 10% of the total export value, for strategic goods, this share is on average just over 2%. For an HHI threshold value of 0.50, the average share of goods with high dependence in the total export value is just under 2% for all goods and only 0.4% for strategic goods.

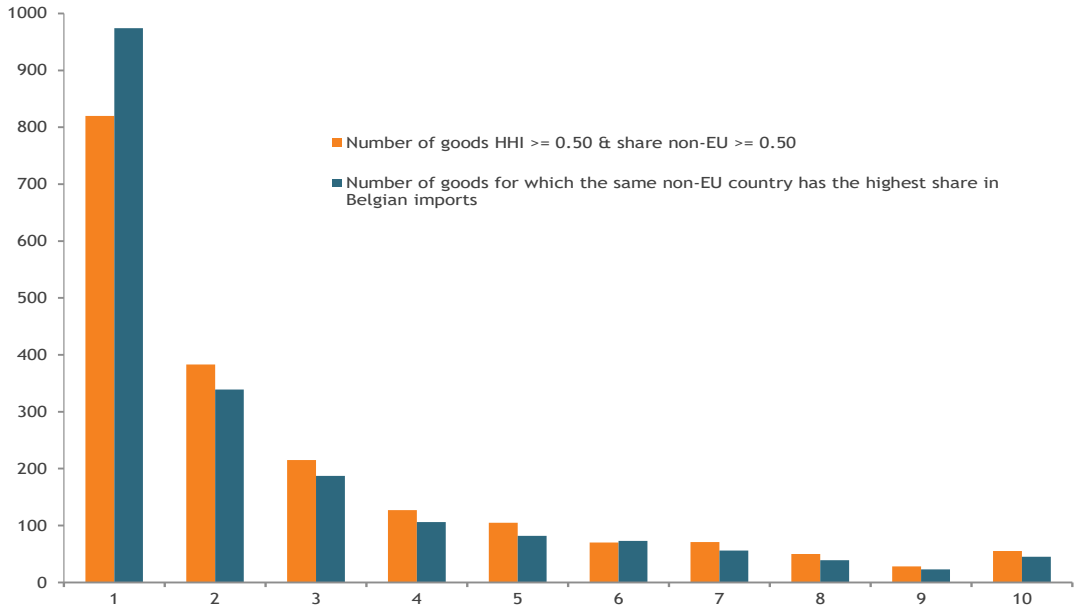
4.1.3. The persistence of dependence

Looking at the decade from 2014 to 2023, we find that for some goods Belgium's imports or exports are highly dependent over the entire period, while for other goods they are highly dependent for only a limited number of years. For imports, the latter case is generally a sign of temporary supply problems (see Graph 4). The firms that are the key players in global supply chains often manage to solve temporary problems quickly, sometimes with support from governments. To get a grasp of persistent dependence of Belgian imports or exports, we must focus on goods for which the HHI and the share of non-EU imports or exports exceed thresholds over a long period. This persistence of dependence may also be examined with respect to a specific country. Martin, Mejean and Parenti (2023) explain persistence in bilateral trade patterns through existing relationships between firms, often within a multinational group. For goods with high search and adjustment costs, long-term trading relationships are important, and uncertainty makes it less likely that new trading relationships are established between firms. For goods for which these costs are limited, uncertainty increases the likelihood that trade relationships are disrupted. Mejean and Rousseaux (2024) use an indicator for the persistence of relationships between firms ('relationship stickiness', as proposed by Martin, Mejean and Parenti 2023) to determine the EU's import dependence during the period 2015-2019. Based on a threshold for the HHI of 0.4, Vicard and Wibaux (2023) find, for the EU-27, that respectively 46% and 22% of the goods considered as dependent in 2014 and in 2018 were no longer dependent in 2019.

Graph 9 is a histogram that allows to evaluate the persistence of import dependence for all goods for which the thresholds for determining import dependence (HHI of 0.50 and share of imports from non-EU countries of 0.50) are exceeded at least once in the years 2014-2023. The histogram displays numbers of goods by number of years of high import dependence. The results reveal that for many goods the HHI and the non-EU import share exceed the thresholds only in a single year, or in a limited number of years. We find an import dependence in at least five out of the 10 years for only 20% of goods, while import dependence is limited to a single year for 46%. There is even less persistence in terms of the non-

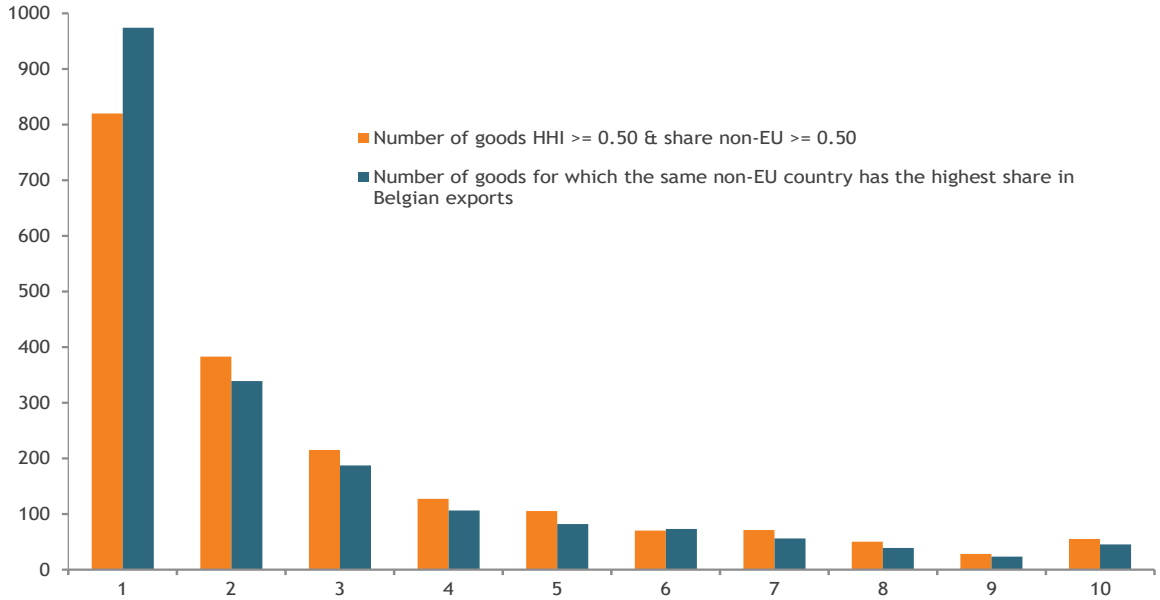
EU country with the highest share in imports of these goods. For a mere 17%, the same country has the highest share in Belgian imports during five years or more. For export dependence, the same overview of persistence is shown in Graph 10. Export dependence turns out to be persistent for even less goods than import dependence. The thresholds for export dependence are exceeded in at least five out of the 10 years for only 11% of the goods for which they are exceeded in at least one year.

Graph 9 Persistence of import dependence (2014-2023)



The graph shows the number of goods, by the number of years in which the thresholds for determining import dependence are exceeded, for all goods for which the thresholds are exceeded in at least one year during the period 2014-2023, and the number of goods, by the number of years in which the thresholds are exceeded and the same non-EU country has the highest share in Belgian imports.
Source: Authors' calculations based on INA, 'Foreign Trade' database.

Graph 10 Persistence of export dependence (2014-2023)



The graph shows the number of goods, by the number of years in which the thresholds for determining export dependence are exceeded, for all goods for which the thresholds are exceeded in at least one year during the period 2014-2023, and the number of goods, by the number of years in which the thresholds are exceeded and the same non-EU country has the highest share in Belgian exports.
Source: Authors' calculations based on INA, 'Foreign Trade' database.

For 47% of these goods, the thresholds for export dependence are exceeded in only one year. Again, there is even less persistence in terms of partner country. For a mere 7% of the goods, the same non-EU country has the highest share in Belgian exports for five years or more.

4.1.4. Strategic goods with persistent dependence

Table 5 lists the 81 strategic goods for which Belgium has a persistently high import dependence on non-EU countries during the period 2014-2023. For drawing up this list, we determine import dependence based on an HHI threshold of 0.50 and a 50% threshold for the share of imports from non-EU countries. We consider only those strategic goods for which the same non-EU country has the highest share in Belgian imports for at least 5 out of the 10 years. Goods are ranked according to declining average import value (over the years in which thresholds are exceeded). The table also reports the country with the highest share in Belgian imports. For 39 of the 81 goods, the United States is the main country of origin, for 11 goods it is China and for six goods the United Kingdom.

Table 5 Strategic goods with persistently high Belgian import dependence on non-EU countries (2014-2023)

Product description	Country with the highest share in Belgian imports
Amino-acids and their esters; salts thereof (excl. those containing > one kind of oxygen function, lysine and its esters, and salts thereof, and glutamic acid, anthranilic acid, tilidine "INN" and their salts and beta-alanine)	Singapore
Anaesthetic apparatus and instruments	Mexico
Steroidal hormones, their derivatives and structural analogues, used primarily as hormones (excl. cortisone, hydrocortisone, prednisone "dehydrocortisone", prednisolone "dehydrohydrocortisone", halogenated derivatives of corticosteroidal hormones, oestrogens and progestogens)	United States
Ferro-chromium, containing by weight > 6% carbon	South Africa
Agglomerated iron ores and concentrates (excl. roasted iron pyrites)	Canada
Phosphoric acid; polyphosphoric acids, whether or not chemically defined	Morocco
Kaolin	Brazil
Aromatic monoamines and derivatives; salts thereof (excl. aniline, toluidines, diphenylamine, 1-naphthylamine "alpha-naphthylamine", 2-naphthylamine "beta-naphthylamine" and their derivatives, and salts thereof, and amfetamine "INN", benzfetamine "INN", dexamfetamine "INN", etilamfetamine "INN", fencamfamine "INN", lefetamine "INN", levamfetamine "INN", mefenorex "INN" and phentermine "INN", and salts thereof)	Japan
Radio-broadcast receivers not capable of operating without an external source of power, of a kind used in motor vehicles, not combined with sound recording or reproducing apparatus	United States
Prostaglandins, thromboxanes and leukotrienes, their derivatives and structural analogues, used primarily as hormones	United States
DL-2-hydroxy-4-"methylthio"butyric acid	United States
Lithium carbonates	Chile
Parts of medical, surgical or laboratory sterilizers, n.e.s.	Switzerland

Product description	Country with the highest share in Belgian imports
Parts of aircraft, n.e.s. (excl. of spacecraft, incl. satellites, and suborbital and spacecraft launch vehicles)	United States
Natural gas condensates	Algeria
Halogenated derivatives of aromatic hydrocarbons (excl. chlorobenzene, o-dichlorobenzene, p-dichlorobenzene, hexachlorobenzene [ISO], DDT [ISO] "clofenotane [INN], 1,1,1-trichloro-2,2-bis[p-chlorophenyl]ethane", pentachloro-benzene "ISO", hexabromobiphenyls and 2,3,4,5,6-Pentabromoethylbenzene)	United States
Turning centres for removing metal, numerically controlled (excl. horizontal turn-ing centres)	United States
Propellers and rotors and parts thereof, for aircraft, n.e.s.	United States
Medicaments containing penicillins or derivatives thereof with a penicillanic acid structure, or streptomycins or derivatives thereof, not in measured doses or put up for retail sale	Japan
Poly"thio-1,4-phenylene", whether or not chemically modified, in primary forms	United States
Bars, rods, profiles and wire, of nickel alloys, n.e.s. (excl. electrically insulated products)	United States
Poly"oxy-1,4-phenylenesulphonyl-1,4-phenyleneoxy-1,4-phenyleneisopropylidene-1,4-phenylene" in blocks of irregular shape, lumps, powders, granules, flakes and similar bulk forms, whether or not chemically modified	United States
Bromine	Jordan
Glass polishes, whether or not in the form of paper, wadding, felt, nonwovens, cellular plastics or cellular rubber, impregnated, coated or covered with such preparations	United States
Articles of cobalt, n.e.s.	United States
Unwrought germanium; germanium powders	China
Hydrides and nitrides, whether or not chemically defined (excl. compounds which are also carbides of heading 2849, and inorganic or organic compounds of mercury)	United States
Wire of copper alloys (other than copper-zinc alloys [brass], copper-nickel alloys [cupro-nickel] or copper-nickel-zinc alloys [nickel silver])	United States
Rotary displacement compressors, single-shaft (excl. compressors for refrigerat-ing equipment and air compressors mounted on a wheeled chassis for towing)	China
Reciprocating displacement compressors, having a gauge pressure capacity > 15 bar, giving a flow/h > 120 m | (excl. compressors for refrigerating equipment and air compressors mounted on a wheeled chassis for towing)	China
Non-electronic viscometers, porosimeters and expansion meters	United States
Unwrought zinc, not alloyed, containing by weight >= 99.95% but < 99.99% of zinc	Mexico
Articles of graphite or other carbon, for electrical purposes (excl. electrodes, carbon brushes and heating resistors)	United States
Under-carriages and parts thereof, for aircraft, n.e.s.	United States

Product description	Country with the highest share in Belgian imports
Animal blood prepared for therapeutic, prophylactic or diagnostic uses	Japan
Cortisone, hydrocortisone, prednisone "dehydrocortisone" and prednisolone "dehydrohydrocortisone"	United States
Catalysts in the form of wire cloth or grill, of platinum	Norway
gamma-Butyrolactone	Taiwan
Derivatives of o-phenylenediamine, m-phenylenediamine, p-phenylenediamine or diaminotoluenes; salts thereof (excl. halogenated, sulphonated, nitrated and nitrosated derivatives, and salts thereof)	United States
Mixture of isomers consisting of 4-methyl-2,6-bis"methylthio"-m-phenylenediamine and 2-methyl-4,6-bis"methylthio"-m-phenylenediamine	United States
Ships' or boats' propellers and blades therefor (excl. those of bronze)	United States
Wire of non-alloy aluminium, with a maximum cross-sectional dimension of <= 7 mm (other than stranded wires, cables, ropes and other articles of heading 7614, electrically insulated wires, strings for musical instruments)	United States
Tungstates "wolframates"	China
Unwrought cermets	United Kingdom
Aromatic cyclic alcohols and their halogenated, sulphonated, nitrated or nitrosated derivatives (excl. benzyl alcohol)	China
3,3',4,4',5,5',6,6'-Octabromo-N,N'-ethylenediphthalimide; N,N'-ethylenebis(4,5-dibromohexahydro-3,6-methanophthalimide)	United States
Deuterium and other compounds of deuterium; hydrogen and compounds thereof, enriched in deuterium; mixtures and solutions containing these products [Euratom] (excl. heavy water "deuterium oxide")	Switzerland
Tequila in containers holding > 2 l *	Mexico
Extracts of glands or other organs or of their secretions, of animals, for organotherapeutic uses	United States
Erythromycin and its derivatives; salts thereof	United States
Aircraft launching gear and parts thereof, n.e.s. (excl. motor winches for launching gliders)	United States
Di"benzothiazol-2-yl"disulphide; benzothiazol-2-thiol "mercaptobenzothiazole" and its salts	India
Butane-1,3-diol	United States
Articles of beryllium, n.e.s.	United States
Aluminium ores and concentrates	China
Diethylamine and its salts	United States
Poly(vinyl fluoride) sheet, and biaxially oriented non-cellular poly"vinyl alcohol" film containing by weight >= 97% of poly"vinyl alcohol", uncoated, of a thickness of <= 1 mm, not reinforced, laminated, supported or similarly combined with other materials, without backing, unworked or merely surface-worked or merely cut into squares or rectangles (excl. self-adhesive products, floor, wall and ceil-	United States
Electromagnetic lifting heads	United States

Product description	Country with the highest share in Belgian imports
Ester or anhydride of tetrabromophthalic acid; benzene-1,2,4-tricarboxylic acid; isophthaloyl dichloride, containing by weight 0,8% or less of terephthaloyl dichloride; naphthalene-1,4,5,8-tetracarboxylic acid; tetrachlorophthalic anhydride; sodium 3,5-bis(methoxycarbonyl)benzenesulphonate	United States
3,6-Dichloropyridine-2-carboxylic acid	United States
Bromomethane "methyl bromide"	United States
Articles of gallium, indium and vanadium, n.e.s.	China
Cobalt waste and scrap (excl. ash and residues containing cobalt)	United Kingdom
Oxides, hydroxides and peroxides, of strontium or barium	China
1,4-Diazabicyclo[2.2.2]octane "triethylenediamine"	Switzerland
Carbides of boron, whether or not chemically defined	China
Manganese oxide containing by weight >= 77% of manganese	United States
Azides, silicides, whether or not chemically defined (excl. compounds which are also carbides of heading 2849, and inorganic or organic compounds of mercury)	India
Base metals, silver or gold, clad with platinum, not further worked than semi-manufactured	United Kingdom
Naphazoline hydrochloride "INNM" and naphazoline nitrate "INNM"; phentolamine "INN"; tolazoline hydrochloride "INNM"	Switzerland
Unwrought zinc, not alloyed, containing by weight >= 97,5% but < 98,95% of zinc	Switzerland
Chloramphenicol and its derivatives; salts thereof	China
Borides, whether or not chemically defined (excl. compounds which are also carbides of heading 2849, and inorganic or organic compounds of mercury)	United States
Diphenyl ether	United Kingdom
Diboron trioxide	Russian Federation
4-Methylpyridine	United States
Trimethyl phosphite	United States
Propyphenazone	United Kingdom
Dextromethorphan "INN" and its salts	India
1,4-Naphthoquinone	United Kingdom
Cadmium oxide	China

Note: The table shows the 81 strategic goods for which Belgium depended persistently on non-EU countries, during the period 2014-2023. We define persistent dependence as dependence where thresholds are exceeded (HHI>=0.5 and non-EU share> 50%) and in at least 5 out of 10 years the same country has the highest share in Belgian imports. Goods are ranked according to declining average import value. * Tequila is listed as a strategic good as, for our analysis at the CN8 product level, the US Harmonised Tariff Schedule code 22089080 ('Undenatured ethyl alcohol of an alcoholic strength by volume of less than 80% Vol, Others'), on the US International Trade Administration's Draft List of Critical Supply Chains is converted to the HS6 code 220890 (Ethyl alcohol of an alcoholic strength of < 80% vol, not denatured) that covers the CN8 code of Tequila (22089075).

Source: Authors' calculations based on INA, Foreign Trade database.

Table 6 lists the 25 strategic goods for which Belgium has a persistently high export dependence on non-EU countries, during the period 2014-2023 (same thresholds as for import dependence), and the same country has the highest share in Belgian exports. The goods are ranked according to declining average export value (over the years in which the thresholds were exceeded). For 11 of the 25 goods, the United States was the main destination for Belgian exports, for 3 it was Switzerland and for 2 it was China. Export dependence of strategic goods is primarily relevant when there is an export ban (whether internationally coordinated or imposed by a third country) of these sensitive goods to certain destinations. Recent examples include the restrictions imposed by the US on Dutch company ASML regarding its exports of lithography machines to China, as well as EU restrictions on exports of certain goods to Russia, following the invasion of Ukraine. However, according to the results in Table 6, the exposure of Belgian exports of strategic goods to geopolitically sensitive destinations is limited.

Table 6 Strategic goods with persistently high Belgian export dependence on non-EU countries (2014-2023)

Product description	Country with the highest share in Belgian exports
Glycosides, natural or reproduced by synthesis, and their salts, ethers, esters and other derivatives (excl. rutoside "rutin" and its derivatives, digitalis glycosides, glycyrrhizic acid and glycyrrhizates)	United States
Waste and scrap of platinum, incl. metal clad with platinum, and other waste and scrap containing platinum or platinum compounds, of a kind used principally for the recovery of precious metal (excl. ash, and waste and scrap of platinum melted down into unworked blocks, ingots, or similar forms, and sweepings containing other precious metals, and e-waste of heading 8549)	Singapore
Waste and scrap of gold, incl. metal clad with gold, and other waste and scrap containing gold or gold compounds, of a kind used principally for the recovery of precious metal (excl. ash, and waste and scrap of gold melted down into unworked blocks, ingots, or similar forms, and sweepings containing other precious metals, and e-waste of heading 8549)	Switzerland
Sterile surgical catgut	United States
Diethanolamine and its salts	United States
Ketone-alcohols and ketone-aldehydes (excl. 4-Hydroxy-4-methylpentan-2-one "diacetone alcohol")	United States
Polymers of vinyl esters and other vinyl polymers, in primary forms (excl. those of vinyl chloride or other halogenated olefins, poly"vinyl acetate", copolymers and poly"vinyl alcohol", whether or not containing unhydrolised acetate groups, and poly"vinyl formal" in blocks of irregular shape, lumps, powders, granules, flakes and similar bulk forms, of a molecular weight of >= 10,000 but <= 40,000 and containing by weight >= 9.5% but <= 13% of acetyl groups evaluated as vinyl acetate and >= 5% but <= 6.5% of hydroxy groups evaluated as vinyl alcohol)	China
Hormones, natural or reproduced by synthesis; derivatives and structural analogues thereof, used primarily as hormones (excl. polypeptide hormones, protein hormones, glycoprotein hormones, steroidal hormones, catecholamine hormones, prostaglandins, thromboxanes and leukotrienes, their derivatives and structural analogues, and amino-acid derivatives, and products of 3002 10)	United States
Propellers and rotors and parts thereof, for aircraft, n.e.s.	United States
Germanium oxides and zirconium dioxide	United States
Platinum in semi-manufactured forms (excl. sheets and strips of a thickness, excl. any backing, of > 0.15 mm and plates, bars, rods, wire and sections)	China

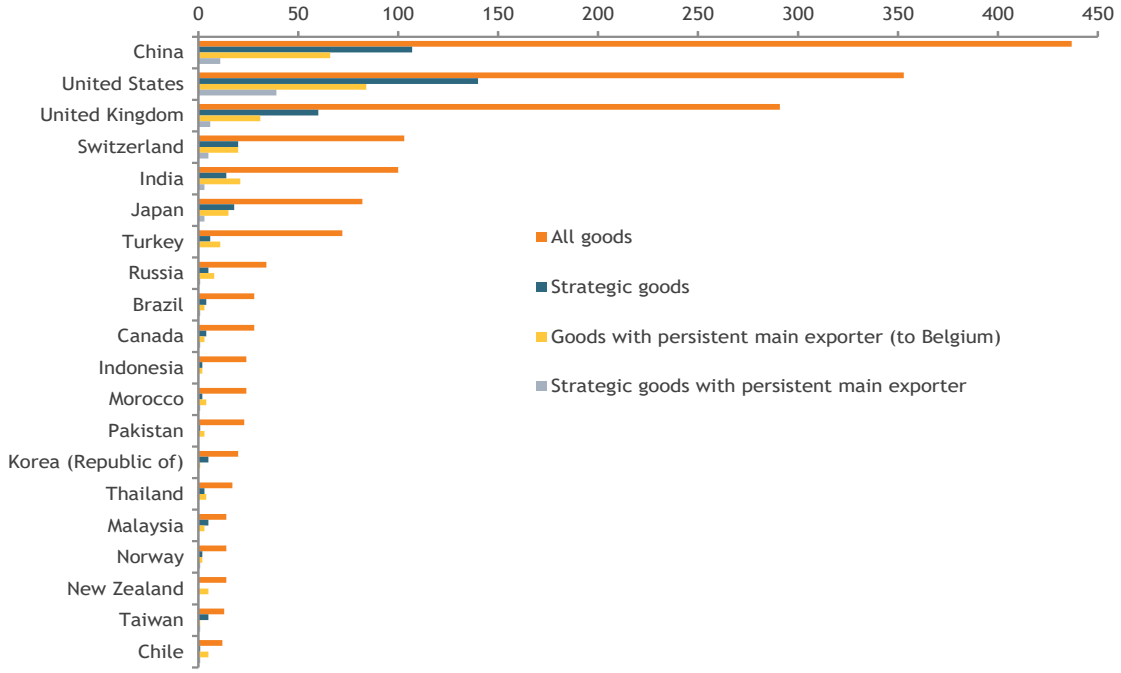
Product description	Country with the highest share in Belgian exports
Medicaments containing pseudoephedrine "INN" or its salts, not containing hormones, steroids used as hormones or antibiotics, not in measured doses or put up for retail sale	United States
Alprazolam "INN", camazepam "INN", clonazepam "INN", clorazepate, delorazepam "INN", diazepam "INN", estazolam "INN", ethyl loflazepate "INN", fludiazepam "INN", flunitrazepam "INN", flurazepam "INN", halazepam "INN", lorazepam "INN", lormetazepam "INN", mazindol "INN", medazepam "INN", midazolam "INN", nimetazepam "INN", nitrazepam "INN", nordazepam "INN", oxazepam "INN", pinazepam "INN", prazepam "INN", pyrovalerone "INN", temazepam "INN", tetrazepam "INN" and triazolam "INN", salts thereof, and salts of chlordiazepoxide "INN"	Brazil
Tungsten waste and scrap (excl. ash and residues containing tungsten)	United States
Dibromomethane	Switzerland
Cobalt waste and scrap (excl. ash and residues containing cobalt)	United States
2,3,4,5,6-Pentabromoethylbenzene	Russian Federation
Molybdenum ores and concentrates (excl. roasted)	Switzerland
Sodium hexafluoroaluminate "synthetic cryolite"	Malaysia
Mixtures of uranium and plutonium [Euratom] (excl. ferro-uranium)	India
Carbides, whether or not chemically defined (excl. of calcium, silicon, boron, tungsten, aluminium, chromium, molybdenum, vanadium, tantalum, titanium, and inorganic or organic compounds of mercury whether or not chemically defined)	Switzerland
Iridium, osmium and ruthenium, in semi-manufactured forms	Argentina
Bars and rods of silico-manganese steel, of square or other than rectangular cross-section, not further worked than hot-rolled, hot-drawn or extruded, and hot-rolled, hot-drawn or extruded, not further worked than clad (excl. semi-finished products, flat-rolled products and hot-rolled bars and rods in irregularly wound coils)	Turkey
Lipoprotein lipase and aspergillus alkaline protease	India
Sulphides of non-metals (excl. phosphorus sulphides, incl. commercial phosphorus trisulphides, and carbon disulphide)	United Kingdom

Note: The table shows the 25 strategic goods for which Belgium depended persistently on non-EU countries, during the period 2014-2023. We define persistent dependence as dependence where thresholds are exceeded (HHI>=0.5 and non-EU share> 50%) and in at least 5 out of 10 years the same country has the highest share in Belgian exports. Goods are ranked according to declining average export value.
Source: Authors' calculations based on INA, Foreign Trade database.

4.1.5. Import and export dependence by trading partner

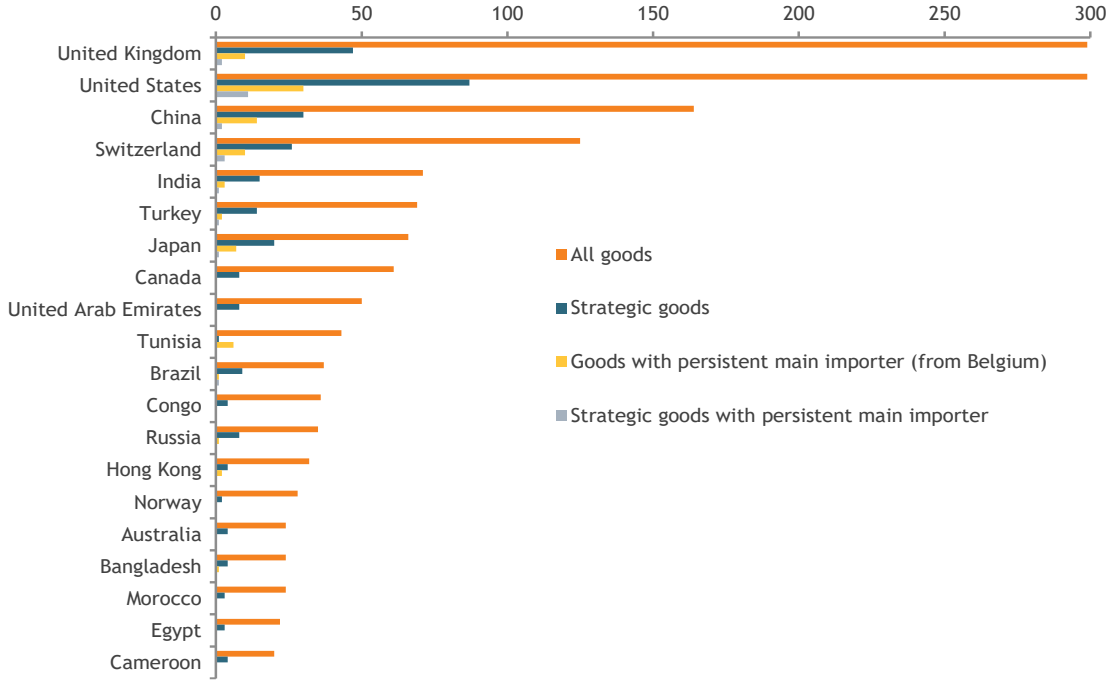
Graph 11 shows the 20 countries on which Belgium depended most for the goods for which it had a high import dependence on non-EU countries, in at least one year during the period 2014-2023. The countries are ranked according to the number of goods with high import dependence for which they are the main country of origin. For the period 2014-2023, there is a total of 1 924 goods for which Belgium, at a threshold for the HHI of 0.50, is highly dependent on non-EU countries for imports.

Graph 11 Belgium's import dependence on non-EU countries, number of goods by country of origin (2014-2023)



The graph displays the number of goods for which the reported country is the main exporter to Belgium over the period 2014-2023, for all goods for which Belgium has a high import dependence on non-EU countries. For each of these countries, it also shows (i) the number of strategic goods with high import dependence for which the country is the main country of origin, (ii) the number goods with high import dependence for which the country is the main country of origin in at least five of the ten years, and (iii) the number of strategic goods with high import dependence for which the country is the main country of origin in at least five of the ten years. Import dependence is based on an HHI threshold of 0.50 and a non-EU import share threshold of 0.50.
Source: Authors' calculations based on INA, 'Foreign Trade' database.

Graph 12 Belgium's export dependence on non-EU countries, number of goods by destination country (2014-2023)



The graph displays the number of goods for which the reported country is the main importer from Belgium over the period 2014-2023, for all goods for which Belgium has a high export dependence on non-EU countries. For each of these countries, it also shows (i) the number of strategic goods with high export dependence for which the country is the main country of destination, (ii) the number goods with high export dependence for which the country is the main country of destination in at least five of the ten years, and (iii) the number of strategic goods with high export dependence for which the country is the main country of destination in at least five of the ten years. Export dependence is based on an HHI threshold of 0.50 and a non-EU import share threshold of 0.50.
Source: Authors' calculations based on INA, 'Foreign Trade' database.

For strategic goods, the number is 445, and when also considering main exporter persistence, there remain 81 strategic goods (listed in Table 5). China is at the top of the ranking as the main country of origin for 437 goods, followed by the United States (353 goods) and the United Kingdom (291 goods).

However, Belgium appears to be more dependent on the United States than on China for strategic goods (140 goods for the US against 107 for China), goods with main exporter persistence (84 against 66) and strategic goods with main exporter persistence (39 against 11). Especially for the latter class of goods, the United States is clearly the country on which Belgium depends most.

As Graph 12 shows, the United Kingdom and the United States (both 299 goods) share the first place in the ranking of countries in terms of the number of goods for which Belgium has a high export dependence on non-EU countries, followed by China (164 goods). For strategic goods, Belgium is more dependent on the United States (87 goods) than on the United Kingdom (47) and China (30). The number of strategic goods for which Belgian exports persistently depend on non-EU countries is very limited (see list in Table 6). For 11 of these goods, the United States is the main importer (from Belgium), while the United Kingdom and China are each the main importer for two of these goods.

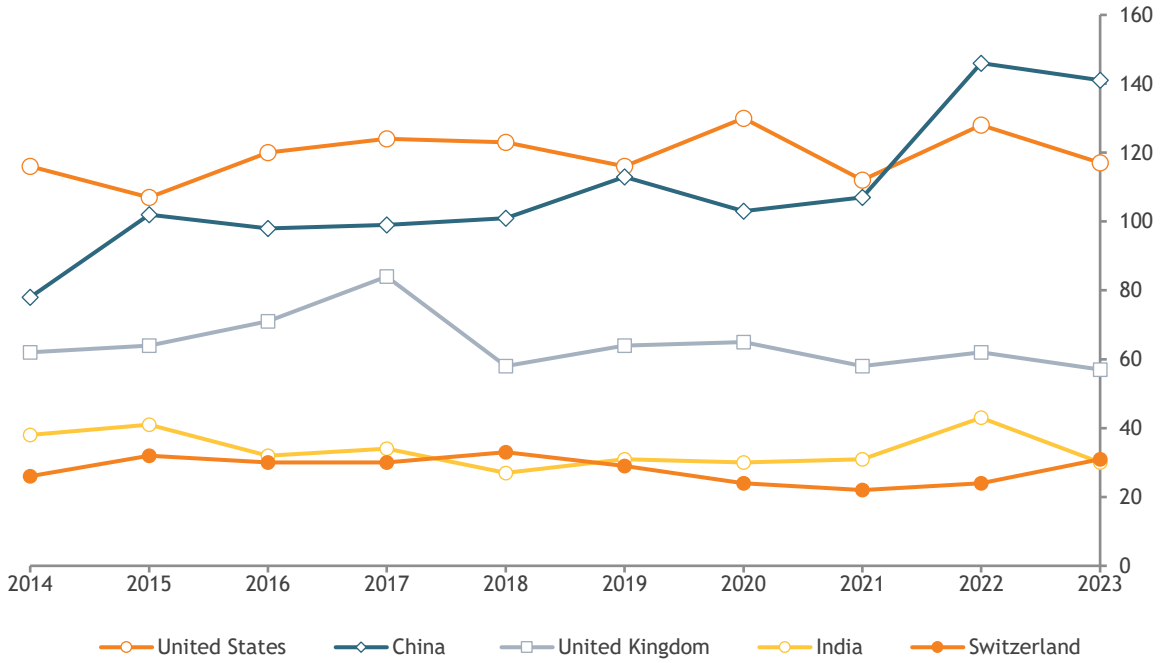
Graph 13 shows the number of goods with high Belgian import dependence, for each year of the period 2014-2023, for the five non-EU countries on which Belgium depends most. Graph 14 shows the number of strategic goods instead of the total number of goods, as in Graph 13.

The overall number of goods with high dependence is rather stable, but the number of goods for which Belgium depends on China has increased, from 78 goods in 2014 to 141 in 2023. The number of goods for which Belgium depended most on the United States has remained stable. As a result, China has overtaken the United States in terms of the number of goods in 2022. The number of goods for which the UK or India is the main exporter has decreased. For Switzerland, this number increased from 26 in 2014 to 31 in 2023. In Graph 13, only China's upward trend is statistically significant (1%), while in Graph 14, India's upward trend and Switzerland's downward trend are statistically significant (5%).

The Global Value Chain Development Report 2023 shows the same evolution for potential export bottlenecks, determined by geographic concentration (HHI), economic relevance and substitution possibilities. China's share in total global bottlenecks increased from 19.1% in 2000 to 36.3% in 2021. The United States' share fell from 18.4% in 2000 to 6.4% in 2021. The UK, which ranked eighth, with a 3.3% share of potential bottlenecks in 2000, is no longer in the top 10 in 2021 (Research Institute for Global Value Chains et al., 2023). The evolution is comparable for strategic goods with high Belgian import dependence, with increasing dependence on China increasing and decreasing dependence on the United States and the United Kingdom.

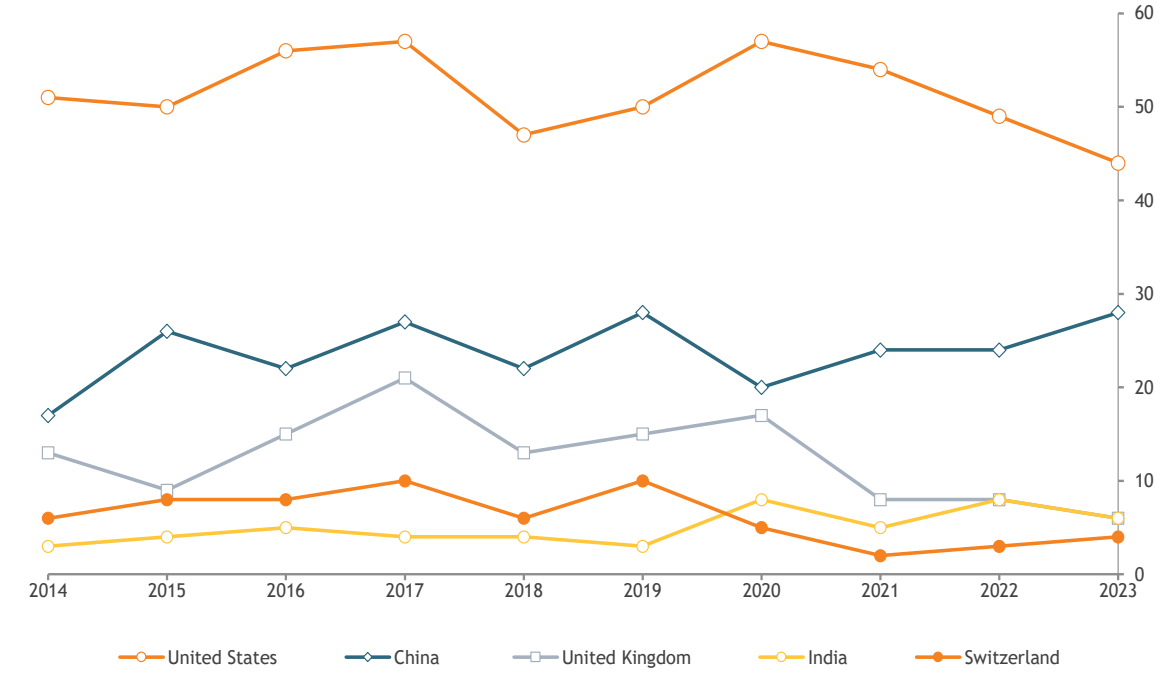
The number of strategic goods with high Belgian import dependence, that are mainly imported from India doubles from 3 in 2014 to 6 in 2023. Of course, this represents very few goods in absolute terms. These are mainly chemical goods, such as azides and silicides, as well as zinc dust. The number of strategic goods with high import dependence that are mainly imported from Switzerland decreased from 6 in 2014 to 4 in 2023. For 2022 and 2023, we find a high import dependence on Switzerland for immunological goods.

Graph 13 Evolution of the number of goods with import dependence on non-EU countries, for the five countries on which Belgium depends most



The graph shows the number of goods with high Belgian import dependence on non-EU countries for which the country is the main exporter (to Belgium).
Import dependence is based on an HHI threshold of 0.50 and a non-EU import share threshold of 0.50.
Source: Authors' calculations based on INA, Foreign Trade database.

Graph 14 Evolution of the number of strategic goods with import dependence on non-EU countries, for the five countries on which Belgium depends most

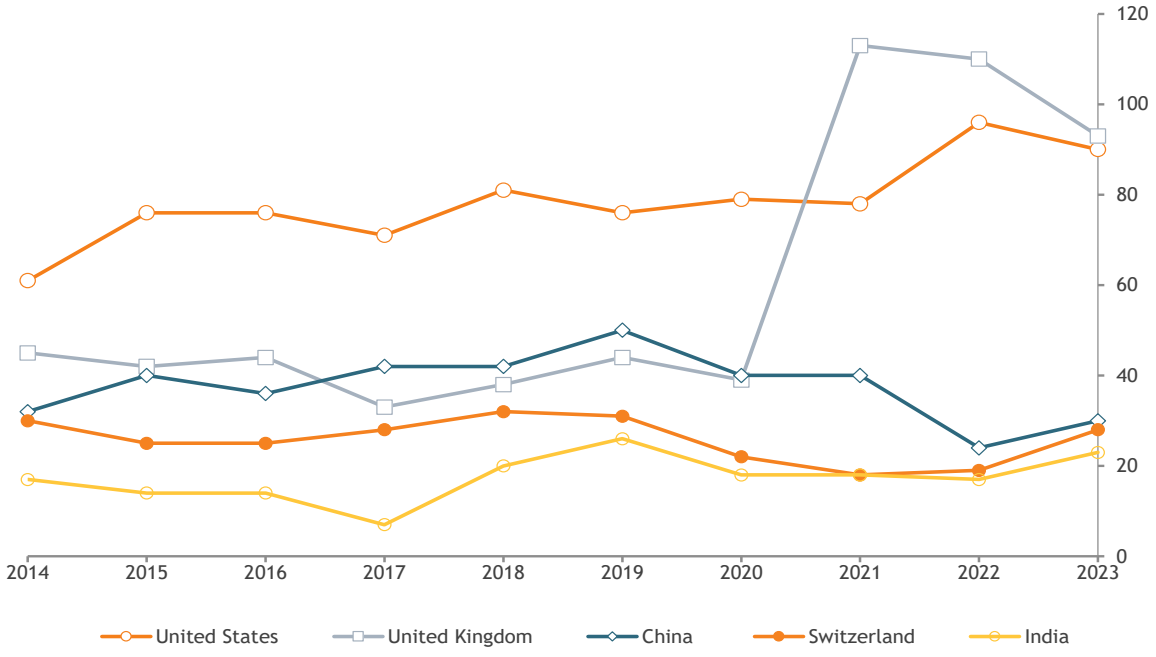


The graph shows the number of strategic goods with high Belgian import dependence on non-EU countries for which the country is the main exporter (to Belgium).
Import dependence is based on an HHI threshold of 0.50 and a non-EU import share threshold of 0.50.
Source: Authors' calculations based on INA, Foreign Trade database.

The country had a share of more than 56% in Belgian imports of these goods, with an average import value of more than €7 billion. This dependence is not considered persistent (for now) as the thresholds were only exceeded in 2022 and 2023.

Graph 15 shows the evolution of the number of goods with high Belgian export dependence in the period 2014-2023, for the five main (non-EU) destinations. Graph 16 shows the evolution for strategic goods with high Belgian export dependence. In contrast to import dependence, Belgium's export dependence on the United States and the United Kingdom, for all goods as well as for strategic goods, has increased. For the other countries, the number of goods for which Belgium is highly dependent in terms of exports remains stable. The upward trends for the United States and the United Kingdom are statistically significant (5%). Despite a marked drop in the total value of exports from Belgium to the UK in 2021, the number of goods with a high export dependence increased.[18] These are mainly goods that belong to the HS2 chapter "Beverages, alcoholic liquids and vinegar". These are thus clearly not strategic goods. Indeed, Graph 16 reveals that the increase in the number of goods with high Belgian export dependence on the UK after 2020 is much more limited for strategic goods than for all goods. The upward trends for the UK and for India are statically significant (for India only at 10%).

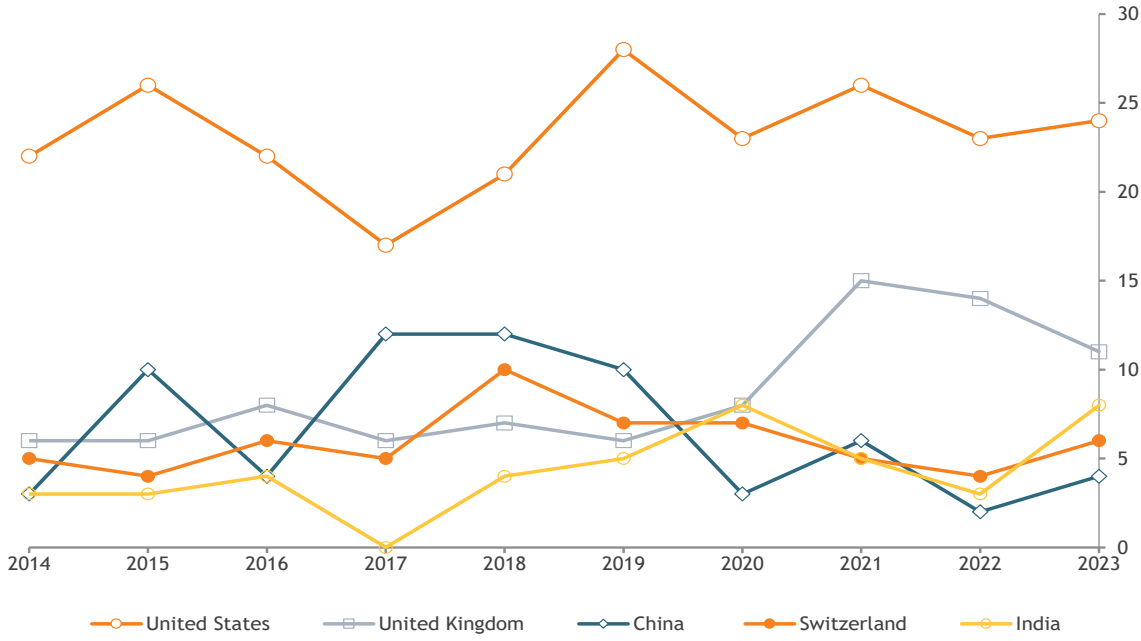
Graph 15 Evolution of the number of goods with export dependence on non-EU countries, for the five countries on which Belgium depends most



The graph shows the number of goods with high Belgian export dependence on non-EU countries for which the country is the main importer (from Belgium).
Export dependence is based on an HHI threshold of 0.50 and a non-EU import share threshold of 0.50.
Source: Authors' calculations based on INA, 'Foreign Trade' database.

[18] The problems with data on the UK's international trade as a result of Brexit are discussed in Box 1 in section 3.1.

Graph 16 **Evolution of the number of strategic goods with export dependence on non-EU countries, for the five countries on which Belgium depends most**



The graph shows the number of strategic goods with high Belgian export dependence from non-EU countries for which the country is the main importer (from Belgium). Export dependence is based on an HHI threshold of 0.50 and a non-EU import share threshold of 0.50.
Source: Authors' calculations based on INA, 'Foreign Trade' database.

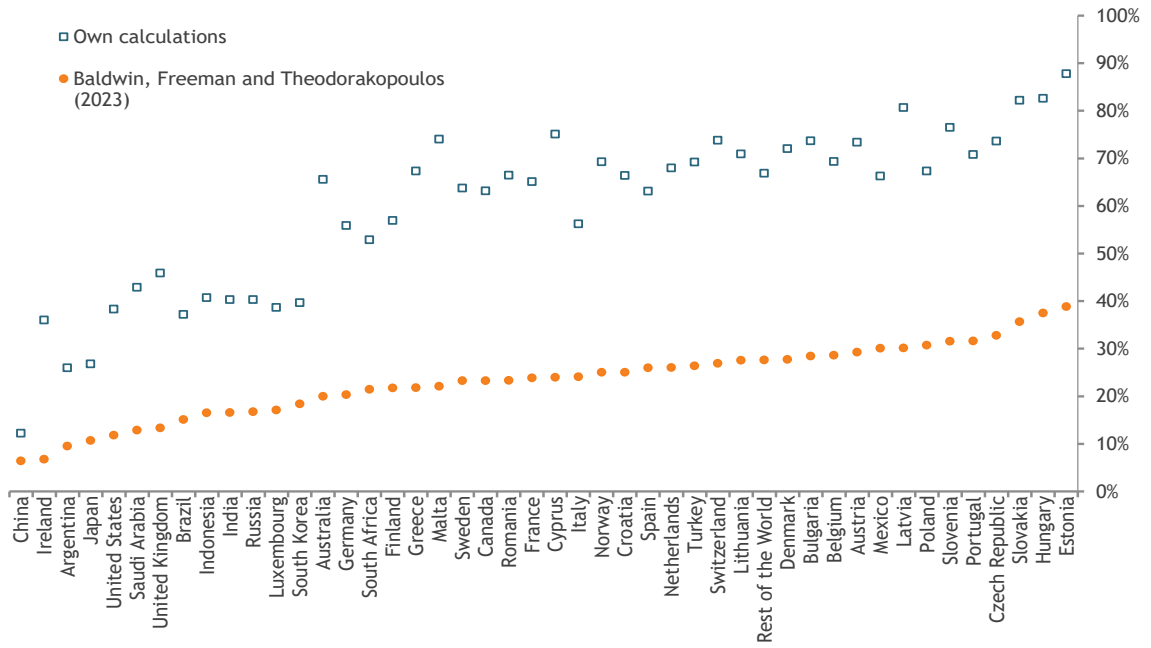
4.2. Belgium's total dependence within global supply chains

In this subsection, we present results on Belgium's total dependence within global supply chains, based on the methodology outlined in 2.2 and the data described in 3.2. The measures of total dependence consider not only direct dependence, as in the previous subsection, but also indirect dependence due to links upstream or downstream within global supply chains. We start with foreign supply chain dependence in terms of input purchases, i.e. import dependence, and then proceed with foreign supply chain dependence in terms of input deliveries, i.e. export dependence.

4.2.1. Import dependence

As emphasized in 2.2, we propose a slightly modified version of the indicators of supply chain exposure defined in Baldwin, Freeman and Theodorakopoulos (2023), which we refer to as dependence. In line with their work, we focus on manufacturing industries. For the sake of readability of the tables and graphs, we use abbreviated industry descriptions. Table A.1 in the appendix provides full industry descriptions. Graph 17 illustrates the difference in results on dependence between the version of Baldwin, Freeman and Theodorakopoulos (2023) and our version. It reports, for each of the 45 countries in the 2021 GMCIO table, the average share of foreign dependence in total dependence (*look-through exposure*) across all manufacturing industries. Countries are ranked, in decreasing order, by the foreign share calculated as proposed by Baldwin, Freeman and Theodorakopoulos (2023). Total foreign dependence based on our definitions is highly correlated with that of Baldwin, Freeman and Theodorakopoulos (2023).

Graph 17 Share of foreign dependence, in total input dependence, 2021



The graph shows the share of foreign dependence in total dependence (*look-through exposure*), on average, across manufacturing industries, for 45 countries and the rest of the world in 2021. The graph shows the difference between the indicators put forward by Baldwin, Freeman and Theodorakopoulos (2023) and the proposed alternative (see table 1 in 2.2).
Source: Authors' calculations based on FIGARO industry-by-industry global multi-country input-output tables (Eurostat).

However, our definition leads to foreign dependence estimates that are systematically higher, because in the version of Baldwin, Freeman and Theodorakopoulos (2023), the initial shock is considered as domestic and therefore increases the domestic share (See the discussion in section 2.2.). China is the country with the lowest share of foreign dependence, regardless of which version is considered. For China, the difference between the two versions is limited, whereas the difference is more substantial for the other countries. In Graph 17, Belgium has the 10th highest share of foreign dependence according to the indicator proposed by Baldwin, Freeman and Theodorakopoulos (2023), and the 15th highest share according to our indicator. When looking at the total dependence (*look-through exposure*) in greater detail, we find that the greatest dependence is domestic, with an average of 30.7% across industries. Next, total dependence is found to be highest with respect to neighbouring countries, with Germany in first place (average 14.8%), followed by the Netherlands (average 7.9%) and France (average 7%).

In the further analysis of Belgium's total dependence through supply chains, we focus on non-EU countries, in line with the criterion used in the analysis of bilateral trade data. There is, however, no guarantee that domestic sourcing, or sourcing from other EU countries, would be less sensitive to shocks than sourcing from non-EU countries. Table 7 reports total import dependence (*look-through exposure*) on non-EU countries, for manufacturing industries in Belgium. The countries are ranked according to descending average dependence across all industries in 2021 (last column). As indicated in subsection 3.2, the multi-country input-output data underlying the calculation of total import dependence cover 45 countries, among which 18 non-EU countries, and a 'rest of the world' country group. Hence, some of the non-EU countries from the list of main countries of origin of goods for which Belgium has a high import dependence (see Graph 11), such as Morocco and Pakistan, cannot be identified individually.

Table 7 Total Belgian import dependence on non-EU countries, by industry (2021)

	Food	Textiles	Wood	Paper	Print	Coke	Chemicals	Pharma	Plastics	Non-metallic	Basic metals	Fabricated metals	Computer/electronics	Electrical equipment	Machinery	Motor vehicles	Other transport	Furniture	Repair	Aver.
China	2.9	6.8	4.9	4.7	3.4	4.8	4.1	4.9	4.2	4.8	5.2	4.6	10.9	9.8	8.0	9.5	6.6	5.7	7.8	6.0
United States	1.3	2.4	1.6	2.2	1.7	3.0	3.1	5.8	2.8	1.7	1.5	1.3	2.0	1.6	2.1	2.0	2.5	1.7	2.0	2.2
Russia	0.8	1.2	1.7	1.1	0.8	4.2	2.4	0.9	1.5	1.7	3.7	2.5	1.0	1.8	1.3	0.6	1.0	1.5	0.9	1.6
United Kingdom	0.9	1.1	0.9	1.2	1.0	2.5	1.6	1.5	1.4	1.1	0.9	0.8	0.9	1.0	1.0	1.5	1.4	1.0	1.1	1.2
Japan	0.4	0.7	0.5	0.7	0.5	0.7	0.8	1.2	0.8	0.7	0.8	0.7	1.2	1.1	1.1	7.4	1.4	0.9	1.1	1.2
South Korea	0.4	0.7	0.5	0.6	0.4	0.6	0.6	0.7	0.6	0.6	0.8	0.7	1.1	1.0	1.1	2.0	6.3	0.6	3.2	1.2
Switzerland	0.8	0.7	0.6	0.7	0.6	0.5	0.8	7.3	0.7	0.5	0.4	0.5	1.3	0.8	0.7	0.5	0.6	0.6	0.7	1.0
India	0.6	1.3	0.5	0.7	0.5	0.8	0.9	1.1	0.9	0.7	0.8	0.7	0.6	0.7	0.7	0.7	0.6	1.5	0.7	0.8
Turkey	0.4	0.6	0.4	0.6	0.5	0.5	0.6	0.5	0.6	0.6	0.7	0.6	0.6	0.7	0.7	1.6	0.5	0.5	0.6	0.6
Mexico	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.7	0.4	0.4	2.7	0.3	0.5	0.3	0.4
Norway	0.2	0.2	0.2	0.3	0.2	2.6	0.4	0.3	0.3	0.4	0.5	0.3	0.2	0.3	0.2	0.1	0.2	0.4	0.2	0.4
Canada	0.2	0.2	0.4	0.2	0.2	0.6	0.3	0.5	0.3	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.4	0.3	0.3	0.3
Brazil	0.2	0.2	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.6	0.4	0.2	0.3	0.3	0.1	0.2	0.3	0.2	0.3
South Africa	0.1	0.2	0.1	0.2	0.1	0.2	0.2	0.4	0.2	0.2	0.2	0.2	0.1	0.2	0.1	0.6	0.1	0.1	0.1	0.2
Indonesia	0.3	0.3	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1
Saudi Arabia	0.1	0.2	0.1	0.1	0.1	0.2	0.3	0.1	0.3	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.0	0.1
Australia	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Argentina	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.1
Rest of the World	3.6	4.2	5.3	3.6	2.4	4.5	4.3	4.3	3.8	3.8	4.8	3.7	3.8	3.6	4.0	3.5	3.6	4.2	3.5	3.9
Direct dependence (face value exposure) - % total dependence																				
Foreign	25.3	29.3	27.0	34.2	30.4	23.9	37.0	45.0	34.0	23.5	24.2	20.0	40.2	35.4	32.0	42.6	19.6	23.3	24.2	30.0
EU 27	22.4	23.2	21.5	30.4	27.8	17.4	29.9	32.9	28.5	19.1	19.0	16.0	33.1	28.7	25.2	31.5	12.5	17.5	18.1	23.9
non-EU	2.9	6.1	5.5	3.8	2.6	6.5	7.1	12.1	5.5	4.4	5.2	4.1	7.0	6.6	6.8	11.1	7.1	5.8	6.1	6.1
Indirect dependence (hidden exposure) - % total dependence																				
Foreign	38.4	38.1	36.9	40.2	37.2	41.3	36.9	41.5	37.6	36.7	41.2	37.0	39.6	40.8	39.7	48.6	38.6	36.8	39.3	39.3
EU 27	27.7	22.8	23.6	26.3	26.5	21.2	22.8	23.3	23.9	23.2	24.3	23.3	21.6	23.5	24.1	26.3	19.7	22.5	22.5	23.6
non-EU	10.7	15.4	13.3	13.9	10.7	20.1	14.2	18.1	13.7	13.5	16.9	13.6	18.0	17.2	15.6	22.2	19.0	14.3	16.9	15.7
Total dependence (look-through exposure) - % total																				
Foreign	63.7	67.4	63.9	74.3	67.6	65.2	74.0	86.4	71.6	60.3	65.4	57.0	79.8	76.1	71.7	91.2	58.2	60.1	63.5	69.3
EU 27	50.1	46.0	45.1	56.7	54.3	38.6	52.7	56.2	52.4	42.3	43.2	39.3	54.7	52.3	49.2	57.9	32.1	40.0	40.6	47.6
non-EU	13.6	21.4	18.8	17.7	13.2	26.6	21.3	30.2	19.2	17.9	22.1	17.7	25.1	23.9	22.5	33.3	26.1	20.1	22.9	21.8

Note: The table reports the share of 18 non-EU countries in Belgium's total import dependence (*look-through exposure*) for all Belgian manufacturing industries in 2021. The countries are ranked in descending order of their average share across all industries, see the last column. See Table A.1 in Appendix for a full description of the industries. In addition, the table reports, for each industry, the direct foreign dependence (*face value exposure*), the indirect foreign dependence (*hidden exposure*) and total foreign dependence (*look-through exposure*), each with a split between EU and non-EU countries. These are all expressed as a share of total supply chain dependence. See table 2 and the discussion in subsection 2.2 on the calculation of these indicators of supply chain dependence.

Source: Authors' calculations based on FIGARO industry-by-industry global multi-country input-output tables (Eurostat).

Among the non-EU countries listed in Table 7, Belgium depends most on China and the United States. This is in line with our findings on import dependence based on bilateral trade data (see Graph 11). Belgium's total dependence on China is highest in the industries 'computer, electronic and optical products', 'electrical equipment', 'motor vehicles, trailers and semi-trailers' and 'machinery and equipment not elsewhere classified '. Moreover, the total dependence on the United States is particularly high for 'basic pharmaceutical products and pharmaceutical preparations'. For this industry, Belgium is even more dependent on Switzerland. Finally, Russia comes third among non-EU countries in terms of Belgium's average total dependence across all manufacturing industries. The total dependence on Russia is particularly significant in 'coke and refined petroleum products' and 'basic metals'.

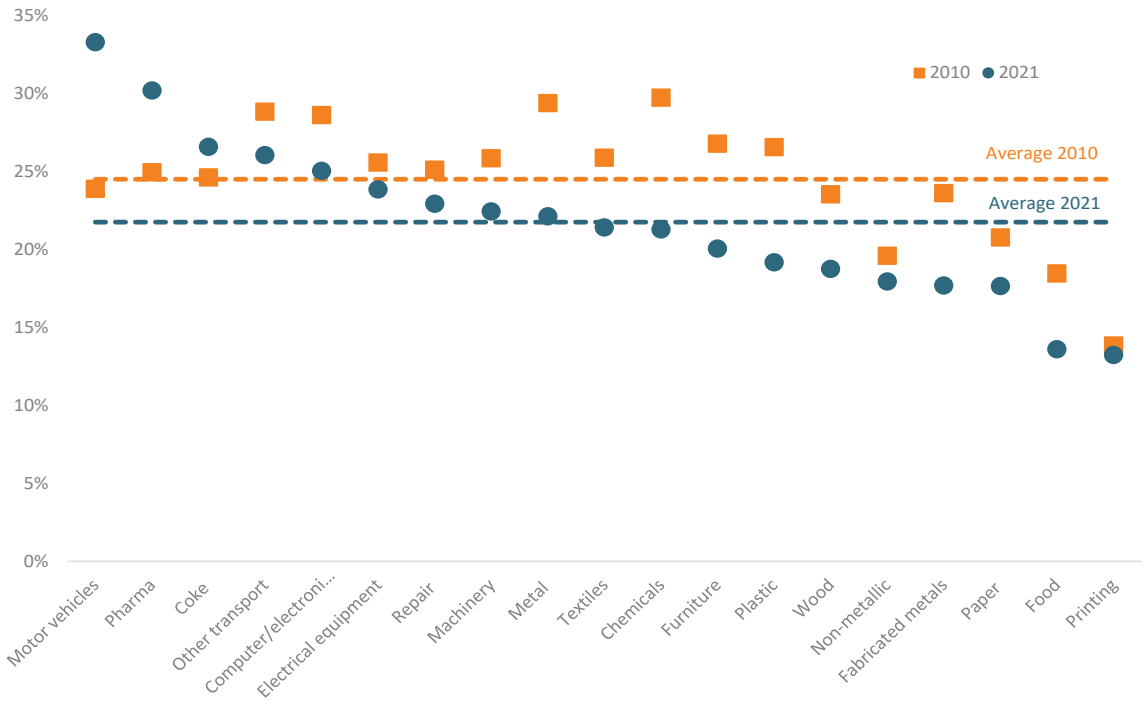
Below the shares of non-EU countries in total foreign dependence, Table 7 also reports summary results on Belgium's direct foreign dependence (*face value exposure*), its indirect foreign dependence (*hidden exposure*) and, again, its total foreign dependence (*look-through exposure*). These indicators are calculated for all manufacturing industries, with data from the 2021 multi-country input-output table from FIGARO and based on the formulas in the last column of Table 1 (section 2.2). All three foreign dependence indicators are expressed as a share of total supply chain dependence, which also comprises domestic dependence. In addition, they are split into dependence on EU-27 countries, and dependence on non-EU countries. The average values for all manufacturing industries are reported in the last column of the table. These results reveal that, in 2021, Belgium's total import dependence on other EU countries was, on average across all manufacturing industries, higher than its total import dependence on non-EU countries (47.6% against 21.8%). Moreover, indirect foreign dependence accounts, on average, for a higher share of total dependence (39.3%) than direct foreign dependence (30%). Table 7 also shows that indirect foreign dependence is relatively more important for non-EU countries, for which it is 2.6 times higher than direct foreign dependence. The shares of direct and indirect dependence on EU countries in total dependence are similar. Thus, direct dependence underestimates total dependence for Belgium, especially for non-EU countries, due to the global supply chain links. Our findings are consistent with a pattern where Belgium's dependence on geographically more distant non-EU countries comes indirectly through the country's imports from EU countries. These results illustrate the importance of taking indirect dependence into account.

It is worth noting that the indicators of face value foreign exposure for manufactured goods and for services are essentially the same as traditional input-output-based indicators of manufacturing and service offshoring when these are defined in terms of gross output (Amiti and Wei, 2005; Castellani et al., 2013). This shift in terminology illustrates a change in perspective on trade in intermediates that has come about with recent shocks and geopolitical tensions. Traditionally, offshoring is viewed as a means to increase productivity through international division of labour and gains from comparative advantage, although, from a home country perspective, it was acknowledged that it entails the risk of reducing labour demand, particularly for low-skilled workers. This is still true today, but what is new is that offshored parts of production processes are perceived as a source of vulnerability. Hence, traditional measures of offshoring are now interpreted as indicators of dependence or of potentially problematic exposure.

The results in Table 7 refer to 2021, which is the most recent year for which the underlying multi-country input-output data are available. To monitor trends over time in Belgium's total import dependence, we

have also calculated the same indicators for the year 2010 based on the corresponding input-output data for that year. Graph 18 compares the total import dependence (*look-through exposure*) of Belgian manufacturing industries on non-EU countries, for 2010 and 2021. The average total import dependence on non-EU countries is lower in 2021 than in 2010, and this holds true individually for all but three industries ('motor vehicles, trailers and semi-trailers', 'basic pharmaceutical products and pharmaceutical preparations' and 'coke and refined petroleum products'). By contrast, Belgium's total import dependence on other EU countries was higher in 2021 than in 2010 (47.6% on average across industries against 44.7%).

Graph 18 Belgium's total import dependence on non-EU countries, 2010 and 2021



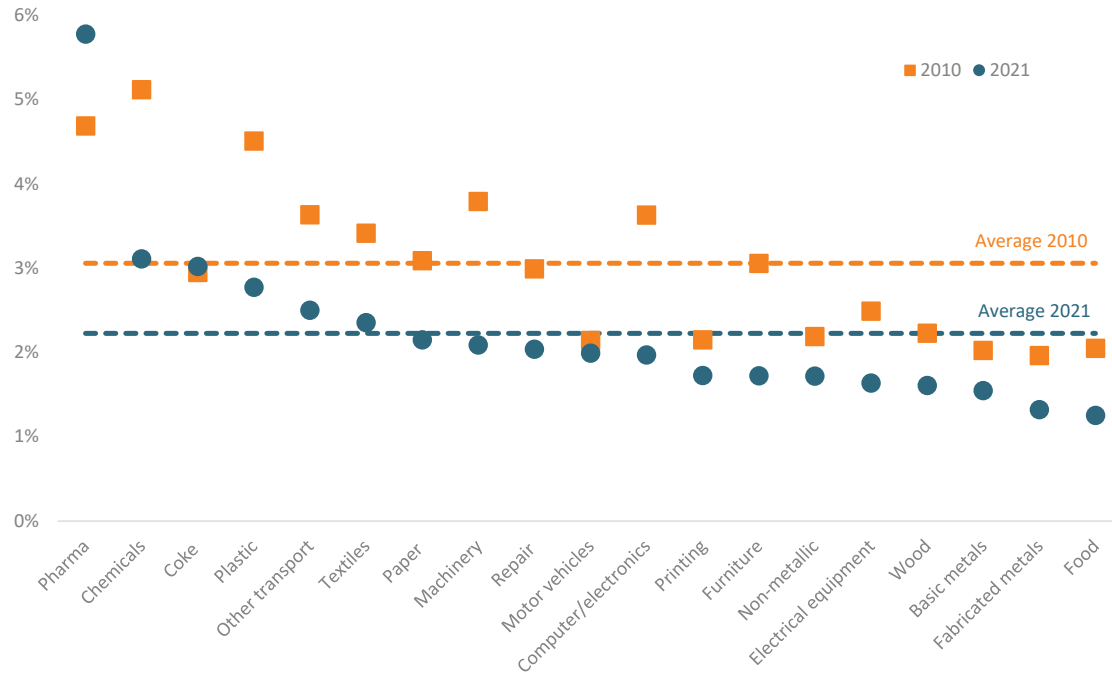
The graph compares total import dependence (*look-through exposure*) on non-EU countries, of all Belgian manufacturing industries, for 2010 and 2021. The industries are ranked in descending order of dependence in 2021.
Source: Authors' calculations based on FIGARO industry-by-industry global multi-country input-output tables (Eurostat).

Finally, we specifically look at the change over time in Belgium's total import dependence on China and the United States. On the one hand, Graph 19 shows that the total import dependence on China has increased in all Belgian manufacturing industries. The biggest increases are found in 'computer, electronic and optical products', 'electrical equipment' and 'motor vehicles, trailers and semi-trailers'. On average, across all manufacturing industries, total import dependence on China has risen from 4% in 2010 to 6% in 2021. On the other hand, Graph 20 shows that total import dependence on the United States has declined for all Belgian manufacturing industries except 'basic pharmaceutical products and pharmaceutical preparations'.

Graph 19 Belgium's total import dependence on China, 2010 and 2021

The graph compares total import dependence (*look-through exposure*) on China, of all Belgian manufacturing industries, for 2010 and 2021. The industries are ranked in descending order of dependence in 2021.
Source: Authors' calculations based on FIGARO industry-by-industry global multi-country input-output tables (Eurostat).

Graph 20 Belgium's total import dependence on the United States, 2010 and 2021



The graph compares total import dependence (*look-through exposure*) on the United States, of all Belgian manufacturing industries, for 2010 and 2021. The industries are ranked in descending order of dependence in 2021.
Source: Authors' calculations based on FIGARO industry-by-industry global multi-country input-output tables (Eurostat).

The decline is considerable in several industries: 'computer, electronic and optical products', 'machinery and equipment not elsewhere classified', 'furniture; other manufactured products', 'chemicals and chemical products' and 'food products; beverages; tobacco products'. On average, across all manufacturing industries, total import dependence on the United States has fallen, from 3% in 2010 to 2% in 2021.

Overall, the picture sketched by the indicators on import dependence computed with input-output data is consistent to the one obtained with bilateral trade data. Belgium's import dependence on non-EU countries has not really increased but there is a shift among the countries of origin of Belgian imports, away from a dependence on the United States towards a growing dependence on China.

4.2.2. Export dependence

As explained in section 2.2, we measure export dependence within supply chains through foreign exposure indicators that are based on the Ghosh input-output model. In the spirit of Baldwin, Freeman and Theodorakopoulos (2023), we define three indicators of export dependence: face value exposure for direct dependence, hidden exposure for indirect dependence and look-through exposure for total dependence, the latter being the sum of the former two. The formulas for the calculation of these indicators are given in Table 2 (last column), and the calculations have been done with industry-by-industry GMCIOs from FIGARO, as discussed in section 3.2.

According to our results for 2021, Belgium's total export dependence in supply chains (foreign look-through exposure) is the 10th highest among the 45 countries covered by the global input-output tables, whereas the export dependence of China and Brazil is particularly low.

When decomposing Belgium's total export dependence in manufacturing industries, we find that Belgium is most dependent on its EU partners, with an average share of 44.2% of total look-through exposure against 26.8% for non-EU countries (see bottom columns and last row of Table 8). In terms of individual countries, Belgium depends most on Germany (10.2% of total look-through exposure), France (9.6%) and China (8.5%). The Netherlands are ranked fourth (6.0%).

Table 8 reports detailed results for the total export dependence of Belgian manufacturing industries, on the 18 non-EU countries in the FIGARO tables for the year 2021. The countries are ranked according to descending average dependence across all industries (last column). Among non-EU countries, Belgium is, on average, most dependent on China. The total export dependence on China is particularly high for the industries 'computer, electronic and optical products', 'furniture and other manufactured products' and 'chemicals and chemical products'. The second country in this non-EU ranking is the United States. However, Table 8 shows that Belgium is much less dependent on the United States than on China, in terms of exports. Belgium's dependence on the United States is particularly high in the pharmaceutical industry. It is noteworthy (i) that Belgium's total export dependence on Russia is much lower than its total import dependence, a fact that is related to imports of gas and oil from Russia that were still substantial in 2021, and (ii) that Belgium's total export dependence on the UK is rather low despite geographic proximity.

Table 8 Total Belgian export dependence on non-EU countries, by industry (2021)

	Food	Textiles	Wood	Paper	Print	Coke	Chemicals	Pharma	Plastics	Non-metallic	Basic metals	Fabricated metals	Computer/electronics	Electrical equipment	Machinery	Motor vehicles	Other transport	Furniture	Repair	Aver.
China	4.6	9.0	5.5	6.7	6.3	8.9	12.5	8.6	9.9	6.4	9.5	6.3	16.0	9.5	9.2	5.8	8.1	12.9	6.2	8.5
United States	2.3	1.7	2.1	3.1	2.5	3.4	3.8	12.9	2.8	2.6	6.5	3.4	3.9	3.3	3.7	4.6	5.3	2.9	2.7	3.9
India	0.9	1.5	0.9	1.9	1.6	2.0	2.9	2.3	1.6	4.6	1.7	1.3	1.6	1.1	1.1	0.5	0.8	2.5	1.4	1.7
Switzerland	0.7	0.8	0.9	1.3	1.0	0.7	0.9	4.3	1.0	1.0	0.9	0.8	1.1	1.1	0.7	0.8	0.7	2.0	0.8	1.1
South Korea	0.7	0.9	0.6	0.7	0.7	0.9	1.3	1.3	1.0	0.8	2.6	1.2	1.6	1.3	1.0	1.3	0.4	0.9	0.9	1.1
Turkey	0.6	0.7	0.5	0.7	0.6	1.1	2.1	4.1	1.2	0.8	1.4	0.8	0.6	0.7	1.2	1.2	0.4	0.7	0.7	1.1
Japan	0.8	0.8	0.7	0.6	0.9	1.1	1.6	1.9	1.0	0.8	1.4	1.0	1.0	0.7	0.8	1.4	0.5	1.0	0.8	1.0
Canada	0.5	0.4	0.4	0.4	0.4	0.8	0.5	1.0	0.5	0.4	1.1	0.7	0.6	0.5	0.6	0.8	4.2	0.5	0.5	0.8
Russia	0.6	0.5	0.5	0.8	0.6	0.7	1.1	0.7	0.9	0.6	0.5	0.5	0.6	0.8	0.8	0.9	0.3	0.6	0.6	0.7
Mexico	0.2	0.4	0.3	1.0	0.5	0.6	0.7	0.4	0.7	0.5	1.0	0.6	0.9	1.3	0.8	0.8	0.2	0.5	0.4	0.6
United Kingdom	0.3	0.2	0.5	0.4	0.5	0.5	0.3	0.4	0.5	0.4	0.3	0.3	0.4	0.4	0.3	0.4	0.6	0.4	0.5	0.4
Brazil	0.2	0.2	0.2	0.3	0.3	0.7	0.7	0.6	0.5	0.3	0.5	0.4	0.4	0.4	0.4	0.4	0.7	0.3	0.3	0.4
South Africa	0.2	0.2	0.2	0.3	0.2	0.4	0.5	0.3	0.3	0.2	0.3	0.2	0.2	0.2	0.3	0.2	0.1	0.2	0.2	0.2
Norway	0.5	0.1	0.4	0.1	0.2	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.1	0.3	0.2	0.1	0.2	0.2	0.1	0.2
Australia	0.2	0.1	0.3	0.4	0.2	0.1	0.2	0.3	0.2	0.3	0.1	0.2	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.2
Indonesia	0.2	0.2	0.1	0.2	0.1	0.2	0.3	0.3	0.2	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.1	0.2	0.1	0.2
Saudi Arabia	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.1	0.1	0.1
Argentina	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.0	0.0	0.0	0.1	0.0	0.1
Rest of the World	4.2	3.4	4.1	6.2	4.3	5.4	5.5	5.7	4.7	4.9	5.5	3.9	5.2	5.1	5.0	4.2	3.0	5.0	3.6	4.7
Direct dependence (face value exposure) - % total dependence																				
Foreign	24.8	32.7	22.2	28.0	12.3	21.1	33.1	45.8	31.8	26.1	33.2	19.5	35.7	31.6	34.5	47.0	32.0	27.6	5.1	28.6
EU 27	19.7	27.7	18.1	20.6	10.4	16.5	23.2	22.4	24.2	20.2	22.5	15.1	24.5	23.7	26.6	38.6	22.6	18.1	3.3	21.0
non-EU	5.1	5.0	4.1	7.4	1.9	4.7	9.9	23.4	7.6	5.9	10.7	4.4	11.2	7.9	7.9	8.5	9.3	9.5	1.8	7.7
Indirect dependence (hidden exposure) - % total dependence																				
Foreign	33.6	38.5	37.4	42.3	49.2	49.5	50.8	38.2	45.0	44.7	51.3	43.0	43.0	42.0	40.5	37.8	31.8	43.6	43.3	42.4
EU 27	20.9	22.2	23.1	24.3	30.3	26.3	25.2	16.2	25.0	25.4	28.2	25.5	19.7	22.7	21.8	22.5	15.6	22.1	24.8	23.3
non-EU	12.7	16.3	14.3	18.0	18.9	23.2	25.5	22.0	20.0	19.3	23.1	17.5	23.3	19.3	18.7	15.3	16.2	21.4	18.5	19.1
Total dependence (look through exposure) - % total																				
Foreign	58.4	71.2	59.6	70.3	61.5	70.6	83.8	84.0	76.8	70.8	84.5	62.6	78.7	73.6	75.0	84.8	63.7	71.2	48.4	71.0
EU 27	40.6	49.8	41.2	44.9	40.7	42.7	48.4	38.6	49.2	45.7	50.8	40.6	44.2	46.5	48.4	61.0	38.2	40.3	28.1	44.2
non-EU	17.8	21.3	18.3	25.3	20.8	27.9	35.4	45.4	27.6	25.1	33.7	21.9	34.5	27.1	26.6	23.8	25.5	30.9	20.2	26.8

Note: The table reports the share of 18 non-EU countries in Belgium's total export dependence (*look-through exposure*) for all Belgian manufacturing industries in 2021. The countries are ranked in descending order of their average share across all industries, see the last column. See Table A.1 in Appendix for a full description of the industries. In addition, the table reports, for each industry, the direct foreign dependence (*face value exposure*), the indirect foreign dependence ('hidden exposure') and total foreign dependence (*look-through exposure*), each with a split between EU and non-EU countries. These are all expressed as a share of total supply chain dependence. See Table 2 and the discussion in subsection 2.2 on the calculation of these indicators of supply chain dependence.

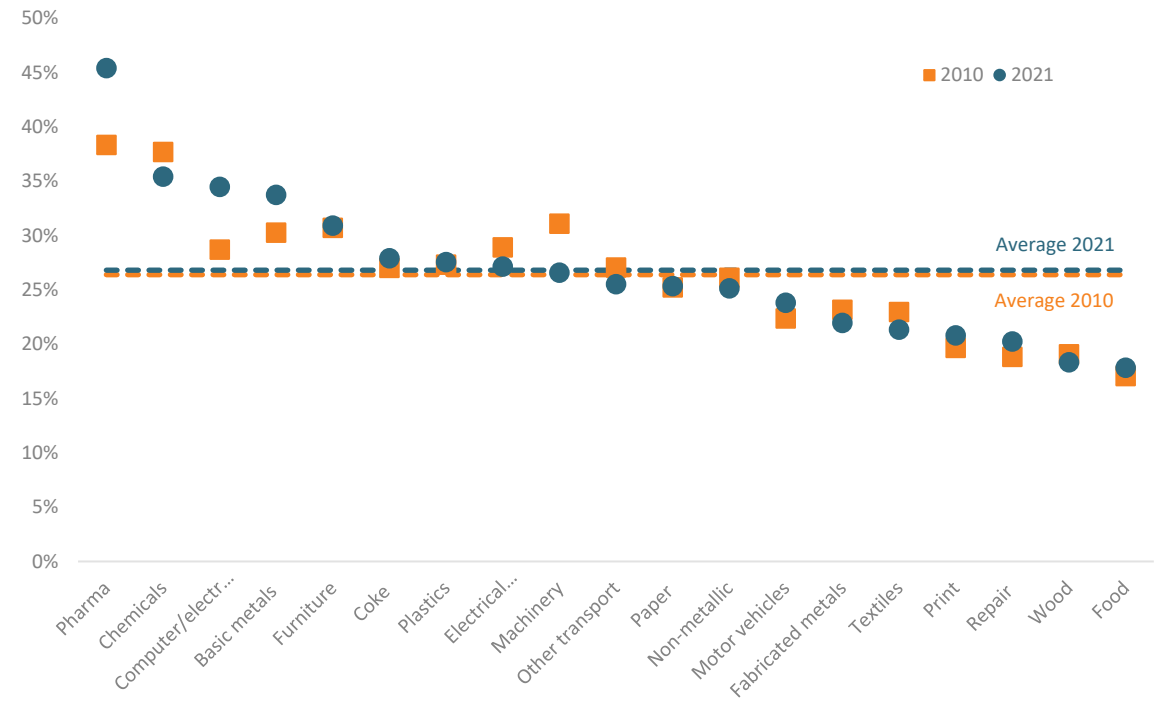
Source: Authors' calculations based on FIGARO industry-by-industry global multi-country input-output tables (Eurostat).

In addition, Table 8 reports the results for direct export dependence (*face value exposure*) and indirect export dependence (*hidden exposure*) of Belgian manufacturing industries in 2021. On average, indirect export dependence largely exceeds direct export dependence (42.4% of total look-through exposure against 28.6%). Moreover, the table shows that Belgium's indirect export dependence on non-EU countries is particularly high compared to direct dependence.

Beyond this analysis of the situation for the most recent year for which the data are available, we also investigate trends in total export dependence on non-EU countries between 2010 and 2021. As shown in Graph 21, there is almost no change in the average total export dependence of Belgian manufacturing industries on non-EU countries. This also holds true for most individual industries. Larger changes in total export dependence are found for the industries 'machinery and equipment not elsewhere classified' (increase), 'computer, electronic and optical products' (decrease) and 'basic pharmaceutical products and pharmaceutical preparations' (decrease).

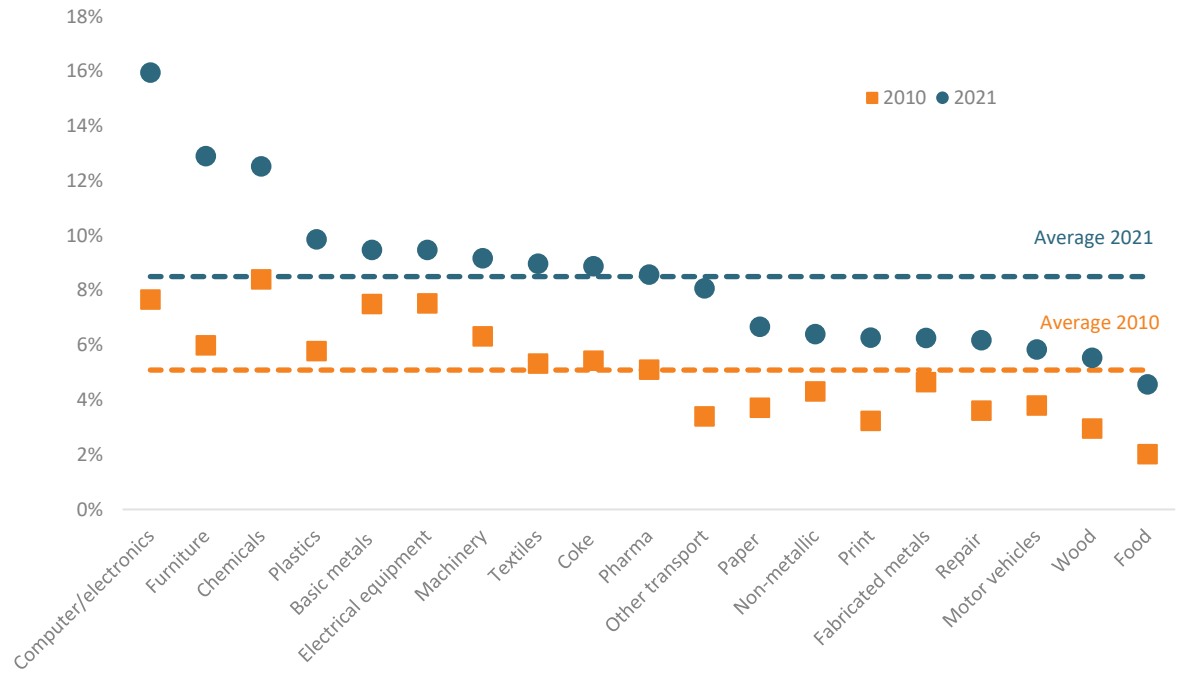
We do, however, find changes over the period 2010-2021, in Belgium's total export dependence on individual non-EU countries. Graph 22 shows that total export dependence on China has increased quite substantially for all Belgian manufacturing industries. There is also an overall rise in Belgium's total export dependence on the United States. Graph 23 reveals that this is driven by the very large increase in the dependence on the United States in the pharmaceutical industry. By contrast, there is a major fall in total export dependence on the United Kingdom, for all Belgian manufacturing industries.

Graph 21 Belgium's total export dependence on non-EU countries, 2010 and 2021



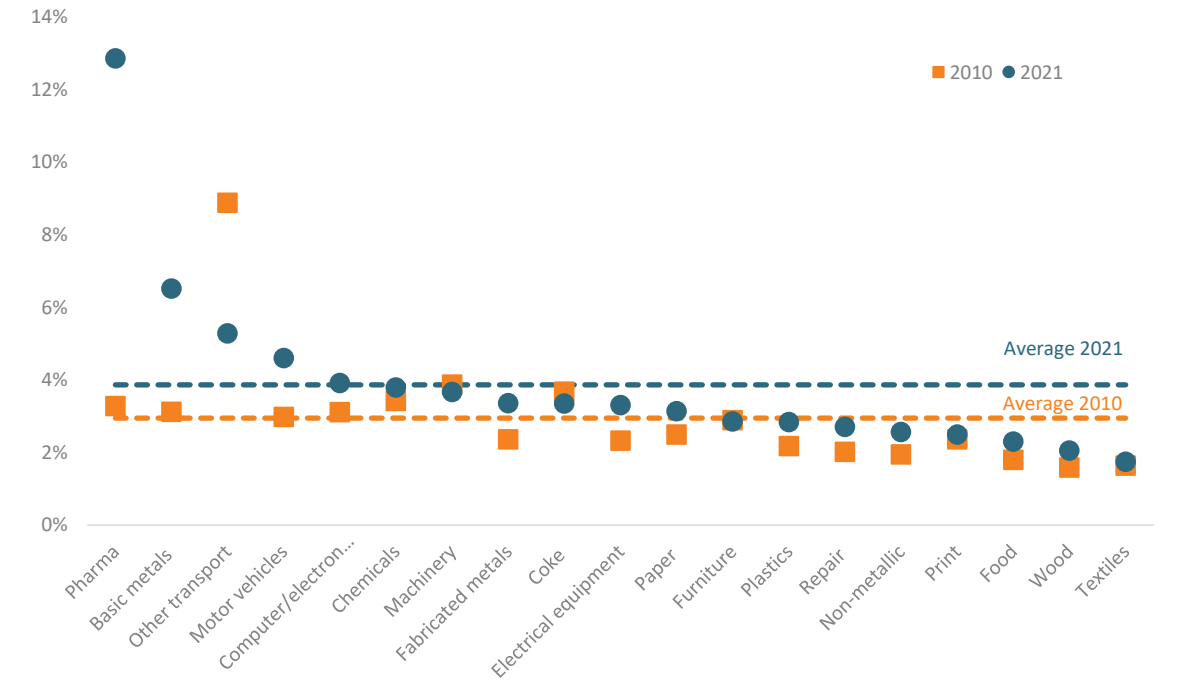
The graph compares total export dependence (*look-through exposure*) on non-EU countries, of all Belgian manufacturing industries, for 2010 and 2021. The industries are ranked in descending order of dependence in 2021.
Source: Authors' calculations based on FIGARO industry-by-industry global multi-country input-output tables (Eurostat).

Graph 22 Belgium's total export dependence on China, 2010 and 2021



The graph compares total export dependence (*look-through exposure*) on China, of all Belgian manufacturing industries, for 2010 and 2021. The industries are ranked in descending order of dependence in 2021.
Source: Authors' calculations based on FIGARO industry-by-industry global multi-country input-output tables (Eurostat).

Graph 23 Belgium's total export dependence on the United States, 2010 and 2021

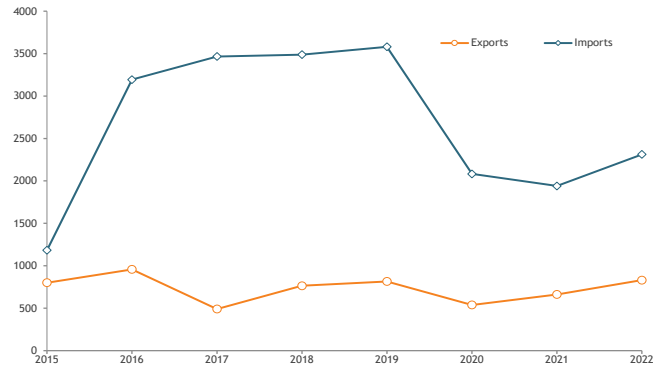


The graph compares total export dependence (*look-through exposure*) on the United States, of all Belgian manufacturing industries, for 2010 and 2021. The industries are ranked in descending order of dependence in 2021.
Source: Authors' calculations based on FIGARO industry-by-industry global multi-country input-output tables (Eurostat).

4.3. The impact on the Belgian economy of a potential disruption of trade in strategic goods with persistent dependence on non-EU countries

To estimate the impact on the Belgian economy of a possible disruption of transactions involving goods for which Belgium has a high import and export dependence on non-EU countries, we consider the list of strategic goods with persistently high dependence from subsection 4.1.4 (Table 5 for imports and Table 6 for exports). Based on these lists, we determine the shocks to be introduced into the input-output model to calculate the impact of strategic dependencies, that is, the transactions to be extracted as part of the 'hypothetical extraction method' (HEM) (see section 2.3 for details). As can be seen in Graph 24, Belgium's total value of imports of strategic goods with persistently high dependence on non-EU countries increases from 2015 onwards, peaks at €3.6 billion in 2019 and then falls to €3.5 billion in 2022. Belgium's total value of exports in strategic goods with persistently high dependence on non-EU countries, fluctuates between €600 million and €960 million. To define the shocks, we take averages of these imports and exports over the period 2015-2022. The imports of strategic goods with persistently high import dependence, are spread over 26 SUT product categories. In terms of annual average value, the main product categories are "basic organic chemical products and fertilisers", "basic pharmaceutical products" and "other inorganic basic chemical products". The exports of strategic goods with persistently high dependence, can be found in 13 SUT product categories, and the most important is 'waste collection and recovery' due to exports of scrap metal. The SUT product categories with high dependence can only include goods, as dependence is identified based on trade in goods.

Graph 24 Total value of strategic goods with persistently high dependence on non-EU countries (2015-2022)
Millions of euros



The graph shows Belgium's total import value of strategic goods with persistently high Belgian import dependence (see Table 5) and its total export value of strategic goods with persistently high Belgian export dependence (see Table 6).
Source: Authors' calculations based on INA, 'Foreign Trade' database.

4.3.1. Disruption in demand for exports

To estimate the effect of a hypothesized total disruption in trade involving strategic goods for which Belgium has a persistently high dependence on non-EU countries, we start with exports because, as discussed in subsection 2.3, this is less complicated than for a shock to imports.

As mentioned above, we take the average of exports of strategic goods with high dependence on non-EU countries, over the period 2015-2022, to determine the shock. In total, this amounts to 694 million euros. According to the 'hypothetical extraction method', the economy-wide loss in output due to a breakdown in demand for Belgian exports of these products is 1,008 million euros. Hence, we have an estimate of the indirect upstream effect due to intermediate input requirements of slightly more than 300 million euros (30%). We have also estimated the total effect of the shock in terms of value added. This loss in value added amounts to 316 million euros, which represents approximately 0.5% of the total value added of the manufacturing industry.

For certain industries, the effects are more substantial. Table 9 shows the results for the five main industries that would be most affected by a disruption in demand for Belgian exports of strategic goods with persistently high dependence on non-EU countries. The amounts in absolute value are also compared to the industries' value added.

Table 9 Effects of potential export shock (main industries)

	Materials recovery	Manufacture of non-ferrous metals	Manufacture of railways and rolling stock	Waste collection and treatment	Pharmaceutical industry
Shock to gross exports	-69.6	-166.7	-2.8	-29.1	-206.3
Total effect in value added	-12.3	-27.2	-1.0	-14.1	-95.6
Indirect effects in value added	-1.4	-3.6	0.0	-3.7	-2.3
Share in total industry value added	2.7%	1.8%	1.6%	0.9%	0.9%

The table shows the effect of a total disruption in demand for Belgian exports of strategic goods with persistent export dependence on non-EU countries, for the five industries that would be most affected by this disruption. The rows report the size of the shock and the effects. All variables are in millions of euros, except for the size of the effect relative to the industries' value added.
Source: Authors' calculations based on 'Foreign Trade' (INA) database and Belgian input-output data.

With a share of 2.7%, the loss is highest in 'material recovery', relative to total industry-level value added. This is followed by 'manufacture of non-ferrous metals' and 'manufacture of railway rolling stock', with losses of 1.8% and 1.6% of value added, respectively. However, the latter industry is very small in Belgium. In absolute value, 'manufacture of pharmaceutical products' would suffer most from this export demand shock, accounting for almost a third of the economy-wide loss in value-added. With respect to the total value-added of 'manufacture of pharmaceutical products' in Belgium, this only represents 0.9%. The indirect effects are relatively smaller in magnitude for these five industries compared to the economy-wide average. Indeed, indirect effects are spread over all industries.

4.3.2. Disruption in supply of imports

Based on average imports of strategic goods with high Belgian dependence on non-EU countries, for the years 2015-2022, we derive a shock to gross production in Belgian manufacturing of 2 823 million euros. The main industries affected are those manufacturing chemical, plastic and basic metal products. Applying the 'hypothetical extraction method', we find a total loss in output for the Belgian economy of 4 219 million euros. Hence, approximately a third of the total effect of the shock to production is indirect, through purchases of intermediate inputs. In terms of value added, the economy-wide effect amounts to 1 210 million euros. This represents 2% of total manufacturing value added.

Again, the magnitude of the effect differs strongly between industries. Here, it is mainly the industries manufacturing chemicals, plastics and basic metals that suffer losses. Next to these, service industries like 'wholesale trade' and 'activities of employment placement agencies' are also indirectly affected. Table 10 reports results for the top 10 industries in terms of the loss in value added, as a share of their total value added. It shows that the effect is largest in various chemical industries.

Table 10 Effects of potential import shock (main industries)

Industries 1-5	Manufacture of basic chemicals	Manufacture of inorganic basic chemicals	Manufacture of rubber products	Manufacture of other chemical products	Manufacture of agro-chemical products
Shock to gross exports	-1083.2	-55.5	-22.8	-99.8	-13.9
Total effect in value added	-307.1	-12.3	-7.8	-49.3	-6.4
Indirect effects in value added	-32.0	-1.4	-0.7	-6.2	-0.7
Share in total industry value added	5.6%	5.0%	3.4%	3.1%	2.6%
Industries 6-10	**Manufacture of paint and printing ink**	**Manufacture of plastic products**	**Manufacture of prepared animal feeds**	**Manufacture of air and spacecraft**	**Manufacture of basic iron and steel**
Shock to gross exports	-44.0	-171.0	-74.3	-29.1	-174.9
Total effect in value added	-12.4	-54.0	-8.8	-16.4	-25.6
Indirect effects in value added	-1.2	-5.6	-0.7	-3.4	-2.6
Share in total industry value added	2.5%	2.5%	2.2%	1.9%	1.9%

The table shows the effect of a total disruption in supply of Belgium's imports of strategic goods with persistent import dependence on non-EU countries, for the ten industries that would be most affected by this disruption. The rows report the size of the shock and the effects. All variables are in millions of euros except for the size of the effect relative to the industries' value added.

Source: Authors' calculations based on 'Foreign Trade' (INA) database and Belgian input-output data.

Table 11 summarises the results of estimating the effects of a potential disruption in imports or exports of strategic goods for which Belgium is persistently dependent on non-EU countries. The table reports the size of the shock, the total and the indirect effect on output, and the total effect on value added in Belgium. The shocks are small compared to economy-wide gross output, especially for exports. Expressed in terms of value added, the effects of the disruption in exports or imports represent respectively 0.5% and 2% of Belgian manufacturing value added. Indirect effects, through purchases of intermediate inputs, account for just over 30% of the total effect, for both types of shocks.

Table 11 Economy-wide effects of a potential disruptions in trade of strategic goods with persistently high Belgian dependence on non-EU countries
Millions of euros

	Exports	Imports
Gross shock	694	2 823
Total effect on output	1 008	4 219
Indirect effect on output	315	1 396
Total effect on value added	316	1 210

The table reports the size of the shock, and the economy-wide total effects, of a total disruption in the demand or supply of strategic goods for which Belgium is persistently dependent on exports to or imports from non-EU countries.

Source: Authors' calculations based on 'Foreign Trade' (INA) database and Belgian input-output data.

When considering the relatively limited size of both the shocks and the overall impact on the Belgian economy, it must be kept in mind that the shocks cover only the rather small number of strategic goods for which Belgium was persistently dependent on non-EU countries during the period 2014-2023. This

concerns 25 goods for exports and 81 goods for imports. A less strict selection – for example all goods for which Belgium is highly dependent in at least one year – would, of course, yield a greater effect. However, we judge a scenario of a complete disruption of demand or supply for all such goods as unrealistic. Nonetheless, non-economic considerations may also play a role when it comes to evaluating dependence on non-EU countries for strategic goods. Finally, these estimations only take direct dependence, based on bilateral trade data into account, and not total dependence within global supply chains, which as shown in subsection 4.2, is considerable. The consideration that a hypothesized shock to the demand for goods exported, or a shock to the supply of goods imported, by Belgium, would very likely also affect other EU-countries, and thereby indirectly also Belgium, is also not accounted for.

5. Conclusion

We have developed a methodology for establishing a list of goods for which Belgium is highly dependent on one, or a small number of countries, for its imports or exports. In this context, we have taken the distinction between EU and non-EU countries as a criterion for determining strong dependence, while other studies have looked at specific groups of countries considered to be problematic, for geopolitical or other reasons. The lists of goods with high dependence on non-EU countries can be further refined based on the economic or strategic importance of the goods. Other criteria that may be considered are, for example, the potential to reduce dependence by finding other or additional suppliers, or by replacing imports by domestic production.

In contrast with most prior studies, our analysis covers an entire decade (2014-2023). This allows to identify goods for which dependence is persistent, rather than the result of temporary supply problems. Designing policies to deal with temporary shocks is not straightforward because of the high uncertainty and diversity of such shocks. There is a risk that focusing on specific shocks could lead to a situation of "generals preparing for the last war", in the words of Baldwin, Freeman and Theodorakopoulos (2023).

Regardless of the threshold used to determine high dependence on non-EU countries, such dependence is temporary for most goods for which the threshold is exceeded. For goods for which the threshold was exceeded only in the most recent years of the period under consideration, it is possible that the dependence will become persistent. This can be determined when data for additional years become available.

During the period 2014-2023, there is no clear trend in the number of goods for which Belgium relies heavily on non-EU countries for imports. For exports, there is a clear upward trend, but not for strategic goods. There are more goods for which Belgium is dependent on non-EU countries for imports than for exports. When considering only strategic goods, there are far fewer goods for which Belgium is dependent on non-EU countries. China is the non-EU country which is the source for the largest number of goods for which Belgium has a high import dependence, followed by the United States and the United Kingdom. For strategic goods, Belgium has a significantly higher dependence on the United States than on China. Overall, Belgium’s dependence on the United States decreases and dependence on China increases. In terms of exports, the United Kingdom and the United States share first place as destination for the largest number of goods for which Belgium has a high export dependence, followed by China. For strategic goods with export dependence, the United States is the leading non-EU country, followed by the United Kingdom and China.

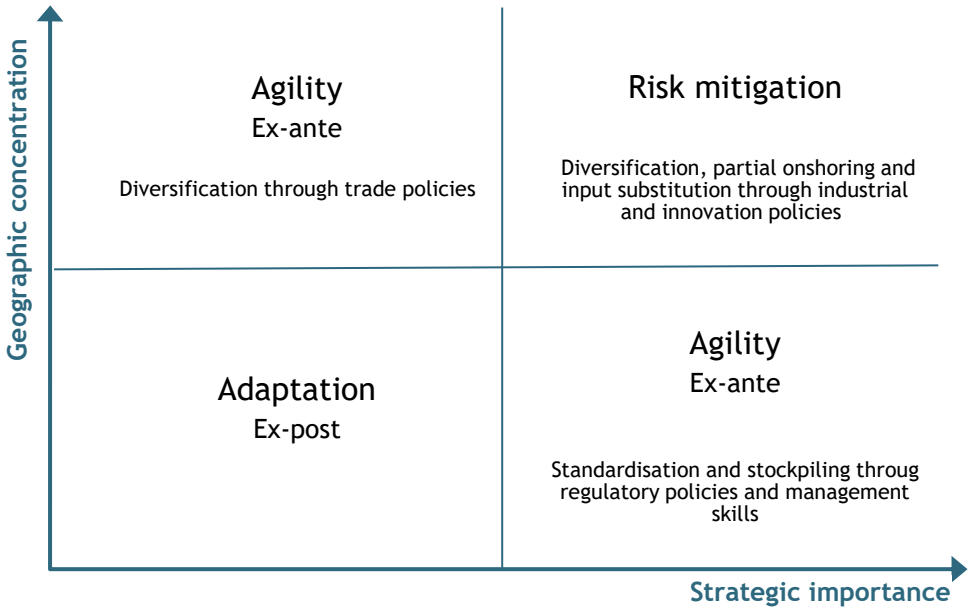
We show that it is important to work with trade data at the most detailed level of disaggregation. This avoids biased estimates of import and export dependence. A drawback of the trade data that we use is that they cover only direct bilateral trade flows and therefore do not allow to investigate indirect dependence. To estimate total dependence (both direct and indirect), we rely on a global multi-country input-output table. This allows mapping dependence within global supply chains. According to the results, China is the non-EU country on which Belgium was most dependent in 2021, followed by the United States and Russia. The share of non-EU countries in Belgium's total import dependence

remained constant between 2010 and 2021, but dependence on China increased while dependence on the United States decreased.

We also estimate the economy-wide impact for Belgium of a potential disruption in trade of goods for which Belgium is highly dependent on non-EU countries. For this purpose, we use Belgian input-output data and assume a full disruption in the demand for goods exported by Belgium or the supply of goods imported by Belgium. Our analysis is restricted to strategic goods with persistently high Belgian dependence. Both the size of the shock (loss in supply or demand) and the overall impact on the Belgian economy are limited, especially on the export side. The effects of the shocks on exports and on imports, represent respectively 0.5% and 2% of the value added in Belgian manufacturing.

Although we do not intend to provide detailed policy recommendations, we provide a brief discussion of potential measure that have been discussed in prior contributions. Graph 25 shows a framework of possible policy measures developed by the OECD. It classifies measures into four types as a function of trade dependence, measured by geographic concentration and strategic importance (specific list of goods). Using trade data at the 6-digit level, Schwellnus, Haramboure and Samek (2023) find that 62.4% of imported goods are not strategic and, moreover, not characterised by high concentration (concentration: HHI > 0.25).

Graph 25 Possible policies according to geographic concentration and strategic importance



Source: Schwellnus, Haramboure and Samek (2023).

Following the same criteria as Schwellnus, Haramboure and Samek (2023), during the period 2014-2023, on average 12% of the goods imported by Belgium had a high geographic concentration with regard to non-EU countries but were not strategic goods. For this, diversification of supply could be considered. On average, only 4% of imported goods were strategic and characterised by high import dependence. For this limited group of goods, possible policy measures are in line with the current discussion on reshoring and industrial policy. If the persistence of dependence is also considered, the percentage of goods is even smaller. On average, 70% of the goods imported by Belgium are not strategic and,

moreover, their imports are not highly concentrated either, while 14% of imported goods are strategic but fall below the thresholds. Regarding Belgian exports, the distribution of goods across the four quadrants of Graph 25 is similar, with slightly lower percentages for goods with high geographic concentration.

Schwellnus, Haramboure and Samek (2023) note that the potential benefits of measures seeking to reduce the risk of high dependence must be weighed against the potential costs. The lack of specialised domestic suppliers and sufficiently qualified personnel can complicate reshoring strategies. The authors also argue for international coordination, to avoid a subsidy war that could result in inefficient duplication and overcapacity. Recent examples of increasing state aid in Europe show that such coordination is also crucial within the EU.

Defining a policy strategy for a green and digital transformation is complicated in the current geopolitical context, in which trade relations are increasingly viewed antagonistically. Even among researchers, views differ increasingly. While Crespi et al. (2021) plead in favour of European technological sovereignty, van Manen et al. (2021) warn that there is a growing danger of techno-nationalism, and Hoekman, Mavroidis and Nelson (2023) urge for multilateral consultations through the World Trade Organisation. There also appears to be a shift in views on industrial policy. Until recently industrial policy was generally frowned upon by many economists - although in practice many policies, even in countries that claimed to be major opponents, could be labelled as such. Nowadays, calls for assertive industrial policy become more common. It is clear from an assessment of the negative implications of the US Inflation Reduction Act of 2022 for the European economy (Attinasi, Boeckelmann and Meunier 2023) that the EU cannot simply rely on the United States. In March 2020, the European Commission announced a European industrial strategy to support the transition to a green and digital economy. This also referred to the importance of monitoring strategic dependencies. Recent initiatives, such as the net zero industry regulation, the critical raw materials regulation for Europe, the industry Green Deal plan and the European chip regulation, fit within this strategy and can also be seen as a response to China and the United States.

Tagliapietra and Veugelers (2023) provide an overview of the history of industrial policy and current opportunities with a view to achieving climate goals, economic growth and resilience. Elia et al. (2021) argue that reshoring policies should be supported by industrial policies that enhance competitiveness and sustainability of the production chain. Others remain dismissive of a more active role for governments in reducing the risk of dependence on global supply chains. Crowe and Rawdanowicz (2023) argue that government interference can lead to costly disruption without improving volatility, or national security, and complicates necessary international coordination on social and environmental objectives. Henrekson, Sandström and Stenkula (2023) also remain sceptical about active industrial policy.

In a study for the European Parliament, Raza et al. (2021) highlight that recent attempts to 'reshore' production have proved unsuccessful and that such a policy would best focus on specific critical sectors and goods with obvious supply problems. Direct imports into the US, from China, decreased during the 2017-2022 period. In parallel, tensions between the United States and China increased, partly due to import tariffs and other trade barriers, imposed on China, by Donald Trump in 2018. Alfaro and Chor (2023) show that as a result, imports into the United States from Vietnam, due to low wages, and from

Mexico, due to 'nearshoring/friendshoring', increased sharply. This is also the case for semiconductor imports from Taiwan. However, it is not clear whether this reduced the import dependence of the United States on China, as during the same period, imports from China into Vietnam and Mexico increased. The trade restrictions appear to have mainly increased prices of goods imported into the United States, with negative effects on US firms that need these goods as inputs for their production. In addition, these restrictions merely reduced direct dependence on China by shifting trade flows, but did not reduce indirect dependence. Freund et al. (2023) point out the difference between rhetoric and reality on the unwinding of US import dependence vis-à-vis China, by showing that the concentration of US imports, as measured by the HHI, hardly changed and that the countries that saw their exports to the United States increase the most saw their imports from China increase, especially for electronic goods. Our analysis shows that the non-EU countries that are the origin of the largest number of goods for which Belgian imports are highly dependent (China, the United States and the United Kingdom) are also with the destinations for the largest number of goods for which Belgian exports are highly dependent. This interdependence highlights the potential risk of retaliation by trading partners if unilateral trade restrictions are imposed.

When analysing dependence on imports and exports from specific countries, it must be kept in mind that even trade flows with EU countries may involve companies from non-EU countries. For example, Poland and Hungary are the main exporters of batteries for electric vehicles to Belgium, but production in those countries is in the hands of companies from China and South Korea. Belgium's imports of electric vehicles from Mexico could also come from Chinese manufacturers that have established affiliates in Mexico to take advantage of Mexico's privileged trading position vis-à-vis the United States. BYD, the largest Chinese manufacturer of batteries and electric cars, is currently building an electric car plant in Hungary. Incidentally, one of the two electric vehicle manufacturers active in Belgium, namely Volvo, also has a Chinese majority shareholder. Data on national production and the nationality of manufacturers could be used to map this dependence.

Pisani-Ferry, Weder di Mauro and Zettelmeyer (2024) argue that an analysis of the vulnerability of production chains, due to high dependence on foreign suppliers and customers, would work best with a model that identifies inter-firm trade relationships and provides information on the ability to swiftly change suppliers. This could include both suppliers of the same product and suppliers of goods that are broadly comparable for consumption or production purposes. They add that such a model does not currently exist and may never exist due to data limitations. For Belgium, firm-level data could be used in future analyses, possibly linked to data on domestic production. When defining a policy strategy on import and export dependence, it is even more important to acknowledge that firms themselves react to the different shocks that occur in their supply chain. A survey conducted in 2022, shows that 90% of German industrial firms have adjusted their procurement strategy in response to disruptions to their supply chain. This mainly involves stockpiling, diversifying suppliers and better monitoring their supply chain. Half of the companies are considering increasing their number of suppliers (Aksoy et al. 2022).

For estimating the overall impact on the Belgian economy, of disruptions in the demand for exported goods, or the supply of imported goods for which there is a high dependence on non-EU countries, it would be interesting to work with firm-level data that permit the identification of importers and exporters.

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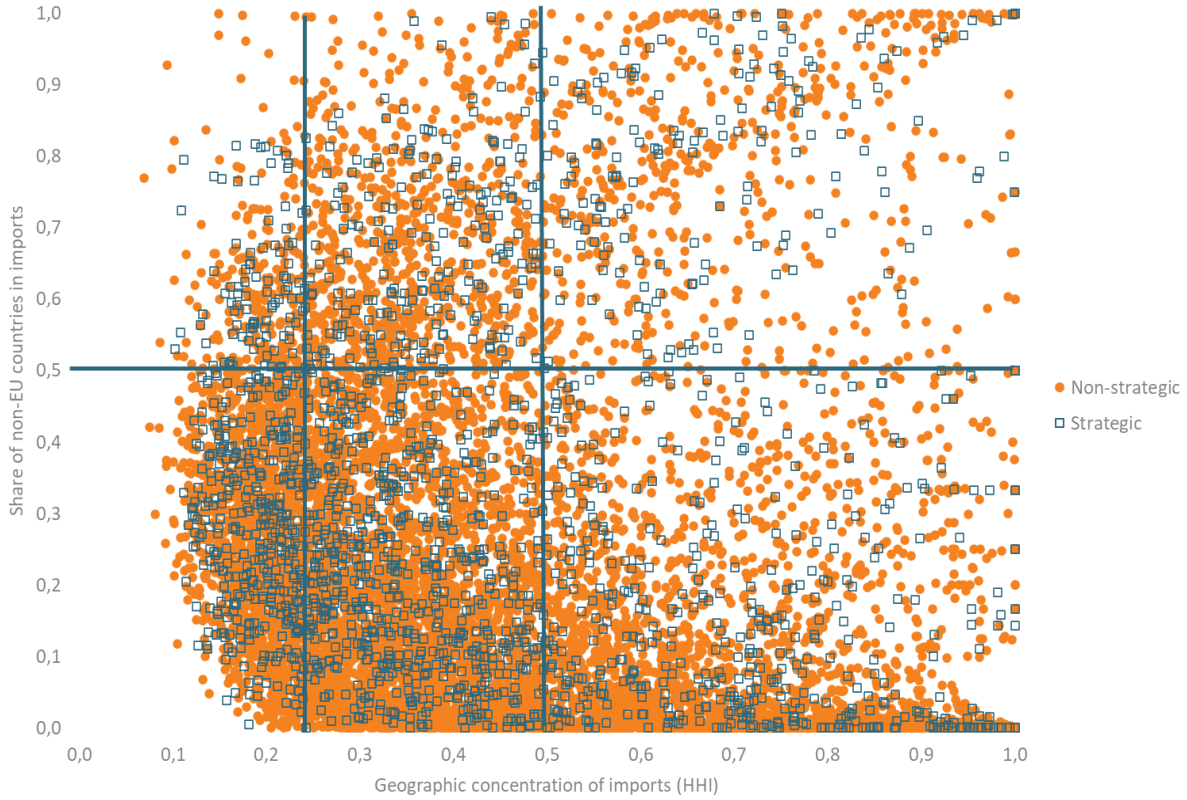
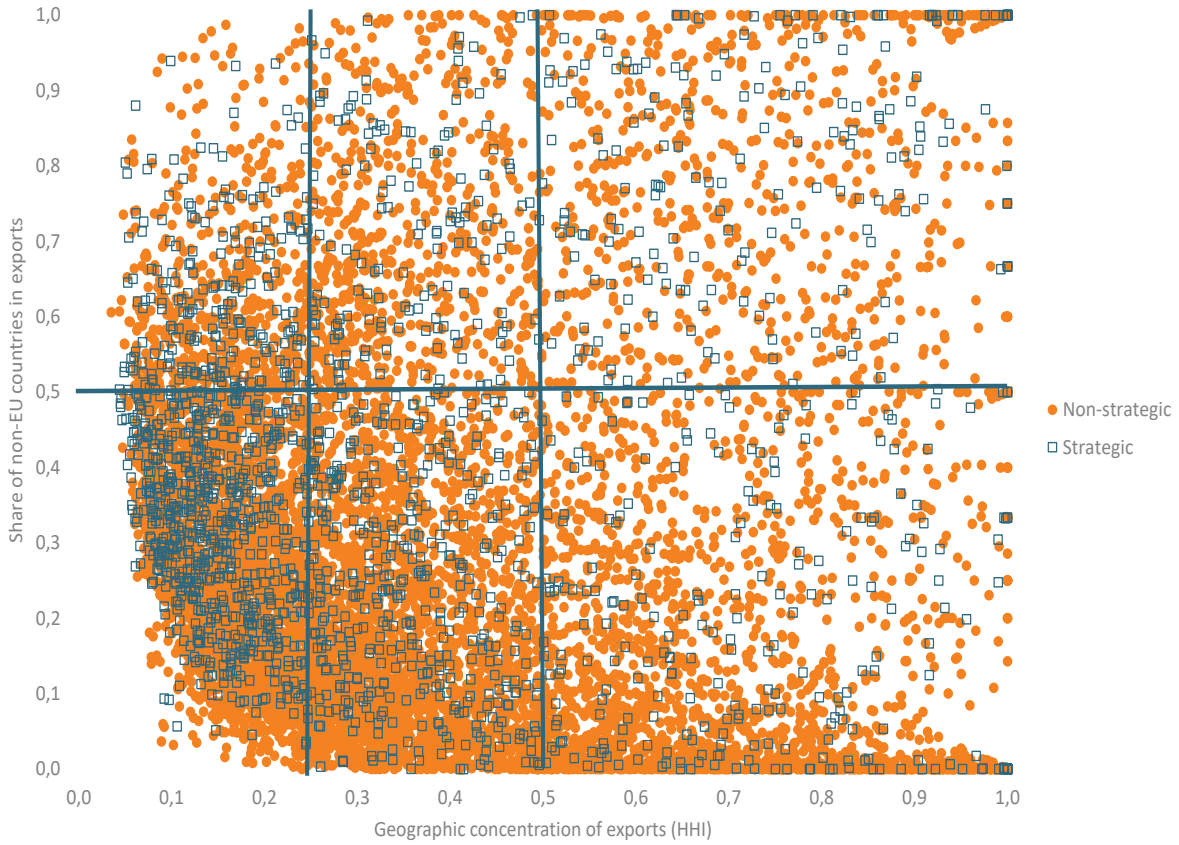
Annex

Annex 1: Graph A.1 Scatter plot of geographical concentration and share of non-EU countries in Belgian imports (2014-2023)



Note: The graph shows, for each good imported by Belgium in at least one year during the period 2014-2023, the average geographical concentration of Belgian imports (HHI), and the average share of non-EU countries in imports. The two vertical lines show respectively the lowest threshold (0.25) and the highest threshold (0.50) that we consider for geographical concentration (HHI). The horizontal line shows the threshold value of 0.5 that we consider for the share of non-EU countries in Belgian imports.

Annex 2: Graph A.1 Scatter plot of geographical concentration and share of non-EU countries in Belgian exports (2014-2023)



Note: The graph shows, for each good exported by Belgium in at least one year during the period 2014-2023, the average geographical concentration of Belgian exports (HHI), and the average share of non-EU countries in exports. The two vertical lines show respectively the lowest threshold (0.25) and the highest threshold (0.50) that we consider for geographical concentration (HHI). The horizontal line shows the threshold value of 0.5 that we consider for the share of non-EU countries in Belgian exports.

Annex 3: Table A.1 Manufacturing industries, full description

Shortened	Full description
Food	Food products; beverages; tobacco products
Textiles	Textiles; clothing; leather and leather products
Wood	Wood, wood and cork products except furniture; manufactures of straw and plaiting materials
Paper	Paper and paper products
Printing	Printing and reproduction of recorded media
Coke	Coke and refined petroleum products
Chemicals	Chemicals and chemical products
Pharma	Basic pharmaceutical products and pharmaceutical preparations
Plastic	Rubber and plastic products
Non-metallic	Other non-metallic mineral products
Metals	Basic metals
Fabricated metals	Fabricated metal products, except machinery and equipment
Computer/electronics	Computer, electronic and optical products
Electrical equipment	Electrical equipment
Machinery	Machinery and equipment not elsewhere classified.
Motor vehicles	Motor vehicles, trailers and semi-trailers
Other transport	Other transport equipment
Furniture	Furniture; other manufactured goods
Repair	Repair and installation of machinery and equipment

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Rue Belliard 14-18 – Belliardstraat 14-18, 1040 Brussels
+32-2-5077311
www.plan.be
contact@plan.be

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