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ANALYSIS OF THE VULNERABILITY OF FRENCH IMPORTS

METHODOLOGY AND APPLICATION TO METAL PRODUCTS

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This working paper reflects the views of the authors only. It is intended to stimulate discussion, comments and criticism.

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Abstract

This working paper introduces a new methodology for assessing the vulnerability of French supplies at the most detailed level of products, and applies it to metal products, that are critical inputs for industries. It builds on previous statistical work on the identification of vulnerable imported products carried out by the French Treasury (*Tresor-Economics* No. 274). The identification of vulnerable metal products is based on a combination of three criteria: (i) a large share of French imports from outside the EU, (ii) a concentration of imports from a limited number of supplier countries outside the EU and (iii) insufficient production at the EU level. This study is one of the first to use the characteristics of firms importing vulnerable products in order to (i) measure the exposure of the different sectors to these products and (ii) characterize the resilience of firms to a shortage of these vulnerable products according to criteria such as the storage behaviour of these firms.

Keywords: working paper; supplies; metal products; vulnerabilities; global value chains; firms; manufacturing; France; inputs; strategic sectors; resilience.

JEL Classification Numbers: F14; F61; L14; L61.

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Résumé

Ce document de travail présente une méthodologie d'évaluation de la vulnérabilité des approvisionnements français au niveau le plus détaillé de la nomenclature, ensuite appliquée aux produits métalliques qui constituent des intrants critiques pour nombre d'entreprises industrielles. L'identification des catégories de produits métalliques vulnérables se base sur la conjonction de trois critères : *(i)* une part importante d'importations françaises hors UE, *(ii)* une concentration des importations sur un nombre limité de pays fournisseurs hors UE et *(iii)* une production insuffisante à l'échelle de l'UE. Cette étude est l'une des premières à exploiter les caractéristiques des entreprises importatrices de produits vulnérables afin *(i)* de mesurer l'exposition des différents secteurs à ces produits et *(ii)* de caractériser la résilience du tissu productif à une pénurie de ces produits vulnérables à l'aune de critères tel que le comportement de stockage de ces entreprises.

Mots-clés : document de travail ; approvisionnements ; catégories de produits métalliques ; vulnérabilités ; chaînes de valeur ; entreprises ; industrie ; France ; intrants ; secteurs stratégiques ; résilience.

Classification JEL : F14 ; F61 ; L14 ; L61.

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Introduction: context and objectives

1) Context

The COVID-19 crisis has underscored some of the vulnerabilities associated with the rise of global value chains (GVCs), which creates interdependence among countries in production processes – processes that are highly segmented in the case of manufactured goods.

Lockdowns across the world have sometimes hindered countries' ability to export, causing multiple problems in delivering inputs and hampering the downstream stages in manufacturing products that require those inputs. This has brought the limitations of just-in-time or zero inventory strategies in manufacturing into sharper focus.

The current crisis is not expected to significantly shorten global supply chains,[1] as their growth had already slowed before stabilizing after the 2009 global financial crisis. First, the potential for firms to step up their digitalization should allow more players to join GVCs. Further, GVCs have exhibited remarkable resilience to major recent shocks to the economy, including in specific supply crises such as the one that followed the 2011 earthquake in Japan.[2] A significant contraction of GVCs would also entail risks, as GVCs allow for major gains in productivity and therefore in competitiveness; joining GVCs continues to be a development strategy for many countries seeking to catch up; and, finally, the existence of international suppliers and customers is a source of resilience against a shock to the national economy.

Increasing awareness of the vulnerability of certain value chains is in line with the evolution in industrial policy thinking over the past decade, the most salient feature of which is probably the adoption of the objective of strategic autonomy at the European level. This strategy involves, for example,[3] assessing the resilience of GVCs at the French and European levels and, if necessary, securing the supply of inputs that are critical to national security and strategic sectors, by encouraging diversification of supply and stockpiling or, when those options are not technically feasible (e.g., in the case of global monopolies or rapid obsolescence of components), production in Europe or within the country. Such a strategy of securing critical inputs can be justified on economic grounds if a supply disruption were to generate negative externalities for the entire economy, beyond the negative effects for the firms concerned. The complexity of international value chains, which generate multiple information asymmetries between successive suppliers and buyers in the chain, may thus lead to individual inventory hedging behaviour that is suboptimal for the economy as a whole.[4]

Effective public interventions presuppose the ability to identify the categories of products potentially concerned by actions to secure supply. As pointed out by I. Méjean and X. Jaravel: "Organizing the resilience strategy around highly specific inputs is essential to ensure the strategy's effectiveness and to avoid the danger of imperfectly targeted support polices, which would be costly for the consumer without fundamentally enhancing resilience. [...] The use of statistical tools to establish the list of targets for resilience policy would provide objective criteria for such industrial policy.[5]"

2) Literature review

DG Trésor (Directorate General of the Treasury)[6] was among the first institutions to propose a statistical

[1] For a well-documented argument, see, e.g., Pol Antràs (2020).
[2] Freund et al. (2021) show that while the 2011 earthquake in Japan resulted in a partial reconfiguration of supply chains (importers with the greatest reliance on Japanese imports had diversified to a larger extent their sources of supply, unlike less vulnerable importers), importers did not however seek nearby suppliers, and the reconfigurations did not lead to increasingly regionalized supply chains.
[3] The "growth" aspect of strategic autonomy is of equal importance: investing today in "sectors of the future" is considered to enhance the future resilience of the European Union.
[4] In some cases, it is impossible to hedge or cover future requirements (e.g., in the absence of opportunities to diversify due to global monopolies, or the absence of derivatives for manufacturing firms).
[5] X. Jaravel and I. Méjean (2021).
[6] C. Bonneau and M. Nakaa (2020).

method for the identification of vulnerable imported products. Drawing on a classification of about 5,000 product categories, French imports were analysed in three stages, taking into account (1) the predominance of imports originating from outside the EU, determined by whether extra-EU imports account for more than 50 percent of total French imports of a product; (2) the concentration of imports of each product based on the number of non-EU supplier countries; and (3) the centrality of the product, i.e. whether alternative sources exist in other countries. According to this methodology, the vulnerability of French imports from outside the EU appears to be low overall: out of approximately 5,000 product categories, 121 are identified as being imported mainly from a small number of countries outside the EU (satisfying criteria (1) and (2)), in particular chemicals and pharmaceuticals, metal products, and certain capital goods (e.g., machine tools, and accumulators). For a quarter of these "concentrated" product categories, the main non-European supplier is China. Among these 121 concentrated product categories, 12 are identified as vulnerable (satisfying criteria (1), (2), and (3)), i.e., the centrality criterion indicates low potential for diversification (e.g., LED lights). France appears to have fewer vulnerable product categories than the country's main EU neighbours.

Recent analyses by the Council of Economic Analysis (CAE)[7] and the European Commission[8] use an approach similar to the one proposed by DG Trésor, which involves screening imports of a given country based on a number of vulnerability criteria to determine a list of vulnerable product categories (see Appendix A for a detailed comparison of the three studies). All three analyses consider imports that come primarily from non-EU countries, and that are concentrated in a small number of exporting countries, to be vulnerable.[9] Unlike the DG Trésor approach, which then applies a centrality criterion, the CAE and European Commission analyses use different indexes, respectively "demand granularity" and "substitutability".

- The CAE analysis is based on a more detailed classification of French customs data (the 8-digit Combined Nomenclature, CN8, codes), which allows for an analysis of a broader sample of product categories. However, the"centrality" criterion cannot be estimated with this classification.[10] Instead, the authors use a "demand granularity" index that identifies product categories for which a single firm accounts for at least 90 percent of imports. While, unlike centrality, demand granularity does not take supply factors directly into account, it can nevertheless highlight a vulnerability of the French economy. The report's authors consider that when a firm is the sole importer of a good from a given country, it is highly probable that the good comes from a single supplier. The CAE identifies 122 categories of vulnerable products in France, in three main sectors: chemicals and pharmaceuticals, metals, and fuels.

- The European Commission's analysis, which covers imports by all EU member states, uses as its third vulnerability criterion the substitutability of EU imports by EU-produced goods. This criterion is calculated using trade data (specifically, the ratio of extra-EU imports to total EU exports,[11] with EU exports taken to assess the EU's capacity to produce the product in question). Similarly, a study by MERICS[12] analyses the EU's trade deficit in certain product categories to identify potential production shortfalls. The Commission study identified a list of 137 categories of vulnerable products, which can be grouped into four product families of strategic importance to the EU: raw materials, pharmaceutical inputs, lithium-ion batteries, and hydrogen.[13]

[7] X. Jaravel and I. Méjean (2021), op. cit.
[8] European Commission (2021).
[9] Both studies use the cutoff specified in the *Tresor-Economics* study (50% share) for extra-EU imports. For import country-of-origin concentration, the CAE and *Tresor-Economics* studies both set the HHI cutoff at 0.5, while the European Commission study sets the cutoff at 0.4.
[10] The centrality criterion uses world trade data that are available only in the Harmonized System (HS6) format.
[11] Where "total EU exports" includes both intra-EU exports and extra-EU imports.
[12] M. Zenglein (2020), Mercator Institute for China Studies (MERICS).
[13] The European Commission has identified an additional two sectors of strategic importance in addressing Europe's technological lag (semiconductors, and cloud and edge technologies).

Several non-EU countries have also launched initiatives to assess the vulnerability of their supply chains, albeit with approaches that sometimes differ from the European methodology. The United States, for instance,[14] has adopted a qualitative methodology focusing on four product families, which consists in breaking down the value chain for those products and, for each stage, mapping the state of the ecosystem and the associated risks. With this approach, vulnerabilities can be assessed at all stages in the value chain. Further, the United States has a critical materials supplier mapping tool,[15] which identifies key national and international nodes in strategic and critical materials supply chains, as well as the relationships between those production nodes and downstream manufacturing sectors.

3) Objectives of this study

There are four main limitations to existing studies: (i) they are sector-agnostic (in that they apply the same vulnerability thresholds to all sectors while failing to identify strategic sectors); (ii) most studies do not directly take into account whether or not a good is produced domestically[16] (in that a good produced in significant volumes elsewhere in the EU could be considered less vulnerable); (iii) they provide no information on the French companies that use such products (e.g., in terms of business sectors, demographic characteristics, or storage capacity); and finally, (iv) they do not allow for the detection of vulnerabilities at all levels of the value chain (e.g., by identifying the concentration of higher-tier suppliers).

The first objective of this study is to develop an extended methodology for identifying "vulnerable" inputs for the French economy. The main methodological innovations are the following:

- The analysis of vulnerable products is based on a more disaggregated customs classification (CN8), similar to the one used by the CAE, which is formed of approximately 10,000 product categories;
- The vulnerability indicators are spread out over three years (2017-2019), and are therefore more stable;
- The vulnerability indicators incorporate the concept of EU production sufficiency.

This study also sets out to characterize vulnerable products based on the characteristics of importing firms. The existing literature typically fails to analyse the demographics of the firms that import vulnerable products -- a consideration crucial for gauging the consequences of a supply disruption for the national economy. One notable exception is the preliminary work published by R. Lafrogne-Joussier, J. Martin and I. Méjean,[17] whose analysis focuses on how French firms were affected by input shortages during the early lockdown period in China based on their supplier diversification and inventory management behaviour. Their findings report that among French firms importing Chinese inputs, firms with relatively high inventories for their sector were able to better mitigate the supply shock.

The analysis presented in the second section of this paper aims to (i) identify the sectors with the greatest exposure to vulnerable products and (ii) characterise the resilience of the productive fabric to a shortage of those vulnerable products, based on criteria such as firms' stockpiling behaviour. The indicators used – which are not, strictly speaking, vulnerability criteria – are intended to provide an analytical framework for establishing a resilience strategy.

[14] White House (2021).
[15] Strategic Materials Assessment and Risk Topography.
[16] The import substitutability criterion in the European Commission analysis is, at the time of writing, the only criterion relating to estimated production capacity in the EU.
[17] R. Lafrogne-Joussier, J. Martin and I. Méjean (2021).

This method is intended to be applied to broad product families rather than to all French imports. We test this method in the area of metal products:

- First, metals are critical inputs for many manufacturing firms (e.g., electronics, aeronautics, and batteries) and are specifically identified in France Relance's calls for projects aimed at securing the supply of critical inputs for industry (e.g., production of raw materials for batteries, recycling of rare-earth elements, and production of superalloys for aeronautics). They are essential inputs for the digital and environmental transition. "Critical metals" were identified by the EU in 2011 as part of the European Raw Materials Initiative launched in 2008.[18] However, the focus of certain studies on specific metals, and rare-earth elements in particular, is not always warranted,[19] in that other metals involve just as many or even more risks; this explains the broad range of metals examined here, which includes inputs used at all levels of the production chain (primary goods, intermediate goods and capital goods).

- Second, metal imports undergo little processing before arriving in France. This has several methodological advantages: (i) upstream, the product is less likely to have been processed via complex value chains stretching across multiple countries, which means that our chosen method of identifying categories of vulnerable products based on direct imports is particularly appropriate; and (ii) downstream, the destination of metal products is not predetermined – a product can be used in production processes across a wide range of industrial sectors in France, not only in metallurgy, but also as an input in motor vehicles, electronics, chemicals, and so on. This makes it even more important to analyse the characteristics of importing firms. In addition, the re-export of metals is relatively low compared to other product families; this tends to improve the quality of the analysis of the sectors impacted downstream in the production chain.

[18] A raw material is considered critical if it has a great economic importance for the EU, combined with a high sourcing risk (a combination of several factors: high concentration of production in countries with poor governance, limited material substitutability, and low end-of-life recycling rates).
[19] A. Løvik, C. Hagelüken and P. Wäger (2018).

1. Method

1.1 Identification of categories of vulnerable imported products

Identification of categories of vulnerable imported products is based on three criteria, which are examined sequentially, in the following order:

1) Percentage of French imports from outside the EU:[20] any import coming directly from a country outside the EU is considered to be non-EU.[21] To adjust for any distortions related to a "Rotterdam effect";[22] if the Netherlands accounts for over half of France's imports of a product from within the EU, then all imports of that product from the Netherlands are considered as non-EU imports.

2) Concentration of imports on a small number of non-EU suppliers: this criterion[23] captures imported goods for which non-EU exporters are not well diversified (i.e., that come from a small number of supplier countries), which could be a vulnerability in the event of a localised shock. The degree of concentration of non-EU supplier countries can be measured by means of a Herfindahl-Hirschman index (HHI), calculated for each product as the sum of the squares of the market shares of each supplier country, ranging from 0 to 1. The higher the index, the greater the concentration of imports in a small number of trading partner countries. For the purposes of this study, we take an HHI value greater than 0.5 to identify the most concentrated imports.[24]

3) Insufficient production in the EU:[25] insufficient production (relative to consumption) increases the vulnerability of supplies to France in that it reduces French firms' ability to source from other EU countries in order to secure their supplies.

   For the purposes of this study, a product with a significant extra-EU trade deficit (i.e., greater than 5 percent of EU imports of that product) is considered to be "not sufficiently produced in the EU". Under this approach, which is used notably in the MERICS study,[26] an EU trade deficit with the rest of the world is taken to indicate, without reference to production data, that the EU does not produce enough of a given good to satisfy its needs.

   Using this criterion presents a number of difficulties. The concept of "sufficient EU production" may not always mean that France could quickly switch to sourcing from an EU supplier. It may also reflect a bias if, for instance, certain goods can be exported at a higher price than their price as imports. Other approaches to EU production are also possible (see Box 1); they are not used here, however, because differences in the granularity of the classifications make it impossible to perfectly match production data (from INSEE) with trade data (from customs).

[20] This is identical to the criterion set out in *Tresor-Economics* No. 274.
[21] See French Customs methodological document: *Le Chiffre du commerce extérieur - Les données Eurostat (finances.gouv.fr).*
[22] Or quasi-transit effect; imports reported as coming from the Netherlands are likely to come from outside the EU, with a considerable flow of goods through the port of Rotterdam.
[23] This is also identical to the criterion set out in *Tresor-Economics* No. 274.
[24] As an illustration, an import HHI of 0.5 may correspond to a situation in which the two main non-EU suppliers account for about 75% of total imports from outside the EU.
[25] This criterion is not used in the methodology set out in *Tresor-Economics* No. 274
[26] M. Zenglein (2020), *op. cit*.

Box 1: How to assess "insufficient production" of a product at EU level

To measure the criterion of insufficient EU production of a product, three options have been considered. They involve the use of production data or, more indirectly, of trade indicators.

Option 1: Exports from EU countries

Principle: If, for a given product, the EU's extra-EU imports are greater than the sum of the 27 Member States' exports (intra- and extra-EU exports), then this product is considered insufficiently produced in the EU.

This method, which has been used by the European Commission,[27] for example has the advantage of using only customs data, which avoids problems of matching data. However, it assumes that exports reflect the production of a given product, whereas a good may be produced but not exported, and vice versa (e.g., because it is not readily exportable, is primarily consumed domestically, or due to the Rotterdam effect).

Option 2: Extrapolation of EU production data

Principle: If, for a given product, imports from outside the EU exceed EU production, then that product is considered insufficiently produced in the EU.

This approach uses Eurostat's Prodcom database, which provides production data for approximately 4,000 categories of goods. Of the three options, it is the only one that directly estimates EU production data. The principal weakness of this method, however, is the imperfect match between Prodcom data and customs data. A single production item in ¨Prodcom can encompass multiple tariff lines in the customs data, and apportioning output to individual tariff lines must therefore be based on arbitrary assumptions. The allocation key that was tested (but ultimately not adopted here) was based on export data: for example, if goods A and B both refer to the same Prodcom code (reported output: €1,000,000), and if A is exported three times more than B, then production would be broken down as A=€750,000 and B=€250,000)

Option 3 (used in this study): Extra-EU trade balances per product

Principle: A good for which the extra-EU trade deficit is greater than 5% of EU imports of that product is considered insufficiently produced in the EU.

This option would appear to have the fewest weaknesses in terms of data matching and the need for manual adjustments; this is a significant advantage in terms of replicating the methodology across several sectors. Moreover, this option provides the most comprehensive results when applied to metal product categories: in combination with the other two criteria for selecting vulnerable product categories, option 1 captures 30 goods and option 2 captures 33 goods, with 23 goods captured under both option 1 and option 2. Option 3 captures 57 items, including all 31 items in option 1 and 32 of the 33 items in option 2 (failing to capture only "nickel alloy tubes").

[27] European Commission (2021).

1.2 Characterization of importing firms

One of the main contributions of this study is to match up individual data on imports of vulnerable metal products with the individual characteristics of French firms importing such products (e.g., sector of activity, exposure rates of sectors, and firms' resilience to a supply shortage based on their available inventories). The "firms" considered here are "legal units" (*entreprises*) identified by their Siren code in the French National Enterprise and Establishment Register Database (SIRENE Register).

An initial set of variables, derived from customs data, describes the number of importers of vulnerable products: (i) the number of firms importing the product and (ii) the concentration of imports around a limited number of importing firms, measured by a Herfindahl-Hirschman type index (HHI).[28] These indicators can be understood as further potential evidence of vulnerability of a category of vulnerable imported products. However, unlike the CAE's analysis, we do not consider these indicators to be sufficiently robust to be used for identifying vulnerable products.

A second set of characteristics is derived from the FARE databases.[29] These databases incorporate data from tax returns and contain firms' detailed balance sheets and income statements as well as other variables such as payroll employment. Matching with customs data provides additional information on firms that import vulnerable products:

(i) Sector of activity: The sectors considered as "strategic" in this sector are those identified as such by France Relance (aeronautics, automotive, agri-food, pharmaceuticals, industrial inputs, electronics, and telecommunications). A strategic sector is considered to be significantly exposed to a vulnerable product when over 25% of its value added is generated by companies that import that product.

(ii) Typical demographic characteristics such as firms' growth, size, and productivity. The raw data for these characteristics are adjusted in light of the sector of activity to which the firm belongs. The following variables from the FARE database are used here: value added at factor cost (VACF)[30] and full-time equivalent (FTE) payroll employees.

(iii) The inventory management behaviour of these firms, which can help identify the categories of vulnerable products for which a supply disruption could have significant consequences in the near term for the French production system (see Box 2). The total gross value of balance sheet inventories in FARE (i.e., before depreciation) is used here, as the tax files do not provide a breakdown between inputs and finished goods.[31]

This analysis is performed on firms with positive value added; it excludes micro-entrepreneurs and firms without employees for the examination of standard demographic characteristics, as they differ considerably from other firms, especially in that they are seldom importers. Further, statistics on firms importing each vulnerable product are not available in cases where statistical confidentiality is not assured, i.e., for product categories imported by fewer than three firms or imported by a single firm that accounts for over 85% of the activity of all firms importing that product.

[28] This import-concentration indicator differs from the one used previously to identify the vulnerable product categories, in that it covers a limited number of importing firms, and not suppliers.
[29] The FARE databases rely on Esane (*Élaboration des Statistiques ANnuelles d'Entreprises*), the French Annual Business Statistics Program, which combines administrative data from company tax filings with data from Insee annual surveys of companies.
[30] The value added at factor cost (VACF) in the FARE database is stated in value terms. In order to determine the value added in volume terms required to compute the individual indicators for productivity and economic activities, the VACF of each firm is divided by the value-added deflator for the sector to which the firm belongs; the deflator is taken from the annual national accounts published by Insee.
[31] While the FARE database provides only a composite indicator of inventories and fails to distinguish between product categories, we do not consider this to be problematic for assessing firms' resilience to temporary shortages of supply, because in all cases, inventories allow firms either to manufacture (intermediate goods) or to sell (finished goods), and thus to absorb the shock.

Box 2: Defining the short-term resilience index of importing firms

A firm's inventory-to-sales ratio, which indicates inventories of inputs, finished products, and merchandise as a percentage of turnover) provides an approximation of the firm's short-term resilience; this is consistent with the preliminary findings of R. Lafrogne-Joussier, J. Martin and I. Méjean.

The short-term resilience index of firms importing a given vulnerable product is calculated as follows:

$$R_p = \sum_e (S_{e,s,p} - \bar{S}_s) * |S_{e,s,p} - \bar{S}_s| * \frac{CA_{e,p}}{CA_p}$$

where $S_{e,s,p}$ is the inventory-to-sales ratio of firm e that is a member of sector s and imports vulnerable product p; $\bar{S}_s$ is the mean (turnover-weighted) inventory-to-sales ratio of all firms in the sector; $CA_{e,p}$ is the turnover of firm e; and CA_p is the turnover of all firms that import vulnerable product p. The firms that import a vulnerable product are said to be non-resilient if $R_p < 0$.

This formula has been chosen for the following properties:

(i) The inventory-to-sales ratio of each importing firm is compared to the mean inventory level of all the firms in its sector. This makes it possible to factor in the heterogeneity of firms' storage behaviour within the sector. This is the approach used by R. Lafrogne-Joussier, J. Martin and I. Méjean. In estimating vulnerability as a deviation from the mean of a sector, it is assumed that the average inventory-to-sales ratio of a sector represents the optimal inventory level in light of the vulnerabilities of that sector. The mean inventory-to-sales ratio in an industry could potentially be suboptimal in terms of supply vulnerability: for instance, a mean level that is too low could be attributed to increased industry competition that encourages all firms to tie up as little cash as possible in inventories, in which case all firms in the sector would have low resilience and the R_p indicator could not differentiate between them. However, the alternative approach of comparing a firm's inventory level to the mean for all of manufacturing would be more problematic in that it would not factor in sector-specific technical considerations (e.g., the amount of intermediate consumption required to produce the final product).

(ii) This indicator captures the variance in the inventory-to sales ratios of importing firms while allowing, via the absolute value term, an offset between high inventories and low inventories of firms importing the same product. In the event of a shortage, firms with high inventories are assumed to be able to raise production capacity to compensate for difficulties faced by firms with low inventories.

(iii) Finally, the last term maintains the volume effect: the contribution to the economy's resilience of a 10-point-higher-than-average inventory level is an increasing function of the firm's share of the activity in its sector.

2. Results

The main results on vulnerable goods are set out in a summary table at the end of this document (see Appendix D).

2.1 The sample of metal product categories

This study uses the eight-digit Combined Nomenclature (CN8), the European Union's classification intended for customs and external trade statistics purposes. Among the 10,000 goods listed in CN8, the "metal" product categories were screened sequentially, and adjusted to determine a list of 908 product categories.[32]

Of these 908 categories of metal products, 906 were imported by France between 2017 and 2019, for an average annual total of €39.0 billion, or 6.9% of total French imports (see Table 1a).[33] The portion of those imports coming from non-EU countries (€9.9 billion for 897 input categories)[34] was relatively small, both in comparison to other French imports[35] and in comparison to imports of metal products from other EU member states.[36] For imports from non-EU countries to France, the UK ranks first in terms of the number of product categories for which it is the leading non-EU supplier, with 227 product categories, ahead of China (204) and the United States (128). On the other hand, in value terms, China ranks first, accounting for €2.7 billion in metal product categories imported by France, ahead of the United States (€1.9 billion) and the UK (€1.1 billion).

The vast majority of metal goods imports are intermediate goods (€35.3 billion), and particularly "generic" intermediate goods, i.e., homogeneous product categories used as inputs in a wide range of industries (€24.1 billion), as opposed to imported "differentiated" goods. Primary metal goods,[37] on the other hand, account for a small number of categories of metal goods imports, and for a smaller amount, but stand apart in that they are mostly imported from countries outside the EU (see Table 1b).

[32] (i) Selection of product categories from the aggregates in the CPF (French Classification of Products, *classification des produits française*): "metallic minerals", "metal products" and "metal products, except machinery and equipment"; (ii) Removal of goods that are too sophisticated or outside the usual scope of metal product categories: "radiators and boilers for central heating", "steam generators, except boilers for central heating", "weapons and ammunition" and "cutlery"; (iii) Removal of goods such as scissors identified as consumer goods in the UN International Standard Industrial Classification, ISIC, in order to examine solely goods capable of being used as inputs in a production process; (iv) Addition of the sub-category "alkali metals and rare-earth elements", classified among the "chemical products" categories in the CPF.
[33] This means that 11 categories of metal products were not imported at all during this period.
[34] The main intra-EU countries supplying metal products to France are Germany (27% of imports to France in 2017-2019), Belgium (18%), Italy (16%) and Spain (13%).
[35] According to Eurostat, 25.4% of French metal imports come from non-EU countries, compared to 35.6% for all French imports. It should be noted that Eurostat tends to overstate the share of European imports relative to French customs data. Any import from an EU country will be considered intra-European, irrespective of whether or not the goods are actually of EU origin. See note on methodology (in French): Le Chiffre du commerce extérieur - Les données Eurostat (finances.gouv.fr).
[36] Imports of "metal product" categories account for 4.9% of French imports from outside the EU; this is also lower than the average for the EU countries (7.1%).
[37] Primary metal goods come directly from the primary sector (i.e., from mining) or have been only slightly transformed by the manufacturing industry.

Table 1a: EU and French imports of metal product categories (annual average, 2017-2019)

	Number	Value (€bn)	Total value, imports in all product categories (€bn)
EU 27 imports from outside EU	908	133.0	1 874.8
French imports from all countries	906	39.0	568.6
French imports from outside EU	897	9.9	202.2
of which. UK	*227*	*1.1*	*24.0*
of which. China	*204*	*2.7*	*30.1*
of which. US	*128*	*1.9*	*30.7*
of which. other countries	*338*	*4.2*	*117.4*

Sources: Customs, Eurostat, DG Trésor calculations. Countries are ranked in descending order based on the number of imported metal product categories they supply

Table 1b: French imports of metal product categories by type of use (annual average, 2017-2019)

	Total imports (€bn)	Imports from outside EU (€bn)
Total	**39.0**	**9.9**
Primary goods	1.3	1.0
Intermediate goods	35.3	8.2
Generic intermediate goods	*24.1*	*5.4*
Differentiated intermediate goods	*11.2*	*2.8*
Capital goods	2.4	0.8

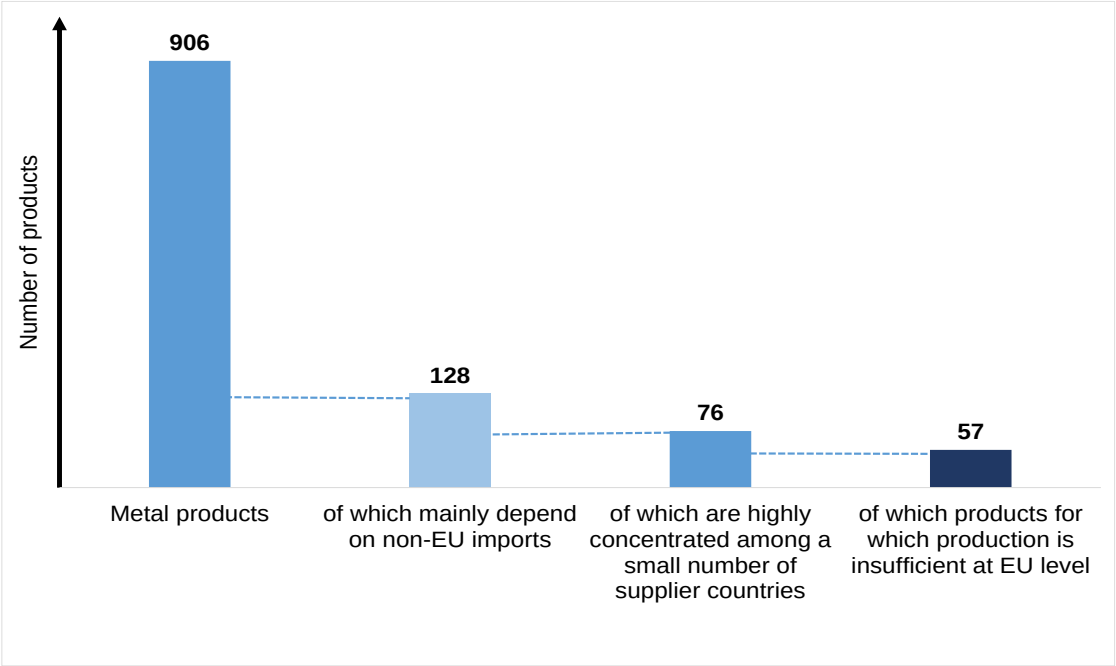
Sources: Customs, Eurostat, DG Trésor calculations.

2.2 Identification of vulnerable metal product categories

A sequential screening process using the three criteria described above[38] initially narrowed the 908 categories of metal products imported into France to the 128 categories for which most imports come from outside the EU, then to a subset of 76 categories for which imports come from a small number of non-EU suppliers, and finally to a subset of 57 categories for which production is insufficient in the EU. These 57 product categories will be referred to as "vulnerable metal product categories" in the remainder of this study (see Chart 1, and Box 3 for a comparison with the list compiled using the methodology described in *Tresor Economics* No. 274).

[38] These criteria are the share of French imports from outside the EU, insufficient production in the EU, and concentration of imports around a small number of suppliers outside the EU.

Chart 1: Identification of vulnerable metal product categories

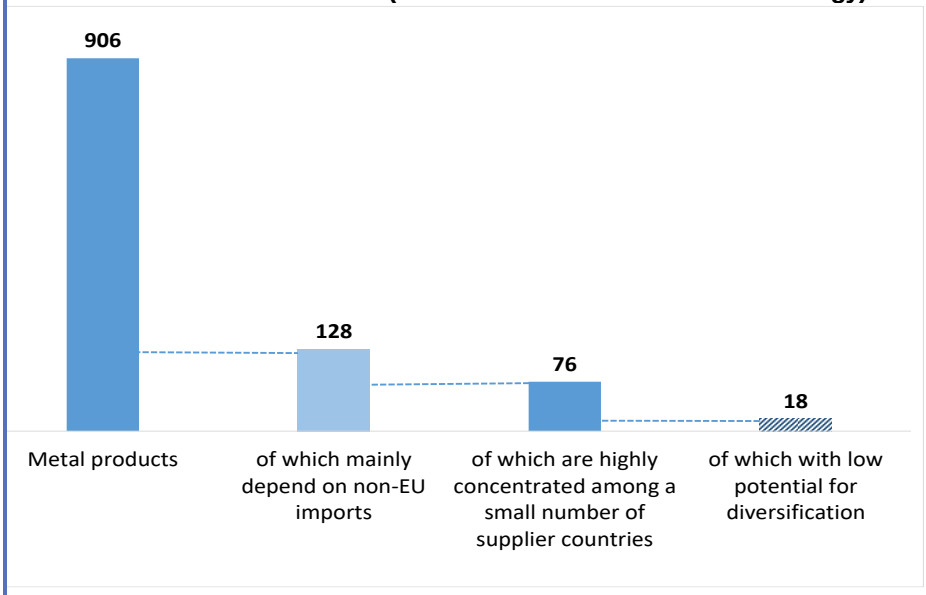


Source: Customs, DG Trésor calculations.

Box 3: Comparison with replication of the methodology in *Tresor-Economics* No. 274 for identification of vulnerable product categories

In this study, the "vulnerable product" categories are not entirely consistent with the criteria used in *Tresor-Economics* No. 274, in which an imported product was considered vulnerable if most imports came from outside the EU, if the HHI exceeded 0.5, and if the centrality index exceeded 2.5. Using the centrality indicator rather than the European production shortfall indicator would change the number of vulnerable metal products from 57 to 18.

Chart 2: Identification of vulnerable metal product categories (*Tresor-Economics* No. 274 methodology)



Customs, DG Trésor calculations.

The 57 categories of vulnerable products account for 6% of the number of categories of imported metal products and 19% of the value of metal products imported from outside the EU (i.e., €1.9 billion, see Table 2a).

The ranking of the countries that are the main suppliers of vulnerable products is not perfectly identical to the ranking of the main non-EU exporters of metal products (see Table 2b). In terms of the number of product categories, China and the United States are tied for first place in the supply of vulnerable goods (16 each), ahead of the UK, whereas in terms of the value of imports, the United States and Chile (with a single product, copper) tied for first as exporters of vulnerable metal products to France, at 32%, twice as high as China.

The breakdown of vulnerable metal goods by type of use does not differ significantly from the breakdown of imported metal goods: the vast majority are intermediate goods (€1.7 billion out of the total €1.9 billion), with generic goods accounting for the largest share of intermediate goods (see Table 2b).

Table 2a: French imports of vulnerable metal product categories and breakdown by leading supplier countries (annual average in 2017-2019)

	Number of metal product categories imported	Value imported from outside EU (€bn)
Metal product categories (total)	897	9.9
Vulnerable metal product categories	57	1.9
from China	*16*	*0.3*
from US	*16*	*0.6*
from UK	*10*	*0.2*
from Switzerland	*4*	*0.1*
from Chile	1	*0.6*
from other countries (Malaysia, Morocco, Ukraine)	*3*	*17*

Sources: Customs, Eurostat, DG Trésor calculations.

Table 2b: French imports of vulnerable metal product categories by type of use (annual average in 2017-2019)

	Value imported from outside EU (€bn)
Total	**1.9**
Primary goods	0.0
Intermediate goods	1.7
Generic intermediate goods	*1.2*
Differentiated intermediate goods	*0.5*
Capital goods	0.2

Sources: Customs, Eurostat, DG Trésor calculations.

These 57 vulnerable metal product categories are broken down into 3 ores, 6 alkali metals and rare-earth elements, 33 basic metal products and 15 manufactured metal products (see Table 2c). The list includes several product categories identified as critical by the European Commission[39],due to their supply vulnerabilities and economic importance as inputs to strategic sectors: titanium, tungsten, nickel, magnesium, manganese, bismuth, niobium, American superalloys used in aeronautics, magnets, precious metals and rare-earth elements.

Table 2c: French imports of vulnerable metal product categories by type of product (annual average 2017-2019)

	Number	Value imported from outside EU (€bn)
Total	**57**	**1.9**
Iron, mixtures and combinations	17	0.2
Other "base metals" (including titanium, tungsten and bismuth)	13	0.0
Alkali metals and rare-earth elements	6	0.0
Tools and components of machines and electrical equipment	5	0.2
Nickel	4	0.3
Miscellaneous articles of base metals	4	0.3
Ores	3	0.0
Precious metals	3	0.2
Copper	1	0.6
Lead	1	0.0

Sources: Customs, Eurostat, DG Trésor calculations.

Applied to France's main EU trading partners (Germany, Belgium, Spain, Italy, and the Netherlands), this method confirms that France is less vulnerable to its metal product imports than each of these countries[40] (all of which had over 57 vulnerable metal product categories in 2017-2019). The principal reason behind this resilience is that French imports of metal products are more likely to come from within the EU[41]. Belgium and the Netherlands have the highest number of vulnerable metal product categories (113 and 105 categories, respectively). Germany trails France with the second-lowest number of vulnerable metal product categories in this sample (58 categories).

[39] European Commission (2020).
[40] This is the case for all imports. See C. Bonneau and M. Nakaa (2020).
[41] The percentage of metal products imported primarily from within the EU is 86% in France, compared to 77% for Belgium, 74% for Germany, 69% for Italy, 67% for the Netherlands and 66% for Spain.

Table 3: EU comparisons (annual average 2017-2019)

	Number of metal product categories imported	of which, categories over 50% dependent on imports from outside EU	of which, categories concentrated on a small number of supplier countries	of which, categories with insufficient production in EU	of which, in common with France
France	906	128	76	57	-
Germany	905	231	93	58	19
Belgium	905	307	206	116	20
Spain	907	213	140	93	26
Italy	904	283	136	76	17
Netherlands	903	299	177	113	33

Sources: Customs, Eurostat, DG Trésor calculations.

2.3 Identification of firms that import vulnerable product categories

Between 2017 and 2019, customs data identify 14,023 French firms that imported vulnerable metal goods.[42] Each of these 57 product categories is imported by a relatively small number of firms (median 28, mean 228), with 11 product categories imported by fewer than 10 firms. For 22 product categories, the Herfindahl-Hirschman Index (HHI) is greater than 0.5,[43] reflecting a relatively high concentration of imports around a limited number of importing firms (see Appendix D).[44]

This concentration might indicate that imports of those product categories are low, and in which supply shortages would have only a limited macroeconomic impact; but it might also be a factor of vulnerability if those inputs were used in multiple sectors, including in strategic industries.

Firms from the metal sector itself account for only 21% of imports of vulnerable metal products in value terms. This justifies an analysis of each importing sector's exposure to these categories of products (measured by the share of the sector's total value added generated by importing firms; see section 2.2). Sectors differ greatly in their exposure to vulnerable product imports (see Appendix C):

- Most sectors have low exposure, with under 10% of their value added generated by firms importing a vulnerable product: a disruption of supply would presumably have only limited direct economic consequences, although the effects could be amplified by chain reactions through the country's production networks.
- Conversely, some sectors are particularly exposed to one or more vulnerable products; these include the manufacture of leather products, pharmaceuticals, rubber and plastic, metal and metal products, transport equipment, electrical and IT products.

[42] Starting with this section, the statistics concerning firms importing each vulnerable product are provided only respect of statistical confidentiality. For the sake of comparison, the Directorate General of Customs and Excise (DGDDI) counted 124,551 French importing firms in 2019.
[43] By way of illustration, an import HHI of 0.5 could correspond to a situation in which the two leading importing firms account for about 75% of total French imports.
[44] The average HHI for 57 vulnerable metal product categories standing at a high level of 0.45.

- France's strategic sectors[45] are particularly exposed to nine vulnerable product categories.[46] For each of these categories, importing firms account for over one-fourth of the activity in at least one strategic sector (see Appendix C). In other words, a disruption of supply in these product categories is likely to affect production in a strategic sector.

There are likely to be additional vulnerable metal product categories that require close attention in formulating a resilience strategy. The analysis presented here has a number of limitations. For many product categories, the actual share of importing firms in their sector's activity is subject to statistical confidentiality[47] (the product categories and sectors concerned by statistical confidentiality are marked with an "s" in Appendix C). Furthermore, the large (16%) share of trading companies in imports of vulnerable metal products mechanically leads to understating the exposure of end-user sectors. Indeed, these wholesalers are often merely intermediaries in international value chains, and the lack of individual data on production networks in France makes it impossible to identify the end-user firms in France that acquire their products from these intermediaries.

The resilience of France's productive fabric to a shortage of vulnerable products also depends on firms' inventory behaviour. Ten product categories are imported by firms whose overall inventory-to-sales levels are below the mean for their sector; this suggests limited short-term resilience in the event of a disruption of supply (see Box 2 and Appendix D). These ten product categories do not overlap with the vulnerable products categories that are used intensively by one or more strategic sectors, suggesting that a scarcity of supply for these goods would not immediately endanger France's strategic sectors. These ten low-stocked items nevertheless call for close scrutiny, in light of the limitations on the data available and particularly the inability to capture firm-to-firm connections. Indeed, while firms importing these product categories may account for a small portion of the value added of strategic sectors, they may in turn sell intermediate metal goods that are essential to strategic sectors.

Finally, among importing manufacturing firms,[48] the 4,800 firms importing vulnerable metal products[49] are found to be larger, to have higher productivity[50], and to grow at a similar rate[51] (see Appendix B). These findings also hold after the variables are adjusted for sector structure.[52] A disruption in the supply of vulnerable metal products would have a negative impact on a relatively dynamic segment of the manufacturing industry.

[45] The notion of "strategic sector" is based on the France Relance (French recovery plan) calls for projects (*appels à projets, AAP*): food industry, pharmaceuticals, rubber and plastics, metal industry, IT and electronics, automobiles and other transportation equipment, and telecommunications.
[46] Ferro-manganese for metalworking; blind rivet nuts for pharmaceuticals and other transportation equipment; bars, rods, profiles and wire of nickel alloys for other transportation equipment; articles of nickel for IT products and other transportation equipment; tubes and pipes of titanium for other transportation equipment; tubular rivets for other transportation equipment; molds for the rubber and plastics, and automotive industries; permanent magnets for the rubber and plastics, IT products, automotive and other transportation equipment industries; base metal fittings for most strategic sectors.
[47] In concrete terms, statistical confidentiality applies to categories of products in which there are fewer than three importing firms, or in which one firm accounts for over 85% sector imports.
[48] 25,369 manufacturing firms that imported at least once in 2017-2018 (identified from the total of all firms with positive value added and at least one payroll employee).
[49] After removing wholesale firms, which are simply intermediaries in international trade, we found 4,800 manufacturing firms that imported categories of vulnerable metal products at least once in 2017-2018 (considering only firms with positive value added and at least one payroll employee).
[50] Productivity is measured in terms of labour productivity, defined as the ratio of real value added (using the national account value added deflators) to the number of full-time equivalent employees.
[51] Growth is measured by the rate of growth in real value added between 2017 and 2018 for firms present in both those years.
[52] The variables are regressed on the manufacturing industry "division" (A88) to which the firm belongs. The sum of the residual and the mean forms the adjusted value of the sector structure for each firm.

3. Conclusion

Fifty-seven of 906 metal product categories imported into France are identified as vulnerable, i.e., likely to be subject to supply disruption in France. The characteristics of firms that import these product categories provide additional criteria for assessing their vulnerability, based on the exposure of various sectors, and particularly strategic sectors, to those products, and on these firms' short-term capacity to absorb a supply shortage, as measured by their inventory behaviour.

This methodology could be replicated for other product families, particularly the most critical inputs for French industry, such as chemicals.

While the statistical methodology developed here has the advantage of being comprehensive and objective, it is not sufficient for determining a list that can serve as the basis for a strategy to secure value chains:

- Insufficient specific data on production chains in France prevents assessment of the extent to which the output of importing firms is essential to the output of other firms located downstream in the production chain, whether in the same or in other sectors. Nor does the methodology take into account the vulnerabilities of suppliers in the second tier and higher (i.e., firms that produce the inputs used by suppliers of French firms) are not taken into account. Low exposure of firms in a strategic sector to an imported vulnerable product is thus not necessarily evidence of a robust value chain. Therefore, qualitative analysis of value chains for strategic finished products, along the lines of the methodology developed in the White House paper, would fill this gap for the most critical strategic products.

- The statistical metrics used here fail to capture certain parameters that are essential for measuring the vulnerability of the productive fabric to a supply disruption, e.g., the substitutability of inputs in the production process, or the exposure of each of a firm's various production lines to a supply disruption.

Therefore, quantitative analysis must be supplemented by feedback from the relevant productions chains and firms, in order to better define the list of strategic vulnerable products categories that warrant special attention.

Finally, to establish a European-level resilience strategy, efforts to perform an equivalent analysis in each Member State should be encouraged. Applying this method to the EU as a whole would, however, present difficulties in terms of data: whereas the identification of vulnerable imported goods can be undertaken at EU level using customs data, analysis of the characteristics of importers would require an exhaustive consolidated European database, which, to our knowledge, is not currently available.

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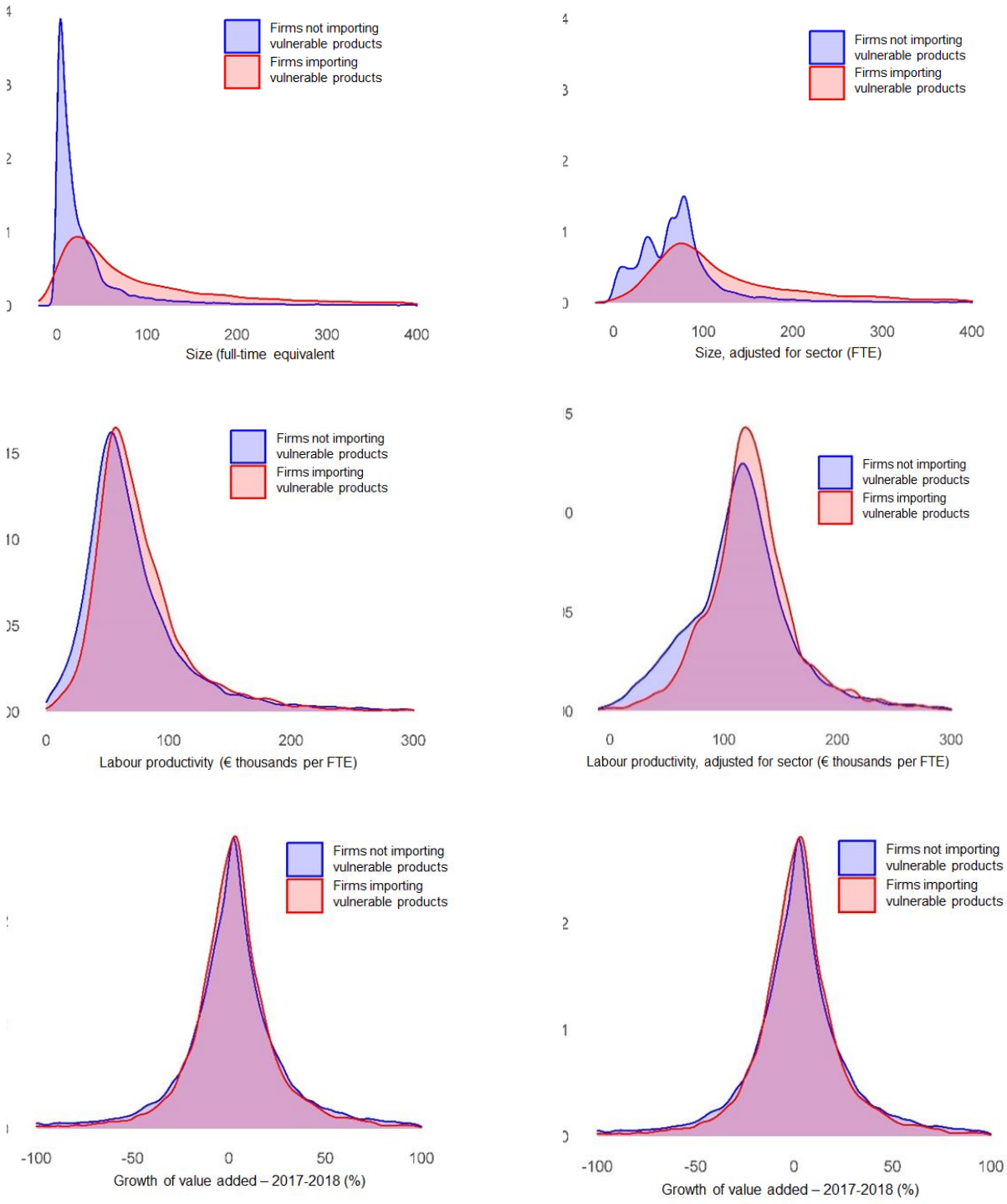
Appendices

A - Comparative table of earlier statistical work on the identification of vulnerable imports

	DG Trésor	European Commission	CAE
	Data analysed		
Database	BACI (*Base pour l'Analyse du Commerce International*)		Individual data from French Customs
Year	2018	?	2017
Classification used	HS6		CN8
Number of product categories	Approx. 5,000		Approx. 10,000
	Vulnerability analysis		
Criterion 1	**Percentage of extra-UE imports** in total imports of product (threshold: > 50%)		
Criterion 2	**Concentration** Import HHI: majority from non-EU countries. Threshold 0.5 (index from 0 to 1)	**Concentration** Import HHI: majority from non-EU countries. Threshold 0.4 (index from 0 to 1)	**Concentration** Import HHI: majority from non-EU countries. Threshold 0.5 (index from 0 to 1)
Criterion 3	**Centrality** of global exports	**Import substitutability:** (extra-EU imports/intra-EU imports > 1)	**Demand granularity** (90% of imports of a product concentrated on a single importing firm)
	Results		
Vulnerable product categories (*criteria 1, 2 and 3*)	12	137	122

Source: C. Bonneau and M. Nakaa (2020); European Commission (2021); X. Jaravel and I. Méjean (2021).

B - Distribution of characteristics of manufacturing firms that imported at least one vulnerable product vs firms that imported only non-vulnerable products, adjusted for sectoral structure (right side) or unadjusted (left side)



Sources: Customs, FARE, DG Trésor calculations.

Scope: This sample excludes micro-enterprises, firms with strictly negative value added, and firms with no salaried employees.
How to read these charts: The distributions in red are those of the characteristics of manufacturing firms that imported vulnerable metal products in 2017-2018, while those of manufacturing firms that imported non-vulnerable products only are shown in blue. The sector structure-adjusted distributions (Charts 3.b and 3.d) are compiled using the residuals of the linear projection of firm characteristics onto indicators for the manufacturing industry "division" (A88) to which the firm belongs. The adjusted distribution of value added growth (Chart 3.f) is identical to the unadjusted distribution because none of the sector indicators is statistically significant.

C – Breakdown of imports by sector, and sector exposure to vulnerable product categories (%)

Legend (%)
5
15
25
35
>50
Statistical confidentiality

	Manufacturing														
	Manufacture of food products	Manufacture of beverage	Manufacture of tobacco products	Manufacture of textiles	Manufacture of wearing apparel	Manufacture of leather and related products	Manufacture of wood and products of wood	Manufacture of paper and paper products	Printing and reproduction of recorded media	Manufacture of coke and refined petroleum products	Manufacture of chemicals and chemical products	Manufacture of basic pharmaceutical products and preparations	Manufacture of rubber and plastics products	Manufacture of other non-metallic mineral products
Share of vulnerable product imports by a given sector (%)	0 %			1 %			0 %			S	1 %	0 %	4 %	
Share of the sector's value added generated by firms importing the product (%)														
Lead ores and concentrates														S
Titanium ores and concentrates											S			1
Precious-metal ores and concentrates (excl. silver ores and oncentrates)											S			S
Calcium	1										S	S	S	S
Alkali metals (excl. sodium)											S	S		
Cerium, lanthanum, praseodymium, neodymium and samarium, of a purity by weight of >= 95% (excl. intermixtures and interalloys)											S	S		S
Scandium, of a purity by weight of >= 95% (excl. intermixtures and interalloys)														
Compounds of europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, lutetium or yttrium, inorganic or organic											8	S		4
Scandium compounds, inorganic or organic														
Powder of silver, incl. silver plated with gold or platinum	0								S		4	S		S
Bars, rods, wire and sections, plates, sheets and strips of a thickness, excl. any backing, of > 0.15 mm, of gold, incl. gold plated with platinum	S			S		S			S		S		S	2
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)	S										8	5		20
Ferro-manganese, containing by weight > 2% carbon (excl. ferro-manganese with a granulometry of <= 5 mm and containing by weight > 65% manganese)											S		S	
Ferro-manganese, containing by weight <= 2% carbon*											S	S		
Ferro-silicon, containing by weight <= 55% silicon and >= 4% but <= 10% of magnesium											S			
Ferro-silico-chromium														
Iron and non-alloy steel, in puddled bars or other primary forms (excl. ingots, remelted scrap ingots, continuous cast products, iron of heading 7203)				S							S		S	S
Semi-finished products of iron or non-alloy steel, containing by weight >= 0.6% carbon, of square or rectangular cross-section, the width < twice the thickness, rolled or obtained by continuous casting (excl. free-cutting steel)														
Semi-finished products of iron or non-alloy steel, containing by weight >= 0.25% carbon, of square or rectangular cross-section, the width < twice the thickness, forged														
Flat-rolled products of iron or non-alloy steel, of a width of < 600 mm, hot-rolled or cold-rolled "cold-reduced", plated or coated with chromium oxides or with chromium and chromium oxides (excl. varnished)													S	
Bulb sections "bulb flat", only hot-rolled, hot-drawn or hot-extruded														S
Flat-rolled products of high-speed steel, of a width of >= 600 mm, not further worked than cold-rolled "cold-reduced"														
Flat-rolled products of silicon-electrical steel, of a width of < 600 mm, not further worked than hot-rolled														
Wire of high-speed steel, in coils (excl. bars and rods)													S	
Tubes, pipes and hollow profiles, of cast iron (excl. products of a kind used in pressure systems)	S	S		0		S	S				2		S	4
Line pipe of a kind used for oil or gas pipelines, spirally welded, of flat-rolled products of stainless steel, of an external diameter of <= 406.4 mm														
Line pipe of a kind used for oil or gas pipelines, spirally welded, [...]iron or steel, of an external diameter of <= 406.4 mm (excl. products of stainless steel or of cast iron)														
Welded link chain of iron or steel (excl. articulated link chain, skid chain and stud-link chain)	3	16	S	2	1	13	5	10	0		1	2	3	11
Blind rivet nuts of stainless steel*	3	S		4	S		5	10	S	S	5	32	23	3
Copper, refined, in the form of cathodes and sections of cathodes														
Unwrought nickel alloys						S					8			
Bars, rods, profiles and wire, of nickel alloys, n.e.s. (excl. electrically insulated products)*										S	S		1	1
Tubes and pipes of non-alloy nickel	S								S		2			
Articles of nickel, n.e.s.*	2			3	1	S		3	1	S	6	8	9	S
Unwrought lead, containing by weight antimony as the principal other element														
Tungsten bars and rods (other than those obtained simply by sintering), profiles, plates, sheets, strip and foil, n.e.s.	S			S							S			0
Molybdenum bars and rods (other than those obtained simply by sintering), profiles, plates, sheets, strip and foil, n.e.s.											S			7
Tantalum bars and rods (other than those obtained simply by sintering), profiles, wire, plates, sheets, strip and foil, n.e.s.											S			S
Unwrought magnesium, containing < 99.8% by weight of magnesium									S				S	
Magnesium raspings, turnings and granules, graded according to size; magnesium powders	S										2	S		
Unwrought bismuth; bismuth powders; bismuth waste and scrap (excl. ash and residues containing bismuth)											S	S	S	
Articles of bismuth, n.e.s.											S			
Tubes and pipes, of titanium*				S							5	S	4	
Articles of zirconium, n.e.s.	S										3			0
Unwrought gallium; gallium powders														
Articles of hafnium "celtium" and germanium, n.e.s.														S
Articles of niobium "columbium" or rhenium, n.e.s.													S	S
Waste and scrap of cermets (excl. ashes and residues containing cermets)														
Chainsaw blades of base metal	S					S	0						S	S
Household hand tools, non-mechanical, with working parts of base metal, n.e.s.	1	23		S	S	57	1	1	S	S	4	6	1	3
Blowlamps and the like (excl. gas-powered blowlamps)	S			S							S	S	S	S
Padlocks of base metal	1	S		S	2	61	S	1	S		1	2	1	4
Base metal mountings, fittings and similar articles (excl. locks with keys, clasps and frames with clasps incorporating locks, hinges, castors and mountings and fittings suitable for buildings, motor vehicles or furniture)*	9	22	S	11	8	63	12	19	3	S	19	42	37	12
Office articles such as letter clips, letter corners, paper clips and indexing tags, of base metal, incl. parts of articles of heading 8305 (excl. fittings for loose-leaf binders or files, staples in strips, drawing pins and clasps for books or registers)	S	S		S	S		0	1	1		1		2	
Tubular or bifurcated rivets, of base metal*	S			4	9	64	4	1	0		S	S	20	0
Injection or compression-type moulds for rubber or plastics*	3	5		3	9	3	S	4	1	S	14	10	50	11
Permanent magnets of metal and articles intended to become permanent magnets after magnetization (excl. chucks, clamps and similar holding devices)*	6	18		7	0	14	2	10	4		4	11	31	13

Legend (%)

5
15
25
35
>50

Statistical confidentiality

	Manufacturing										Wholesale & retail trade			Services
	Manufacture of basic metals	Manufacture of fabricated metal products, except machinery & equipment	Manufacture of computer, electronic and optical products	Manufacture of electrical equipment	Manufacture of machinery and equipment n.e.c.	Manufacture of motor vehicles, trailers and semi-trailers	#REF!	Manufacture of other transport equipment	Manufacture of furniture	Repair and installation of machinery and equipment	Wholesale and retail trade and repair of motor vehicles and motorcycles	Wholesale trade, except of motor vehicles and motorcycles	Retail trade, except of motor vehicles and motorcycles	Telecommunications
Share of vulnerable product imports by a given sector (%)	21 %		1 %	S	1 %	16 %		4 %			16 %			0 %
Share of the sector's value added generated by firms importing the product (%)														
Lead ores and concentrates	S											0		
Titanium ores and concentrates		S					S					0	S	
Precious-metal ores and concentrates (excl. silver ores and oncentrates)									S			0	0	
Calcium	0			S					S		S	0	0	
Alkali metals (excl. sodium)	S	S	S	2								0	S	
Cerium, lanthanum, praseodymium, neodymium and samarium, of a purity by weight of >= 95% (excl. intermixtures and interalloys)	S											0		
Scandium, of a purity by weight of >= 95% (excl. intermixtures and interalloys)												S		
Compounds of europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, lutetium or yttrium, inorganic or organic	S	S	13	S					S			0		
Scandium compounds, inorganic or organic	S											S		
Powder of silver, incl. silver plated with gold or platinum	S	S	S	12	S				S	S		S	S	
Bars, rods, wire and sections, plates, sheets and strips of a thickness, excl. any backing, of > 0.15 mm, of gold, incl. gold plated with platinum	S	0	23	1	0	S	S		5		S	S	0	
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)	1	S	13	1	S	S			8		S	0	S	
Ferro-manganese, containing by weight > 2% carbon (excl. ferro-manganese with a granulometry of <= 5 mm and containing by weight > 65% manganese)	16	S		S	S	S						0	S	
Ferro-manganese, containing by weight <= 2% carbon*	27	S	S		S							0	S	
Ferro-silicon, containing by weight <= 55% silicon and >= 4% but <= 10% of magnesium	2	0										0		
Ferro-silico-chromium	S									S		S		
Iron and non-alloy steel, in puddled bars or other primary forms (excl. ingots, remelted scrap ingots, continuous cast products, iron of heading 7203)	12	1	S	3	S	S	23	S	S	S	S	0	S	
Semi-finished products of iron or non-alloy steel, containing by weight >= 0.6% carbon, of square or rectangular cross-section, the width < twice the thickness, rolled or obtained by continuous casting (excl. free-cutting steel)	2	S			S			S				0		
Semi-finished products of iron or non-alloy steel, containing by weight >= 0.25% carbon, of square or rectangular cross-section, the width < twice the thickness, forged												S		
Flat-rolled products of iron or non-alloy steel, of a width of < 600 mm, hot-rolled or cold-rolled "cold-reduced", plated or coated with chromium oxides or with chromium and chromium oxides (excl. varnished)	S		S		S							S		
Bulb sections "bulb flat", only hot-rolled, hot-drawn or hot-extruded		S		S	S		8			0		0		
Flat-rolled products of high-speed steel, of a width of >= 600 mm, not further worked than cold-rolled "cold-reduced"		0										S		
Flat-rolled products of silicon-electrical steel, of a width of < 600 mm, not further worked than hot-rolled			S											
Wire of high-speed steel, in coils (excl. bars and rods)	1	0	S		S							0	S	
Tubes, pipes and hollow profiles, of cast iron (excl. products of a kind used in pressure systems)	3	1	S	10	4	S	8	S	S	0	1	3	1	
Line pipe of a kind used for oil or gas pipelines, spirally welded, of flat-rolled products of stainless steel, of an external diameter of <= 406.4 mm		S			1	S				S	S	0		
Line pipe of a kind used for oil or gas pipelines, spirally welded, [...]iron or steel, of an external diameter of <= 406.4 mm (excl. products of stainless steel or of cast iron)		S			S		S	S		0	S	0	S	
Welded link chain of iron or steel (excl. articulated link chain, skid chain and stud-link chain)	25	2	0	6	10	S	10	S	S	8	3	5	4	
Blind rivet nuts of stainless steel*	5	8	24	29	23	8	63	1	1	10	3	6	3	
Copper, refined, in the form of cathodes and sections of cathodes	6	0	S	10	1	S	S			S		0		
Unwrought nickel alloys	11	S	0	S	1		S			S		0	0	
Bars, rods, profiles and wire, of nickel alloys, n.e.s. (excl. electrically insulated products)*	6	5	2	1	8	S	26		S	6	S	1	S	
Tubes and pipes of non-alloy nickel	1	0	S	S		S	9			S		0		
Articles of nickel, n.e.s.*	10	6	28	11	10	12	73	S	2	14	S	4	1	
Unwrought lead, containing by weight antimony as the principal other element	0	S		S		S						S		
Tungsten bars and rods (other than those obtained simply by sintering), profiles, plates, sheets, strip and foil, n.e.s.	1	1	S	3	1	2	S		0	S		0	S	
Molybdenum bars and rods (other than those obtained simply by sintering), profiles, plates, sheets, strip and foil, n.e.s.	1	2	11	S	0		S			S		0		
Tantalum bars and rods (other than those obtained simply by sintering), profiles, wire, plates, sheets, strip and foil, n.e.s.		1	S	S	0	S			S			0	S	
Unwrought magnesium, containing < 99.8% by weight of magnesium	0		S	S	S	S						0		
Magnesium raspings, turnings and granules, graded according to size; magnesium powders	S	0	11		S		S					0	S	
Unwrought bismuth; bismuth powders; bismuth waste and scrap (excl. ash and residues containing bismuth)	2	0				S			1			0		
Articles of bismuth, n.e.s.	1	0	S		S				S			0		
Tubes and pipes, of titanium*	1	1	1	S	4	S	59		1	2	S	0	S	
Articles of zirconium, n.e.s.	S	0	S	S	1				1	4	S	1	1	
Unwrought gallium; gallium powders			S	S	S							0		
Articles of hafnium "celtium" and germanium, n.e.s.		S	19		S					S		S	S	
Articles of niobium "columbium" or rhenium, n.e.s.	S	S	S	S	S		S			S		S		
Waste and scrap of cermets (excl. ashes and residues containing cermets)	S											S	S	
Chainsaw blades of base metal		0			2	S	S			S	S	1	S	
Household hand tools, non-mechanical, with working parts of base metal, n.e.s.	2	4	2	16	5	S	17	S	1	7	3	12	22	S
Blowlamps and the like (excl. gas-powered blowlamps)	1	0	S	1	1	S	23		S	0	0	3	5	
Padlocks of base metal	S	6	5	17	5	4	23	S	S	5	2	9	16	S
Base metal mountings, fittings and similar articles (excl. locks with keys, clasps and frames with clasps incorporating locks, hinges, castors and mountings and fittings suitable for buildings, motor vehicles or furniture)*	25	17	44	36	33	21	91	33	20	21	4	17	13	68
Office articles such as letter clips, letter corners, paper clips and indexing tags, of base metal, incl. parts of articles of heading 8305 (excl. fittings for loose-leaf binders or files, staples in strips, drawing pins and clasps for books or registers)	1	0	4	4	2	S	S	S	2	S	0	3	13	
Tubular or bifurcated rivets, of base metal*	0	5	10	9	5	19	54	2	3	7	4	6	1	
Injection or compression-type moulds for rubber or plastics*	6	8	11	38	15	42	6	8	26	0	0	3	S	
Permanent magnets of metal and articles intended to become permanent magnets after magnetization (excl. chucks, clamps and similar holding devices)*	5	12	32	37	31	30	50	13	23	12	6	14	16	

Sources: Customs, FARE, DG Trésor calculations.

Methodological note: Values are subject to statistical confidentiality for a given product and sector when fewer than three firms import that product or when a single importing firm accounts for over 85% of the value added of all firms importing that product. The only sectors studied here are manufacturing, trade (as a means of redistributing imports), and telecommunications (the only strategic sector in "services"). This does not mean that other sectors (e.g., in "services") are not exposed to certain categories of vulnerable products.

How to read this table: "Strategic" sectors (as defined by France Relance) are indicated in red. The first row provides the breakdown of total imports of vulnerable products by sector, in value. The rest of the table provides the value added generated by the firms importing the product (on the horizontal axis) and as a percentage of the total value added of the sector (on the vertical axis). For example, firms operating in Other Transportation Equipment that import permanent magnets account for 50% of the value added of their sector. Product categories not subject to statistical confidentiality that are imported by at least one-fourth of a strategic sector are indicated in blue and followed by an asterisk.

D - Import and importing firm characteristics by vulnerable metal product

Vulnerable metal products	Identification criteria			Imported product characteristics			Importing firm characteristics	
Category	Non-EU share of FR imports	EU balance/ EU imports	HHI	French imports from outside EU	Leading non-EU supplier 2018	Import HHI	Min number of strategic sectors making high use of these products	Stock index*100
Lead ores and concentrates	80,6%	-84,2%	1,00	77 281	Morocco	0,47	0	1,567
Titanium ores and concentrates	92,3%	-97,7%	0,51	13 945 290	Brazil	0,87	0	0,077
Precious-metal ores and concentrates (excl. silver ores and concentrates)	71,3%	-89,3%	0,79	90 823	UK (2017)	0,48	0	0,530
Calcium	91,2%	-15,1%	0,87	5 933 443	China	0,89	0	S
Alkali metals (excl. sodium)	98,1%	-81,8%	0,52	8 821 495	UK	0,34	0	0,294
Cerium, lanthanum, praseodymium, neodymium and samarium, of a purity by weight of >=95% (excl. intermixtures and interalloys)	62,2%	-52,4%	0,77	71 612	China	0,73	0	0,096
Scandium, of a purity by weight of >= 95% (excl. intermixtures and interalloys)	83,8%	-92,2%	1,00	913	UK	1,00	0	S
Compounds of europium, gadolinium, terbium, dysprosium, holmium, erbium, thulium, ytterbium, lutetium or yttrium, inorganic or organic	92,3%	-68,9%	0,65	8 340 757	China	0,23	0	1,987
Scandium compounds, inorganic or organic	64,2%	-80,4%	0,70	2 243	USA	0,49	0	-0,260
Powder of silver, incl. silver plated with gold or platinum	87,8%	-22,9%	0,54	43 951 070	USA	0,30	0	S
Bars, rods, wire and sections, plates, sheets and strips of a thickness, excl. any backing, of > 0.15 mm, of gold, incl. gold plated with platinum	61,0%	-30,4%	0,67	112 954 078	Switzerland	0,16	0	S
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)	82,7%	-96,9%	0,62	14 194 441	USA	0,12	0	S
Ferro-manganese, containing by weight > 2% carbon (excl. ferro-manganese with a granulometry of <= 5 mm and containing by weight > 65% manganese)	62,3%	-85,6%	0,66	8 370 423	Malaysia	0,26	0	1,094
Ferro-manganese, containing by weight <= 2% carbon	66,7%	-54,1%	0,98	3 657 233	South Africa	0,35	1	0,236
Ferro-silicon, containing by weight <= 55% silicon and >= 4% but <= 10% of magnesium	55,9%	-98,3%	0,82	175 138	Brazil (2017)	0,20	0	-0,037
Ferro-silico-chromium	94,8%	-27,1%	1,00	12 601	UK (2019)	0,42	0	-0,659
Iron and non-alloy steel, in puddled bars or other primary forms (excl. ingots, remelted scrap ingots, continuous cast products, iron of heading 7203)	79,3%	-90,2%	0,50	9 125 779	Ukraine	0,17	0	S
Semi-finished products of iron or non-alloy steel, containing by weight >= 0.6% carbon, of square or rectangular cross-section, the width < twice the thickness, rolled or obtained by continuous casting (excl. free-cutting steel)	98,6%	-85,1%	1,00	129 227 067	UK	0,90	0	-0,314
Semi-finished products of iron or non-alloy steel, containing by weight >= 0.25% carbon, of square or rectangular cross-section, the width < twice the thickness, forged	99,9%	-99,2%	0,92	10 029	China	0,36	0	S
Flat-rolled products of iron or non-alloy steel, of a width of < 600 mm, hot-rolled or cold-rolled "cold-reduced", plated or coated with chromium oxides or with chromium and chromium oxides (excl. varnished)	59,0%	-71,6%	1,00	1 621 369	USA	0,95	0	-0,193
Bulb sections "bulb flat", only hot-rolled, hot-drawn or hot-extruded	72,6%	-42,8%	0,77	5 440 338	Turkey	0,83	0	-2,598
Flat-rolled products of high-speed steel, of a width of >= 600 mm, not further worked than cold-rolled "cold-reduced"	79,9%	-82,2%	1,00	165 853	UK (2017)	0,82	0	S
Flat-rolled products of silicon-electrical steel, of a width of < 600 mm, not further worked than hot-rolled	80,8%	-76,2%	0,88	13 968	Switzerland	0,00	0	S
Wire of high-speed steel, in coils (excl. bars and rods)	58,0%	-68,4%	0,64	261 179	UK	0,20	0	0,009
Tubes, pipes and hollow profiles, of cast iron (excl. products of a kind used in pressure systems)	82,7%	-80,2%	0,86	17 621 005	India	0,44	0	5,790
Line pipe of a kind used for oil or gas pipelines, spirally welded, of flat-rolled products of stainless steel, of an external diameter of <= 406.4 mm	98,7%	-36,3%	0,91	7 696 475	India	0,99	0	0,798
Line pipe of a kind used for oil or gas pipelines, spirally welded, of flat-rolled products of iron or steel, of an external diameter of <= 406.4 mm (excl. products of stainless steel or of cast iron)	92,4%	-87,8%	0,99	5 357 594	Turkey	0,64	0	S

Blind rivet nuts of stainless steel	53,2%	-30,9%	0,60	7 452 458	USA	0,24	2	1,047
Copper, refined, in the form of cathodes and sections of cathodes	68,6%	-9,9%	0,78	617 828 008	Chile	0,81	0	0,063
Unwrought nickel alloys	69,8%	-61,0%	0,59	48 206 864	USA	0,22	0	0,402
Bars, rods, profiles and wire, of nickel alloys, n.e.s. (excl. electrically insulated products)	72,4%	-53,9%	0,77	136 116 531	USA	0,15	1	1,137
Tubes and pipes of non-alloy nickel	96,8%	-62,6%	0,94	9 126 600	USA	0,93	0	S
Unwrought lead, containing by weight antimony as the principal other element	77,1%	-59,7%	1,00	32 405 447	UK	0,99	0	-0,099
Tungsten bars and rods (other than those obtained simply by sintering), profiles, plates, sheets, strip and foil, n.e.s.	60,4%	-77,8%	0,57	261 784	China	0,11	0	0,425
Molybdenum bars and rods (other than those obtained simply by sintering), profiles, plates, sheets, strip and foil, n.e.s.	61,7%	-88,1%	0,53	1 456 167	UK	0,22	0	1,907
Tantalum bars and rods (other than those obtained simply by sintering), profiles, wire, plates, sheets, strip and foil, n.e.s.	76,1%	-82,7%	0,69	2 755 748	USA	0,53	0	4,701
Unwrought magnesium, containing < 99.8% by weight of magnesium	92,2%	-64,7%	0,93	5 228 369	China	0,99	0	2,528
Magnesium raspings, turnings and granules, graded according to size; magnesium powders	77,8%	-83,4%	0,54	2 617 722	China	0,39	0	3,065
Unwrought bismuth; bismuth powders; bismuth waste and scrap (excl. ash and residues containing bismuth)	56,4%	-62,2%	0,72	1 159 154	China	0,39	0	-0,324
Tubes and pipes, of titanium	95,3%	-86,6%	0,60	14 235 332	USA	0,19	1	1,322
Unwrought gallium; gallium powders	52,7%	-9,1%	0,72	66 852	USA	0,21	0	0,029
Waste and scrap of cermets (excl. ashes and residues containing cermets)	97,7%	-16,6%	0,99	6 179 096	Switzerland	0,94	0	0,001
Chain of iron or steel (excl. articulated link chain, skid chain, stud-link chain, welded link chain and parts thereof; watch chains, necklace chains and the like, cutting and saw chain, skid chain, scraper chain for conveyors, toothed chain for textile machinery and the like, safety devices with chains for securing doors, and measuring chains)	54,4%	-49,4%	0,63	7 753 167	China	0,10	0	1,361
Articles of nickel, n.e.s.	89,4%	-38,1%	0,51	74 807 872	USA	0,22	2	1,160
Articles of bismuth, n.e.s.	73,0%	-10,1%	0,74	1 999 524	UK	0,30	0	-0,779
Articles of zirconium, n.e.s.	63,7%	-62,7%	0,85	8 299 709	USA	0,33	0	2,172
Articles of hafnium "celtium" and germanium, n.e.s.	61,2%	-30,0%	0,52	776 656	USA	0,35	0	2,976
Articles of niobium "columbium" or rhenium, n.e.s.	62,8%	-63,6%	0,72	3 024 981	China	0,66	0	1,417
Chainsaw blades of base metal	55,3%	-73,6%	0,80	11 831 294	Switzerland	0,27	0	0,168
Household hand tools, non-mechanical, with working parts of base metal, n.e.s.	54,4%	-82,9%	0,73	24 258 381	China	0,03	0	0,393
Blow lamps and the like (excl. gas-powered blow lamps)	75,0%	-71,5%	0,71	4 112 348	China	0,10	0	0,021
Padlocks of base metal	68,0%	-24,2%	0,54	31 204 764	China	0,10	0	0,202
Base metal mountings, fittings and similar articles (excl. locks with keys, clasps and frames with clasps incorporating locks, hinges, castors and mountings and fittings suitable for buildings, motor vehicles or furniture)	80,2%	-34,8%	0,65	235 211 615	USA	0,30	6	0,866
Office articles such as letter clips, letter corners, paper clips and indexing tags, of base metal, incl. parts of articles of heading 8305 (excl. fittings for loose-leaf binders or files, staples in strips, drawing pins and clasps for books or registers)	66,1%	-82,9%	0,81	2 779 577	China	0,04	0	-1,421
Tubular or bifurcated rivets, of base metal	51,1%	-26,4%	0,75	24 289 037	USA	0,15	1	1,084
Injection or compression-type moulds for rubber or plastics	58,0%	-22,9%	0,65	156 240 712	China	0,02	2	0,116
Permanent magnets of metal and articles intended to become permanent magnets after magnetization (excl. chucks, clamps and similar holding devices)	66,7%	-66,1%	0,51	39 823 408	China	0,05	4	1,873

Sources: Customs, FARE, Eurostat, DG Trésor calculations.

How to read this table: The boxes in red correspond to French imports from outside the EU exceeding €10 million (column 4), Herfindahl-Hirschman indices exceeding 0.5 (column 6), product categories imported by firms representing over 25% of the value added of at least one strategic sector of activity and not subject to statistical confidentiality (column 7) and negative inventory variables (column 8)