Securing the EU's Medical Supply Chains: Setting the Legal and Economic Scene for Achieving Import Diversification

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Abstract 1119
Keywords 1120
I. The Growing Issue of Medical Supply Chain Risks 1120
II. Multilateral Framework on Trade and Export Restrictions 1126
1. General Framework on Disciplining Export Restrictions 1127
2. Specific Framework for the Essential Product 'Food' 1128
III. An Economic Approach to Securing Supply Chains 1130
1. Commodity At-Risk Identification 1131
2. Import Patterns and Diversification Potential 1134
3. Production Complexity 1137
4. Patterns of Export Restrictions Across Trade Partners 1141
5. The EU's Extra-Regional Supply-Chain Exposure 1142
6. Connectedness of EU's Extra-Regional Demand 1144
IV. Limitations and Further Research 1145
V. Results 1147
VI. Policy Recommendations and Conclusion 1148

Abstract

Amid the COVID-19 pandemic, the European Union (EU) initiated the European Health Union (EHU) to fortify medical supply chains, aligning

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with broader economic security goals. Geopolitical tensions prompted the EU to adopt a package of initiatives centred on 'open strategic autonomy'. This paper explores the legal and economic mechanisms for securing medical supply chains, focusing on the World Trade Organization (WTO) framework and identifying critical import dependencies. Findings reveal a need for an economic approach to supplement WTO rules. A methodology for identifying vulnerable medical commodities is presented, emphasising risk assessment and import diversification. The study highlights the potential repercussions of export restrictions on medical goods, stressing the importance of securing supply chains. The paper concludes with recommendations for the EU to navigate legal and economic strategies for robust medical supply chains.

Keywords

Medical Goods – International Trade – Strategic Autonomy – European Union – Geopolitics

I. The Growing Issue of Medical Supply Chain Risks

In the wake of the COVID-19 pandemic, the EU Commission announced the creation of a European Health Union (EHU),[1] which aims to establish robust medical and pharmaceutical supply chains[2] and secure the availability of medical goods to citizens and health systems.[3] This objective is aligned with the EU's general attempt to increase its economic security. Respective approaches have been initiated responding to past and recent geo-economic and political tensions like the trade disputes initiated by the United States (US) and the Russian invasion of Ukraine, both contributing to the perception of supply chain fragility. The EU initiated a whole package of initiatives[4] around the

1 European Commission, 'Building a European Health Union: Stronger Crisis Preparedness and Response for Europe', Press Release, 11 November 2020, available at <https://commission.europa.eu/>, last access 21 November 2025.

2 The EU identified medical and pharmaceutical supplies to be severely disrupted during the pandemic due to an enormous sure in demand compared to supply that was worsened due to imposition of export restrictions by some countries. See more here: OECD, 'Global Value Chains: Efficiency and Risks in the Context of COVID-19, 2020', 11 February 2021, available at <https://www.oecd.org/>, last access 21 November 2025; European Commission, 'Updating the 2020 New Industrial Strategy: Building a Stronger Single Market for Europe's Recovery', COM/2021/350 final, 5 May 2021.

3 European Commission, 'Commission Steps up Actions to Address Critical Shortages of Medicines and Strengthen Security of Supply in the EU', Press Release, 24 October 2023, available at <https://commission.europa.eu/>, last access 21 November 2025.

4 Arthur Leichthammer, 'Navigating the Geoeconomic Tide: The Commission's Quest for a Policy Compass', Policy Brief, Hertie School Jacques Delors Centre, 16 April 2024, available at: <https://www.delorscentre.eu>, last access 21 November 2025.

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principle of 'open strategic autonomy', first mentioned in the trade strategy of 2021: The new general strategy on 'Economic Security' of 2023 and the 'Industrial Strategy' of 2020 are accompanied by sector-specific approaches like the 'Raw Material Act' of 2024, the 'Pharmaceutical Strategy' of 2020, the 'Food Contingency Plan' of 2021 as well as the 'Critical Medicines Acts' announced in early 2025. One of the youngest strategies is the European Compass of Competitiveness based on prior Draghi-, Letta- and Niinistö-reports – all considering a balance of strengthening European independence.

All these new initiatives by the EU are aimed at securing resilience of supply chains and avoiding risks associated with a strategic (ab)use of economic dependencies by trade partners, for which in principle a range of different and partially ambivalent tools are available. These are split between a domestic focus on raising self-sufficiency by increasing domestic production (on- or re-shoring) and establishing stockpiles, and a trade-focus that aims at reducing import dependencies.[5]

Although early EU initiatives heavily focused on securing access to critical raw materials[6] and semi-conductors,[7] the EU is now expanding its approach to include medical goods due to its goal of creating a robust EHU, the imposition of export restrictions during the COVID-19 pandemic, and rising geopolitical tensions having spillover effects on trade in medical goods.[8] The term 'medical goods' hereby describes a wide array of commodities used for medical purposes, in particular pharmaceuticals (e. g. vaccines and insulin), supplies (e. g. disinfectants and gloves), and equipment (e. g. x-ray generators and face masks). Differentiating between these goods is crucial in analysing and overcoming export restrictions as they greatly vary in terms of existing dependencies, cost structure, and the ability to near- or reshore in response to supply shocks.

Access to these medical commodities may be politically pursued by both, the domestic and the 'trade approach' to ensure EU's economic security. This

5 The Pharma Strategy specifically repeats access to and affordability of medicines and therapies, well-functioning supply chain, at the same time competitiveness and crisis preparedness. These aims remind of the 70-year-old aims of the food policy in the EU that laid down the Treaty on the Functioning of the European Union (TFEU) (Art. 39 TFEU) addressing availability of supplies, reasonable prices for consumers, ensure a fair living for farmers while at the same time envisage stable markets, and increase in productivity. European Commission, 'Pharmaceutical Strategy for Europe', COM/2020/761 final, 25 November 2020; Art. 39 TFEU.

6 European Commission, 'Critical Raw Materials: Ensuring Secure and Sustainable Supply chains for EU's Green and Digital Future', Press Release, 16 March 2023, available at <https://commission.europa.eu>, last access 21 November 2025.

7 European Chips Act, available at <https://commission.europa.eu>, last access 21 November 2021.

8 Michael Bayerlein and Pedro A. Villarreal, 'Global Health Governance and Geopolitics: How Germany Can Contribute to a New Global Health Architecture After Covid-19 Amid Growing Geopolitical Tensions', SWP Comment 2023/C57, 12 December 2023, doi: 10.18449/2023C57.

is because while re-shoring and stockpiling can be economically feasible in a few cases, the basis of securing EU's supply of medical commodities should be to strengthen supply chains via diversified and open trade, i. e. the trade approach.[9] This is because re-shoring and stockpiling are costly, slow, and viable only for a narrow set of products, whereas diversifying imports across multiple reliable partners reduces concentration risks, cushions the impact of export restrictions and shocks, and secures access more efficiently in line with the EU's 'open strategic autonomy'.

The principle of open trade was violated during the COVID-19 pandemic when export restrictions were widely applied by countries.[10] The lack of diversification of supply-chains aggravated the situation further, eventually worsening the access to vital medical equipment and supplies by increasing prices, market volatility, and distorting investment decisions. Ultimately, the scope for the EU's access to medical goods was limited.[11] In addition to securing domestic supply by restricting exports, the resulting price effects may have supported a strategic use of export restrictions. This strategy was aimed at benefiting the exporting country by improving their terms of trade.[12]

As of the writing of this paper, the EU has yet to address its dependencies on medical commodity inputs provided by non-EU countries. The recently proposed Critical Medicines Act (CMA)[13] is a step towards reaching this goal. The CMA, however, has two major shortcomings. First, it

9 Michael Bayerlein, 'Medicine Shortages: Diversification of Supply Chains as the Primary Goal', Point of View, SWP, 17 May 2023, available at <https://www.swp-berlin.org/>, last access 21 November 2025; World Bank Group and World Trade Organization, 'Trade Therapy, Deepening Cooperation to Strengthen Pandemic Defenses', 2022.

10 Michael Bayerlein, 'The EU's Open Strategic Autonomy in the Field of Pharmaceuticals', SWP Comment 2023/C 02, 11 January 2023, available at: http://hdl.handle.net/10986/37494; Anirudh Shingal and Prachi Agarwal, 'COVID-Era Trade Policy Passthrough to Trade Flows: Idiosyncratic or Not?', Covid Economics 78 (2021), 159-191.

11 Will Martin and Kym Anderson, 'Export Restrictions and Price Insulation During Commodity Price Booms', American Journal of Agricultural Economics 94 (2012), 275-609; OECD, 'The Economic Impact of Export Restrictions on Raw Materials', in: OECD Trade Policy Studies Paris (OECD Publishing 2010); Mark Wu, 'Export Restrictions' in: Aaditya Mattoo, Nadia Rocha and Michele Ruta (eds), *Handbook of Deep Trade Agreements* (World Bank Group 2020), 87-110; Shingal and Agarwal (n. 10); Matteo Fiorini, Bernard Hoekman and Aydin Yildirim, 'COVID-19: Expanding Access to Essential Supplies in a Value Chain World' in: Richard Baldwin and Simon Evenett (eds), *COVID-19 and Trade Policy: Why Turning Inward Won't Work* (CEPR Press 2020), 63-76.

12 Shingal and Agarwal (n. 10).

13 European Commission, 'Laying a Framework for Strengthening the Availability and Security of Supply of Critical Medicinal Products as well as the Availability of, and Accessibility of, Medicinal Products of Common Interest, and Amending Regulation (EU) 2025/102', COM/2025/102 final, 11 March 2025.

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only focuses on pharmaceutical goods, neglecting the dependencies on medical goods, like face masks and equipment, in general. Second, re-shoring and stockpiling are still regarded as viable options for reducing the EU's critical dependencies while the diversification of supply-chains remains largely neglected, although the effects of and remedies against trade restrictions are well studied.

Research in economics and trade, which delves into the allocation of production and the resulting trade patterns and dependencies, frequently centres on the availability, accessibility, and trade of raw materials,[14] and commodities including food,[15] while political research on international relations and dependencies in the past often emphasised the flows of development aid[16] or sovereign debt.[17] The effects of trade-restricting measures and specifically of export restrictions is analysed intensively by economic modelling. Often the focus lies on food, a sector in which such restrictions are regularly and extensively applied – and at the same time criticised by affected countries.[18] Similarly, a growing number of publications extended the focus on trade restrictions of critical raw materials.[19]

14 Katrin Kamin, Michael Bayerlein and Jacqueline Dombrowski, 'Zeitenwende für die Außenwirtschaftspolitik', Wirtschaftsdienst 103 (2023), 23-26; Elena Vyboldina, Alexey Cherepovitsyn, Sergey Fedoseey and Pavel Tsvetkov, 'Analysis of Export Restrictions and Their Impact on Metals World Markets', Indian Journal of Science and Technology 9 (2016), doi: 10.17485/ijst/2016/v9i5/87633.

15 Siddhartha Mitra and Tim Josling, 'Agricultural Export Restrictions: Welfare Implications and Trade Disciplines', IPC Position Paper, January 2009, International Food & Agricultural Trade Policy Council; Robert Howse and Tim Josling, 'Agricultural Export Restrictions and International Trade Law: A Way Forward', IPC Position Paper, 2012, International Food & Agricultural Trade Policy Council; Will Martin and Joseph Glauber, 'Trade Policy and Food Security' in: Richard E. Baldwin and Simon J. Evenett (eds), *COVID-19 and Trade Policy: Why Turning Inward Won't Work* (CEPR 2020), 89-101.

16 Marcus Power and Giles Mohan, 'Towards a Critical Geopolitics of China's Engagement with African Development', Geopolitics 15 (2010), 462-495.

17 Sebastian Horn, Carmen Reinhart and Christoph Trebesch, 'China's Overseas Lending', Journal of International Economics 133 (2021), 103539.

18 OECD, 'The Economic Impact of Export Restrictions' (n. 11); Bettina Rudloff, *Trade Rules and Food Security, Scope for Domestic Support and Food Stocks* (Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). 2015).

19 Frank van Tongeren, 'The Impact of Export Restrictions on Raw Materials on Trade and Global Supply', in: OECD, *Globalisation, Comparative Advantage and the Changing Dynamics of Trade* (OECD Publishing 2011), 317; Jeonghoi Kim, 'Recent Trends in Export Restrictions on Raw Materials' in: OECD, *The Economic Impact of Export Restrictions on Raw Materials* (OECD Publishing 2010), 13-57; Przemyslaw Kowalski and Clarisse Legendre, Raw Materials Critical for the Green Transition: Production, International Trade and Export Restrictions, OECD Trade Policy Paper No. 269, 11 April 2023, doi: 10.1787/c6bb598b-en.

In contrast, economic research that specifically focuses on trade in medical commodities and critical dependencies is still scarce. Notable exceptions provide comprehensive deep dives into drivers of drug shortages[20] and dependencies when it comes to starting materials and active pharmaceutical ingredients (API)[21] as well as the risks associated with offshoring biosimilars.[22] We build on these important contributions by extending the research to still understudied commodities: Medical goods in general and finished pharmaceutical products. Further, we add to the literature by developing a methodology on how to identify critical dependencies and how to overcome them. The limited research is surprising as the political goal of securing access to raw materials is accompanied by a plethora of analyses with medical commodities receiving less attention.[23] Additionally, while legal analyses at least focus on medical goods by addressing the regulatory framework for countries to impose trade restrictions,[24] they lack an interdisciplinary approach that combines the legal assessment with economic assessments.

In addressing this research gap, and against the background of the EU's aim of securing medical supply chains, this paper focuses on the WTO rules as the key multilateral framework governing international trade, including restrictions that directly affect the supply of essential goods. In doing so, we ask two research questions: How do legal rules under the WTO regime secure access to medical goods? How can economic strategies to assess dependencies secure access? And how can legal shortcomings be compensated through economic action? Our core argument is that WTO rules, even when compared to the relatively more elaborated framework for food products, leave wide discretion to exporting states and are therefore insufficient to secuire access to medical goods. We therefore explore how insights from food-related trade rules can inform the discussion, while showing why an economic de-risking approach is necessary to supplement the legal framework.

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20 David Francas and Stephan Mohr, 'On the Drivers of Drug Shortages: Empirical Evidence from Germany', International Journal of Operations & Production Management 43 (2023), 1520-1538; Joost Pauwelyn, 'Export Restrictions in Times of Pandemic: Options and Limits Under International Trade Agreements', J. W. T. 54 (2020), 727-747.

21 David Francas, Manuel Fritsch and Jasmin Kirchhoff, Resilienz pharmazeutischer Lieferketten, Study for the Association of Research-Based Pharmaceutical Companies (vfa) of 31 March 2022.

22 David, Francas and Jasmin Kirchhoff, Wer Reshoring möchte, muss Offshoring vermeiden, Study on Behalf of Pro Generika e. V., 2023, Köln.

23 Lisandra Flach, Feodora Teti, Isabella Gourevich, Lisa Scheckenhofer and Leif Grandum, *Wie abhängig ist Deutschland von Rohstoffimporten? Eine Analyse für die Produktion von Schlüsseltechnologien*, (ifo Institut 2022); Andreas Baur, Florian Dorn, Lisandra Flach and Clemens Fuest, 'Rethinking Geoeconomics: Trade Policy Scenarios for Europe's Economy, EconPol Policy Report 44 (2023), available at <https://www.ifo.de/en/econpol/publications/2023/working-paper/rethinking-geoeconomics-trade-policy-scenarios-europes-economy>, last access 21 November 2025.

24 Pauwelyn (n. 20).

We answer these research questions by examining the legal framework governing the implementation of export restrictions, with a specific focus on the food sector as a possible blueprint for medical commodities as they are both considered essential goods and therefore display several similarities. Despite of differences in the characteristics of food and medical supply chain we focus on the different policy experiences with restrictions and different regulatory scopes to react. Drawing upon provisions primarily and since long established in the food sector, our analysis reveals that countries possess a significant level of discretion when implementing trade-restrictive measures. Additionally, we contend that even within the comparatively more regulated food sector, countries are afforded various exceptions to the overarching framework of liberalised trade, posing an additional challenge in enforcing rules. Consequently, we assert that establishing EU's supply chain security necessitates an approach grounded in economics.

The economic aspect of our analysis presents a methodology for identifying medical commodities with crucial dependencies and suggests economic strategies based on individual risk assessments. Initially, we identify a subset of 36 vulnerable medical commodities by considering EU's relative import volume and the concentration of trade partners. Subsequently, we juxtapose the current sources of EU's imports for these vulnerable medical products with major global exporters of similar goods, thereby offering insights into potential import diversification tactics. Additionally, we pinpoint products characterised by high unit values, which may signify superior quality or advanced technology integration.[25] To this end, the EU's reliance on imported medical products, particularly those with high unit prices, can expose it to supply chain disruptions, especially in the absence of domestic production or substitutes. Therefore, import diversification becomes imperative in such scenarios.[26] We further assess whether the EU's primary trading partners have previously imposed

25 Alf Maizels, 'The Manufactures Terms of Trade of Developing and Developed Countries with Japan, 1981-2000', Queen Elizabeth House Working Paper Series – QEHWPS36, 2003; Sanjaya Lall, 'The Technological Structure and Performance of Developing Country Manufactured Exports, 1985-98', Oxford Development Studies 28 (2000), 337-369.

26 Moreover, higher import prices can indicate a higher quality of traded goods that tend to be concentrated in technologically sophisticated countries as opposed to those that remain stuck in low innovation intensity. Hence, import diversification towards technologically advanced economies could help secure reliant supply chains. Russell Hillberry and Christine McDaniel, 'A Decomposition of North American Trade Growth Since NAFTA, Office of Economics, Working Paper No. 2002-12-A, December 2002, doi: 10.22004/ag.econ.15866; Peter Schott, 'Do Rich Countries and Poor Countries Specialize in a Different Mix of Goods? Evidence from Product Level U.S. Trade Data', National Bureau of Economic Research, Working Paper No. 8492, September 2001, doi: 10.3386/w8492; Lall (n. 25); Raphael Kaplinsky and Amelia Santos Paulino, 'Innovation and Competitiveness: Trends in Unit Prices in Global Trade', Oxford Development Studies 33 (2005), 333-355.

restrictions on medical commodity trade, which we identify as an increased risk of potential future trade limitations by these partners. Furthermore, we estimate the extent of supply chain exposure through the EU's internal trade in medical goods and its domestic demand.

The remainder of this paper is structured as follows: Section II delves into an examination of the multilateral legal framework governing international trade, with a specific emphasis on rules governing food products as a possible blueprint for medical commodities. Following this, in Section III, we introduce a comprehensive methodology for identifying 'critical import dependencies'. This encompasses several key steps: identification of at-risk commodities, mapping of current import dependencies and diversification potential, assessment of product complexity, identification of trade-restricting partners, calculating the exposure of the EU's supply chains, and the EU's demand for pharmaceuticals. Section IV discusses the necessary limitations of the findings. In Section V, we synthesise our findings to draw conclusions regarding the strategies available to the EU for establishing reliable supply chains of medical goods and mitigating potential import disruptions. The last section outlines policy recommendations.

II. Multilateral Framework on Trade and Export Restrictions

Since 1947, the General Agreement on Tariffs and Trade (GATT) and its successor, the World Trade Organization (WTO) (established in 1995), have championed the cause of unrestricted international trade of imports and exports. Their regulations tackle various trade mechanisms, both those directly impacting border controls such as tariffs, standards, and quantitative restrictions, and those influencing international competitiveness, like domestic and export subsidies. Quantitative restrictions are viewed as the most obstructive to trade and are therefore expressly prohibited.[27]

While the goal remains to facilitate unrestricted trade, various exceptions are delineated based on specific justifications. For instance, criteria are established for the imposition of quantitative restrictions under certain conditions such as domestic shortages (GATT XI). Moreover, general exceptions permit countries to pursue environmental objectives or safeguard public morals (GATT XX), or for reasons pertaining to national security (GATT XXI). Additionally, regulations govern adherence to import requirements, addressing sanitary and phytosanitary concerns (SPS Agreement) or technical speci-

27 Alan Sykes, The Laws and Economics of International Trade Agreements (Edward Elgar 2023), 155.

fications (TBT Agreement) across multiple criteria.[28] In addition to trade in goods, specific rules are in place to address regulatory matters concerning services (General Agreement on Trade in Services [GATS]). Furthermore, a separate framework of rules enables countries to respond to the trade practices of other nations through the utilisation of anti-dumping and countervailing measures (GATT VI and corresponding Agreements), as well as safeguards (GATT XIX and relevant Agreements).[29]

Of particular significance to the trade of medical goods and associated regulatory considerations is the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), which guarantees the protection of intellectual property rights while outlining exceptions and criteria for licensing. Additionally, the Pharmaceutical Agreement, a plurilateral pact with EU as a member eliminates tariffs on medical goods and advocates for duty-free access not only among its signatories but also ensures the application of these regulations on a most-favoured-nation (MFN) basis for all WTO members. This agreement aligns with the EU's objective to boost medical imports.[30]

1. General Framework on Disciplining Export Restrictions

The WTO and its precursor GATT know several rules for divergent measures to limit trade, as exceptions from unhindered trade.[31] Restrictive trade barriers can be linked to products and can cover quantitative barriers, monetary fees or administrative ones like licenses.[32] Under GATT Article XI, there is a general aim to eliminate quantitative restrictions on imports and exports; however, certain exceptions are also provided.[33] Paragraph 2(a) focuses on export restrictions and outlines criteria for their temporary application, aiming to alleviate critical shortages of foodstuffs or other products deemed 'essential'

28 See for example in Bernard Hoekman and Charles Sabel, 'Open Plurilateral Agreements, International Regulatory Cooperation and the WTO', Global Policy 10 (2019), 297-312; Keith E. Maskus, 'Regulatory Standards in the WTO: Comparing Intellectual Property Rights with Competition Policy, Environmental Protection, and Core Labour Standard', World Trade Review 1 (2002), 135-152.

29 An overview of different nature of measures, see Table 1 of Bettina Rudloff, 'Yes, He Can: Trump Provokes a Trade War', SWP Comment 2018/C 29, 19 July 2018, available at <https://www.swp-berlin.org/publikation/yes-he-can-trump-provokes-a-trade-war>, last access 21 November 2025.

30 Deborah Gleeson et al., 'Analyzing the Impact of Trade and Investment Agreements on Pharmaceutical Policy: Provisions, Pathways and Potential Impacts', Globalization and Health 15 (2019), 1-17; Hoekman and Sabel (n. 28).

31 World Bank Group and World Trade Organization (n. 9), 70 ff.

32 World Bank Group and World Trade Organization (n. 9), 72, fig. 2.4.

33 Ryan Cardwell and William Kerr, 'Can Export Restrictions Be Disciplined Through the World Trade Organisation?', The World Economy 37 (2014), 1186-1196.

to the exporting party. While no further definitions are provided for these criteria, they are extensively discussed in academic circles and have been subject to scrutiny in WTO disputes, offering insights for interpretation.[34] For instance, empirical observations suggest that once applied, export restrictions tend to persist.[35] Disputes such as those involving China and Indonesia have shed light on the potential extension of the definition of 'essential' products to include raw materials or natural resources.[36] Moreover, the determination of the criticality of shortages is examined within the context of a crisis deemed of paramount importance.[37] In addition to the general framework, specific regimes are established for certain products, such as food products. Recognising the essential nature of food products, we argue that the regulations governing trade in these goods are quite analogous to the trade in medical goods. This similarity offers an opportunity to explore whether the regulatory approaches to trade in food products can serve as a model to develop strategies aimed at securing medical commodity supply chains.

2. Specific Framework for the Essential Product 'Food'

Aside from the general rules under the GATT and WTO that are relevant for trade in all products, specific regulations are dedicated to trade in food products. These regulations are governed by the Agreement on Agriculture (AoA), ratified in 1994, which encompasses a wide range of policies aimed at ensuring supply security. These policies encompass various aspects, including the design and value of subsidies, as well as the reduction and establishment of maximum levels for tariffs.[38] GATT Article XI explicitly addresses quantitative restrictions on imports and exports, particularly focusing on food and agricultural products. Paragraph 2(1) specifies food as well as 'essential goods' for which exceptions are permitted to impose quantitative restrictions on exports.

Further, Paragraph 2(c) of the GATT includes agricultural and fisheries products among those subject to import restrictions. The Agreement on Agriculture (AoA) further elaborates on these criteria in Article 12, which

34 Ahan Gadkari, 'Legality of Export Restrictions Imposed During COVID-19 in International Economic Law', Journal of International Trade Law and Policy 22 (2023), 33-50.

35 Report Shows Many G20 Export Restrictions Remain in Place, Including on Food and Fertilizers, 4 July 2023, <https://www.wto.org/>.

36 World Trade Organization, 'WTO Analytical Index: GATT 1994 – Article XI (DS Reports)', available at <https://www.wto.org/english/res_e/publications_e/ai17_e/gatt1994_art11_jur.pdf>, last access 12 November 2025.

37 World Trade Organization (n. 36).

38 Rudloff, *Trade Rules* (n. 18).

outlines disciplines on export prohibitions and restrictions. These include considering the effects on importing countries' food security (Paragraph 1 a) and providing a timely advance notice (Paragraph 1 b). However, these criteria do not apply to any developing country, unless it is a net-exporter of the specific food product concerned (Paragraph 2). Consequently, numerous countries frequently employ export restrictions on food without the obligation to notify the WTO, as the classification of developing countries relies on self-declaration. Countries such as India, (so far) China, and Argentina fall into this category and commonly implement export restrictions.

During the food price crisis triggered by the Russian invasion of Ukraine, additional measures were devised to alleviate the escalating global prices of numerous agricultural and fertilizer products, along with the increasing imposition of export restrictions, which had the potential to further exacerbate prices.[39] At the WTO 12th Ministerial Conference in 2022, members adopted several pertinent decisions encapsulated within the 'Geneva-package' addressing food-related issues.[40] The 'Ministerial Decision on World Food Programme (WFP) Food Purchases Exemptions from Export Prohibitions or Restrictions', stipulated that members agreed not to impose export bans or restrictions on foodstuffs purchased for humanitarian purposes by the World Food Programme. Nonetheless, this resolution does not inhibit any member from implementing measures aimed at ensuring its domestic food security. Moreover, the guiding principle for the WFP was rooted in procurement decisions based on the principle of 'do no harm' to the food-supplying members.

Another pivotal resolution, the 'Ministerial Declaration on the Emergency Response to Food Insecurity',[41] acknowledged the array of diverse approaches to achieving food security through trade and reiterated the significance of refraining from imposing export bans or restrictions in a manner contradictory to WTO provisions. It also emphasised the importance of information exchange and monitoring. Collectively, these initiatives highlight the delicate balance between addressing domestic food security – often a pertinent political concern – and simultaneously fostering open trade.

In conclusion, even in an area as regulated as food trade, the leeway on export restrictions remains high,[42] and despite existing rules and the new initiatives on raising awareness, agricultural trade remains the most affected by export restrictions – with some exceptions due to the COVID-19 pan-

39 See Table 1 in Bettina Rudloff, 'Politischer Umgang mit Nahrungsrisiken: Herausforderungen, Optionen und Verbesserungsansätze', Wirtschaftsdienst 103 (2023), 50-56.

40 Cosimo Avesani, Twelfth WTO Ministerial Conference (MC12) – Outcomes for Agriculture and Fisheries, Trade Policy Briefs 49, July 2022, doi: 10.4060/cc1235en.

41 World Trade Organization, MC12 Outcome Document of 22 June 2022, WT/MIN(22)/24.

42 Pauwelyn (n. 20).

demic pertaining to restrictions on medical goods. Because of legal loopholes and existing exemptions legal frameworks – although contributing to trade liberalisation – are not wholly capable of serving as a blueprint for securing medical supply chains. Hence, rather than only improving the rules governing the trade in medical goods, de-risking of supply chains must be based primarily on an economic approach. Building on this conclusion, we turn to the economic dimension: the EU must adopt economic strategies that identify critical dependencies, assess diversification potential, and develop tools to reduce exposure to trade disruptions.

III. An Economic Approach to Securing Supply Chains

The outlined WTO rules provide only limited constraints on export restrictions. Economic strategies therefore play a crucial role in complementing the legal framework, particularly by addressing vulnerabilities that law leaves unresolved. When dealing with goods, the EU has already established some approaches to assess whether a commodity is 'critical'. This is most pronounced for raw materials. Here, the EU currently defines a raw material as critical based on its economic importance and supply risk.[43] The supply risk is determined based on the global export and EU import concentration, import reliance, and end-of-life recycling. Economic importance is calculated with the share of end-use applications, domestic value added, and the substitutability of a commodity. Research concerned with supply-chain risk assessments and the identification of critical import dependencies often applies a similar approach with certain modifications. Flach et al. propose a three-pronged assessment strategy to identify critical import dependencies via commodity relevance, import concentration, and substitutability through internal production.[44] Other contributions move beyond the import concentration and estimate diversification potential through global production and export shares of other countries.[45]

We develop a risk-assessment framework (RFA) that builds on the previous approaches, but introduces several modifications to account for particularities of medical commodities and allows for a granular and direct deduction of actionable recommendations. With our RFA methodology we can identify critical medical goods in six steps: 1) At-risk commodity identifica-

43 European Commission, Directorate-General Joint Research Centre: Gian Andrea Blengin et al., *Methodology for Establishing the EU List of Critical Raw Materials* (European Commission Publications Office 2017).

44 Flach, Teti, Gourevich, Scheckenhofer and Grandum (n. 23).

45 Lukas Mankhoff and Marius Zeevaert, 'Deutschland kann seine Versorgungssicherheit bei mineralischen Rohstoffimporten erhöhen', DIW-Wochenbericht 50 (2022), 667-675.

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tion, 2) import diversification potential analysis, 3) product complexity assessment, 4) export restriction evaluation, 5) extra-regional supply-chain exposure assessment, and 6) domestic demand analysis.

In detail, we first identify medical commodities 'at-risk', i. e., goods deserving particular attention, based on the EU's import volume and concentration. Second, for these at-risk commodities, we the EU's import partners to the top global exporters of these commodities to identify import diversification potential. Third, we calculate the unit price of commodities to gauge their complexity and substitutability, providing insights into supply disruption risks. Fourth, we analyse previous and current trade restrictions by high volume trade partners. Fifth, we estimate exposure to global supply chains through reliance on intra-EU trade. Lastly, we examine the foreign value added in domestic final demand. By applying this methodology, we identify 36 at-risk commodities with different levels of criticality. The results of our analysis are summarised in Figure 1.[46] The next sections provide a step-by-step application of our approach.

1. Commodity At-Risk Identification

The identification of commodities at-risk is based on the World Trade Organization's (WTO) list of medical goods from 2020, with which the WTO proposes a comprehensive identification of medical commodities beyond the goods that are essential for countering the COVID-19 pandemic.[47]

46 The figure indicates the degrees of criticality with values from 1 to 4 and different shades of grey from low criticality (1, light grey) to high criticality (4, dark grey). Additionally, we also calculate an unweighted composite score for each commodity and the commodity group. The composite scores are colour code from light grey (score below 2), mid-light grey (score between 2 and <2.5), mid-dark (2.5 to <3), and dark grey (score >3). The summary does not include the analysis of the foreign value added as data is only available for pharmaceutical commodities. Based on the summary figure, we can already discern that criticality is highest in the group of medical equipment and supplies, followed by medicaments and Personal Protective Equipment (PPE).

47 The list is a combination of three previously developed collections of medical commodities. These collections are the Information Technology Agreement (ITA) Expansion, the 1994 Agreement on Trade in Pharmaceutical Products, and the World Customs Organization's (WCO) HS Classification reference for COVID-19 medical supplies. Although being comprehensive, additional lists by WHO, WTO, as well as the World Bank (WB) do exist, which sometime provide slight changes. For further discussion of the different lists see Pierre Cotterlaz, Guillaume Gaulier, Aude Sztulman and Deniz Ünal, 'Pioneering a New Classification: a Comprehensive Study of Healthcare Products in Global Trade, Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) Working Paper No. 2024-02, January 2024, available at <https://cepii.fr/PDF_PUB/wp/2024/wp2024-02.pdf>, last access 12 November 2012; World Trade Organization, 'Trade in Medical Goods in the Context of Tackling COVID-19, World Trade Organization Information Note No. 2020/01, 3 April 2020, doi: 10.30875/5a1af59c-en.

The list identifies 92 medical commodities on the Harmonized System (HS) 6-digit level and groups the commodities into medicaments, medical supplies, medical equipment, and PPE.[48] Notably, the list does not include starting materials and Application Programming Interfaces (APIs) used in the production of finished pharmaceutical products. This fits well with the research gap addressed by our analysis.[49]

Using United Nations (UN) Comtrade,[50] we compiled a granular dataset of export flows from 165 countries to the world and to the EU. We exclusively focused on export flows to keep the reporters, i. e., the individual countries, constant and avoid mixing export and import data, which often shows discrepancies that stem from differences in the quality of the trade data reporting.[51] Hence, the 'EU imports' are determined by the exports of other countries to the EU.

Using this approach, we calculated the total weight of EU imports between 2018 and 2022 for the 92 commodities identified by the WTO. We extended the data to cover the years prior to the pandemic in order to account for any biases in the data that might arise due to focusing on a single year or the altered trade patterns during the COVID-19 pandemic.[52] Additionally, we followed previous contributions and used trade volume in terms of trade weights to mask quantitative dependencies on cheap products, e. g., generic antibiotics.[53]

48 The full list of commodities including their descriptions and HS codes is displayed in Table A.1.

49 For a detailed analysis on starting materials and APIs see Francas, Fritsch and Kirchhoff, Resilienz (n. 21).

50 UN Comtrade Database, <https://comtradeplus.un.org/>.

51 Imports, Exports and Mirror Data with UN COMTRADE, <https://wits.worldbank.org/wits/wits/witshelp/content/data_retrieval/T/Intro/B2.Imports_Exports_and_Mirror.htm>, last access 12 November 2025.

52 Guglielmo Caporale, Anamaria Sova and Robert Sova, 'The COVID-19 Pandemic and European Trade Patterns: A Sectoral Analysis', International Journal of Finance & Economics 30 (2024), 729-749

53 Bayerlein, 'EU's Open Strategic Autonomy' (n. 10).

Figure 1: Critical Medical Goods Summary

Category	HS Code	Product	Diversification Potential	Production Complexity	Export Restrictions	External Dependency	Commodity Criticality Score	Unweighted Category Score
	300215	Immunological products (for retail)	4	4	1	3	3	
	300220	Vaccines for human medicine	2	4	2	1	2,25	
	300320	Antibiotics (not for retail)	4	1	3	3	2,75	
	300410	Penicillins (for retail)	3	1	4	1	2,25	
Medicaments	300431	Insulin (for retail)	2	2	3	1	2	2,28
	300432	Corticosteroid hormones (for retail)	1	2	2	1	1,5	
	300439	Hormones or steroids (for retail)	2	3	2	2	2,25	
	300441	Ephedrine (for retail)	3	4	2	1	2,5	
	300460	Antimalarial active principles (for retail)	2	3	4	1	2,5	
	300490	Medicaments n.e.s. (for retail)	2	1	2	2	1,75	
	284700	Hydrogen peroxide	1	1	3	1	1,5	
	300212	Antisera and other blood fractions	3	4	1	3	2,75	
	300510	Adhesive dressings and other articles	1	3	2	2	2	
	300590	Wadding, gauze, bandages and the like	3	2	3	2	2,5	
	350400	Peptones and their derivatives	2	2	1	2	1,75	
	350790	Enzymes and prepared enzymes, n.e.s.	3	3	2	2	2,5	
Supplies	380894	Disinfectants	2	1	2	1	1,5	2,52
	382200	Diagnostic or laboratory reagents	3	4	2	3	3	
	392620	Apparel and clothing of plastic sheeting	4	1	2	4	2,75	
	401511	Surgical gloves	3	2	4	4	3,25	
	401519	Gloves, mittens and mitts	4	1	4	4	3,25	
	901831	Syringes, with or without needles	2	3	3	3	2,75	
	901839	Needles, catheters, cannulae and the like	2	4	4	3	3,25	
	841920	Medical, surgical or laboratory sterilisers	2	1	1	2	1,5	
	901812	Ultrasonic scanning apparatus	3	4	1	4	3	
	901813	Magnetic resonance imaging apparatus	4	4	2	4	3,5	
	901819	Other electro-diagnostic apparatus	2	4	2	3	2,75	
Equipment	901920	Therapeutic respiration apparatus	2	2	2	4	2,5	2,6
	902212	Computer tomography apparatus	2	3	2	4	2,75	
	902214	Apparatus based on the use of X-rays	2	2	2	4	2,5	
	902290	X-ray generators	3	3	3	3	3	
	902519	Thermometers and pyrometers	3	1	2	3	2,25	
	940290	Medical furniture	4	1	2	2	2,25	
	340220	Other cleaning products	2	1	2	1	1,5	
PPE	392690	Plastic face masks	2	2	2	2	2	2,25
	630790	Textile face masks	3	4	2	4	3,25	

Our at-risk definition is based on the total weight of country's exports to the EU, i. e., EU imports and the import concentration measured by the Herfindahl-Hirschman Index (HHI). The HHI measures trade concentration by estimating the market share of different providers, i. e., countries. It runs from 0 to 1, with 1 indicating absolute market concentration with only one

provider, i. e., a monopoly.[54] As a rule of thumb, values below 0.15 are categorised as unconcentrated markets, while values above 0.25 indicate highly concentrated markets.[55] For our at-risk classification we use an HHI of 0.2 as the cut-off point as the commodities with values of 0.2 and above already indicate moderately concentrated markets that merit a closer look.[56]

Since it is not only a question of trade concentration but also demand, we introduce a second cut-off based on the total weight of the EU imports. This cut-off is determined by calculating the median import weight for each commodity group (medicaments, supplies, equipment, and PPE). We consider a commodity at-risk if the import weight is above the median of the respective commodity group, i. e., if a large amount of the good is imported by the EU. We use the median instead of the mean, as the median is robust against outliers while at the same time captures the commodities with large trade quantities. The results of applying both cut-offs are displayed in Figure 2.

The figure shows several at-risk goods within each commodity group. While several goods show a high import volume, most fall slightly above the median, underscoring that the import volumes of most medical commodities within the four groups are similar. Contrary to that, HHI values display a considerable variance with many goods greatly exceeding the 0.2 and even the 0.25 mark. This indicated a very high import concentration for most commodities in the WTO list. In total, we identified 36 at-risk commodities based on the import concentration and the total import weights between 2018 and 2022. For these 36 at-risk commodities we further analysed existing trade patterns and developed import diversification scenarios.

2. Import Patterns and Diversification Potential

In the next step of our identification strategy, we analysed existing trade patterns and developed diversification scenarios. For this purpose, we first calculated the EU's import shares for each of the 36 commodities and listed the top ten import partners, i. e., the top ten exporters to the EU. In a second step, we calculated the global export shares of our sample countries and again listed the top ten exporters to the world for each commodity. Based on this, we compared the top EU partners to the list of major global exports and identified new potential partners.

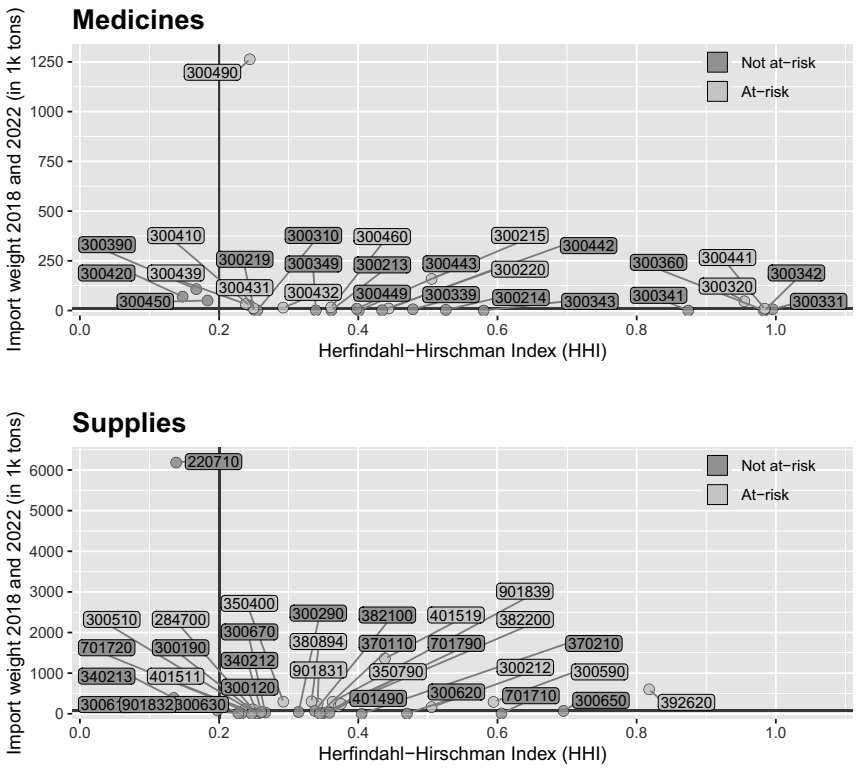
54 Depending on whether market shares are expressed in percent or decimals values can also range from 0 to 10,000.

55 U. S. Department of Justice and the Federal Trade Commission, 'Horizontal Merger Guidelines', 19 August 2010, available at <https://www.justice.gov/atr/horizontal-merger-guidelines-08192010>, (accessed 12 November 2025).

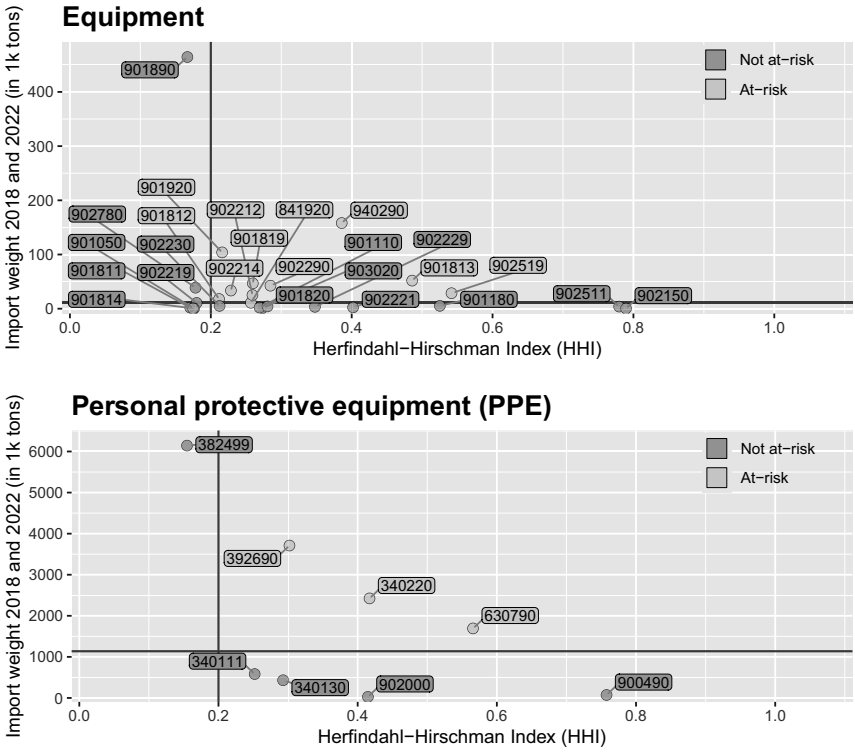
56 Ivan Brezina, Juraj Pekár, Zuzana Čičková and Marian Reiff, 'Herfindahl–Hirschman Index Level of Concentration Values Modification and Analysis of Their Change', Central European Journal of Operations Research 24 (2016), 49-72.

To move beyond the mere identification of such partners, we also derived scenarios of potential import diversification. For these scenarios we first calculated the average export shares to the EU for each commodity to identify common trade volumes. Second, we increased the EU import shares with these new partners up to the average trade share, while reducing the import shares of the largest and sometimes second largest EU import partner by the same amount.[57] Based on this new configuration of import partners we calculated the simulated HHI. Figure 3 provides on overview over the simulated HHI reduction (red) and the current HHI (blue) for each of the 36 at-risk commodities. The detailed list of the top EU partners and global exporters as well as the diversification scenarios are displayed in Table A.2 to A.5 in the appendix.

Figure 2: At-Risk Commodity Identification

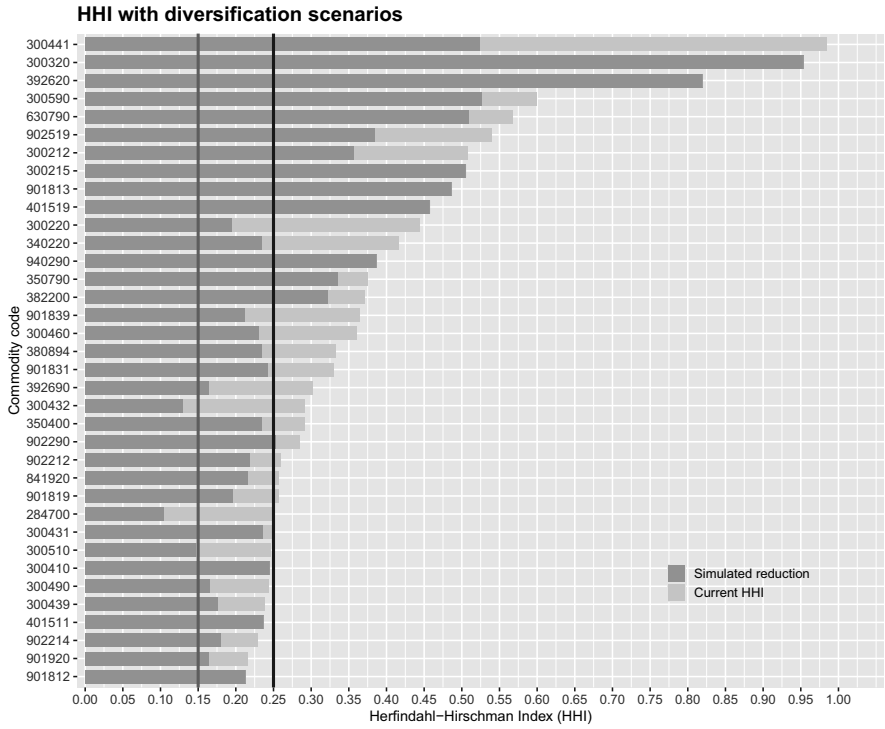


57 This approach assumes a constant trade volume with partner countries as well as a constant EU demand for the respective commodities. Additionally, we assume substitutability of commodities between different countries. See Section 'Limitations and Further Research' for a more in-depth discussion of these assumptions and resulting limitations.



The figure shows considerable variance in the EU's import diversification potential. For some commodities like medicaments containing alkaloids (HS 300441), the HHI can almost be reduced by 50 % through import diversification, while other goods like antibiotics (HS 300320) show no import diversification potential. Although the import diversification not always results in the HHI falling below the critical value of 0.25, for a large share of the commodities analysed, we developed diversification scenarios that reduced the import concentration to levels below 0.25 (33 %) and even below 0.15 (8 %). Based on the HHI reduction, we grouped the commodities by four categories that indicated the diversification and criticality reduction potential: None, low, moderate, and high. The 'none' category is defined by the EU's import partners being identical with the top global exporters and the HHI lying above 0.25. The category 'low' indicates the absence of export potential below the values of 0.25 and the existence of export potential that falls short of reducing the HHI below 0.25. Commodities are classified as 'moderate' if the simulated reduction brings the HHI below the 0.25 mark or further reduces a HHI already below 0.25. Commodities falling below a simulated HHI of 0.15 are categorised as having a 'high' criticality reduction potential.

Figure 3: Current and Simulated HHI



3. Production Complexity

Moving beyond the current and potential import diversification, we analysed the production complexity of the at-risk commodities based on the level of sophisticated technology required to produce them. Previous research already focuses on the complexity of products to estimate supply chain resilience for the individual commodities.[58] The reasoning behind this is that highly complex products are dependent on a multitude of production steps and suppliers, which make the supply chain vulnerable to shocks. Additionally, countries can arguably not respond to disruptions in the supply-chain of these highly complex products due to various supply-side factors: a lack of close substitutes,[59] the highly sophisticated technology or

58 Robert Inman and Dennis Blumenfeld, 'Product Complexity and Supply Chain Design', International Journal of Production Research 52 (2014), 1956-1969.

59 Lawrence Edwards and Robert Z. Lawrence, 'Do Developed and Developing Countries Compete Head to Head in High-Tech?, National Bureau of Economic Research, Working Paper No. 16105, June 2010, doi: 10.3386/w16105.

tools required for their production, and the time taken to establish production capabilities in exporting country.[60]

Even on the demand side, the price or unit value of a product can indicate the quality of the product[61] as capital and skill-rich countries tend to specialise in superior varieties that need more sophisticated technologies for production.[62] Therefore, to determine the complexity of products that can also be viewed as higher quality[63] or a measure for the technology embodied in the product,[64] we calculated the average unit value in current US$ for each at-risk commodity. It is important to note that while unit values are correlated with quality, quality increases beyond a certain threshold do not tend to drive prices as high production efficiency would keep prices stable.[65] Hence, although it is not a perfect measure of quality or embodied technology, it can be used as a general measure of complexity of final medical products imported by the EU.[66]

Since the quality of imported products is conditional on its price[67], the unit value (price) was calculated by dividing the value of the imports by the import quantity (for example, in tons, or number of pieces, or weight). For each of the four commodity categories we determined the relative complexity based on the distribution of the unit price values. For the lowest quartile, we assumed a low complexity of products. Commodities falling between the lowest quartile and the median were categorised as moderately complex. Goods with an average unit price between the median and the

60 Robert C. Feenstra and John Romalis, 'International Prices and Endogenous Quality', The Quarterly Journal of Economics 129 (2014), 477-527.

61 Peter K. Schott, 'Across-Product Versus Within-Product Specialization in International Trade', The Quarterly Journal of Economics 119 (2004), 647-678.

62 Alexandra Bykova, Mahdi Ghodsi and Robert Stehrer, 'The Evolution of Trade Unit Values: a Measurement on Quality', UNIDO Inclusive and Sustainable Industrial Development Working Paper Series WP 1/2018, available at <https://downloads.unido.org/ot/10/16/10166456/WP_1.pdf>, last access 12 November 2025.

63 Juan Carlos Hallak, 'Product Quality and the Direction of Trade', Journal of International Economics 68 (2006), 238-265.

64 Bykova, Ghodsi and Stehrer (n. 62).

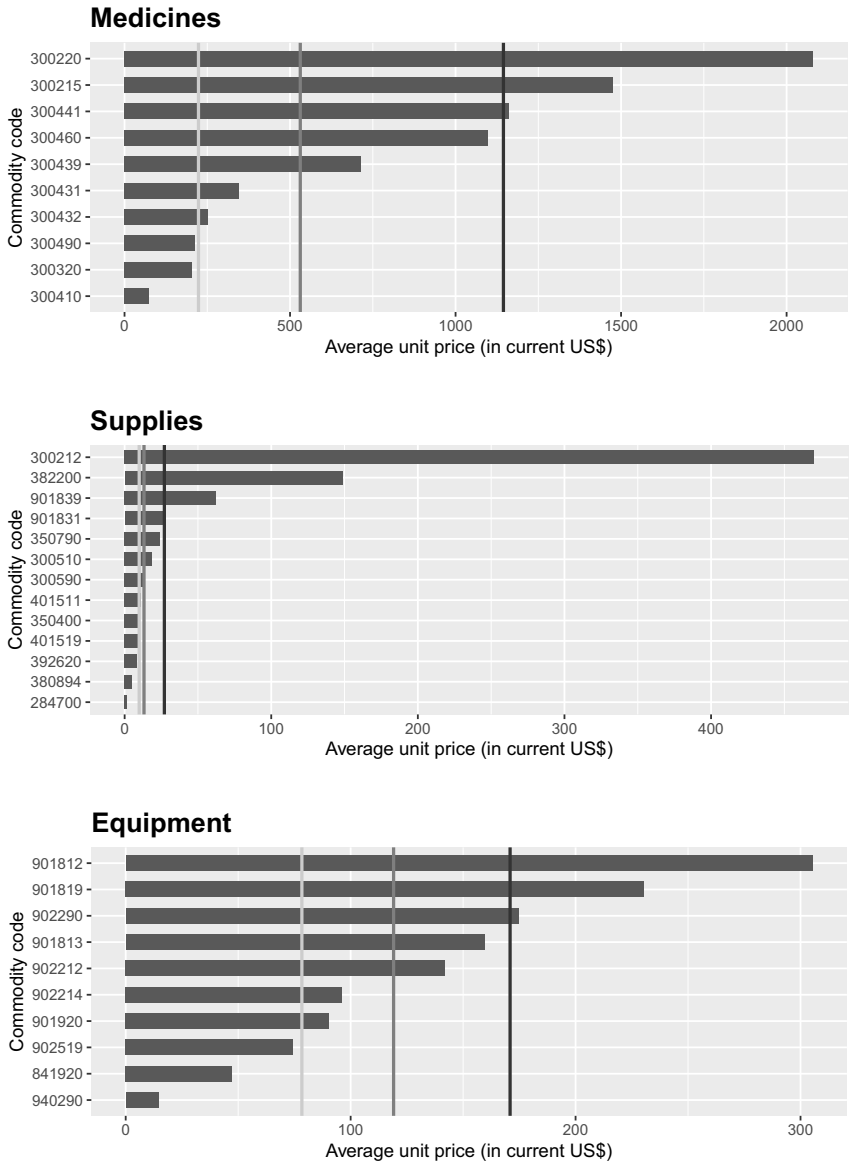
65 Christian Henn, Chris Papageorgiou and Nikola Spatafora, Export Quality in Developing Countries, IMF Working Paper WP/13/108, 15 May 2013, doi: 10.5089/9781484351635.001.

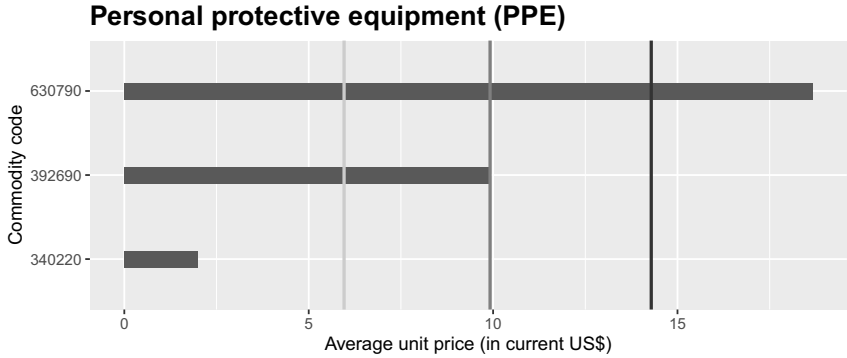
66 Our study does not capture the trade in medical intermediate products, especially APIs that have low unit values usually due to optimised production (scale). Moreover, unit values of patented medicines depend on the remaining period of a patent held by a firm and distort average values. Further research can be conducted to determine the impact of patents on prices of medication. Patented-high-value medicines also tend to be traded through small B2C orders that are not usually captured in country-level trade data. Therefore, they have been excluded from this analysis.

67 Amit Khandelwal, 'The Long and Short (of) Quality Ladders', The Review of Economic Studies 77 (2010), 1450-1476.

upper quartile resembled rather complex products, and commodities above the upper quartile were the most expensive and, in our reasoning, the most complex products. Using these cut-offs, Figure 4 shows the average unit price for the 36 commodities.

Figure 4: Product Complexity Assessment





Focusing on medical goods, two commodities display particularly high average unit prices. These commodities are vaccines (HS 300220) and blood antisera for retail sale (HS 300215). Since vaccines are highly complex products, the identified products support our approach of measuring product complexity via the average unit price. Conversely, medical supplies like hydrogen peroxide (HS 284700) as well as disinfectants (HS 380894) are rather cheap products with a low production complexity.[68]

The interpretation of high and low complexity is dependent on the time horizon and intention. While higher product complexity correlates with higher supply-chain disruption risks and lower short-term compensation through re-shoring, re-shoring might nonetheless, be an option in the long run due to higher revenues associated with the commodity and the development of local production capabilities over time. At the same time, low product complexity can enable countries to re-shore production in the short-term but may not be economically feasible for some countries in the long run as high labour costs could drastically increase the price of commodities. For our analysis, we put greater weight on complexity being a short-term threat to securing medical supplies as we are interested in supply-chain security and overcoming immediate disruptions.

68 Note that antibiotics (HS code 300320) and penicillin (HS code 300410) also show a very low unit price. While the production of both medicaments is somewhat less complex than manufacturing for example vaccines, it is important to point out that economies of scale and expired patent protection reduce unit prices. Further, although the EU might have the necessary infrastructure to manufacture antibiotics, if necessary, this does not go for other countries. Thus, the evaluation of the complexity is highly context specific and does not permit us to derive that a low unit price means that all countries can produce the product.

4. Patterns of Export Restrictions Across Trade Partners

To determine the level of exposure of the EU's medical supply chains due to export restrictions introduced by partner countries, we drew on data from the Global Trade Alert (GTA) database.[69] This dataset provides information on trade-affecting policies implemented by partner countries in our sample between 2008 and 2022. Due to our research interest, we exclusively focused on export restricting measures. The export measures included in the analysis are the following: ban, licensing requirement, quota, tariff quota, tax, related non-tariff measure, and other export inventive. We also only considered an intervention as relevant if the intervention according to GTA 'likely involves discrimination against foreign commercial interests' (amber GTA evaluation) or 'almost certainly discriminates against foreign commercial interests' (red GTA evaluation). Additionally, only measures on the national and supranational level were included.

We matched the 36 identified at-risk commodities with those affected by the respective export restrictions at the HS 6-digit level and by the implementing authority, as indicated in the GTA database. In total, we find 281 export restrictions imposed by countries on the 36 at-risk commodities.[70] Next, we matched the EU's top import partners with the countries with a recent history of applying export-restricting measures. Utilising our import flow database, we determined the number of the EU's import partners that have introduced export-restricting measures for each of the 36 commodities, i. e., the number of restriction-imposing countries on whom the EU is dependent for the respective commodity. Figure 5 shows the number of export-restricting partners for the commodities (at HS 6-digit) among the top five import partners.

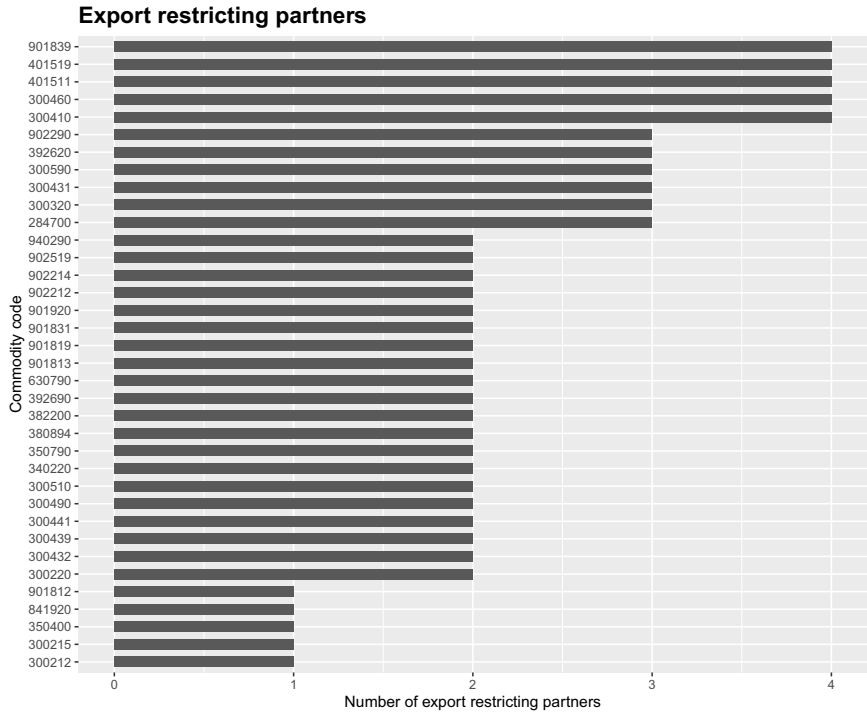
The figure shows that all of the EU's imports of medical commodities are dependent on at least one country with a history of restricting export of medical goods. For five of the 36 at-risk commodities, we uncover that four of the top five trade partners have previously introduced measures limiting the export of medical goods. Six of the commodities have three top trading partners that implemented one or more export restrictions since 2008. Further, for an astonishing 20 out of the 36 commodities we find two trade partners with a history of export restricting measures. Lastly, only five commodities are primarily imported from partners where only one of the

69 Independent Monitoring of Policies that Affect World Commerce, <https Khandelwal:// www.globaltradealert.org/>, last access 12 November 2025.

70 The total is distributed across the types of export restrictions as follows: bans (137), licensing requirements (105), quotas (12), tariff quotas (0), taxes (7), related non-tariff measures (20), and other export inventives (0).

countries restricted the export of medical commodities.[71] Based on this, we again classify the commodities into four tiers of criticality depending on the number of export-restricting partners from very high (four+) to high (three) and moderate (3) as well as low (1 or less).

Figure 5: Export Restrictions by Import Partners



5. The EU's Extra-Regional Supply-Chain Exposure

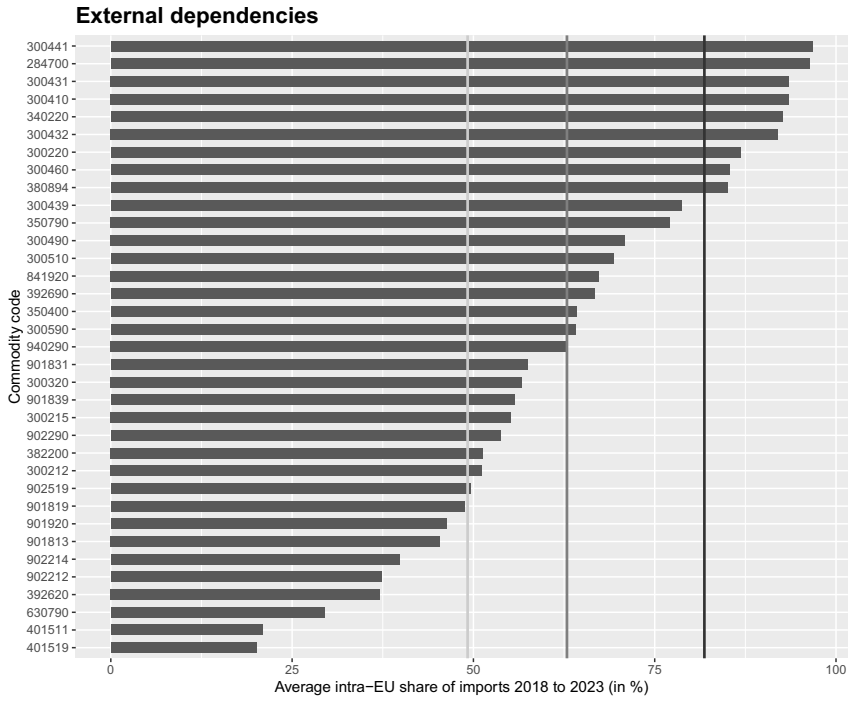
The EU imports medical goods from several non-EU countries outlined in Tables A.2 to A.5 as well as from within the twenty-seven EU member states. A case can be made that if the EU does import most medical goods from inside the bloc, it would be more insulated from geopolitical supply shocks. To identify

71 It is important to note that our analysis includes the years 2020 to 2022 and therefore also captures export restrictions introduced during the COVID-19 pandemic. Although countries applied these measures prior to the pandemic, the GTA data shows an increase of these measures during the pandemic. We nonetheless include the behaviour of countries between 2020 and 2022 as the introduction of export restrictions during the pandemic is a testimony of how countries behave in crises. The criticality of the EU's import dependencies must include especially these circumstances.

the commodities with a higher self-reliance we used data from UN Comtrade but this time the import data as it is reported by the EU was used.[72] With this data, we calculated the share of intra-EU imports in each of the 36 products that were branded to be at-risk. The data was again divided in quartiles using the median instead of the mean, as it is robust against outliers. The results are displayed in Figure 6 with vertical lines indicating the cut-off points.

Using this approach, we find nine products with the lowest intra-EU import shares, or the highest dependence on non-EU imports belonging to the lowest quartile, and therefore more exposed to global supply constraints and shocks. The identified commodities include several appliances (x-ray machines, therapeutic respiration apparatus, surgical instruments) and medical supplies made of rubber, plastic, and textiles. For these products, the intra-EU import share in total imports by the EU was below 48.2 percent, i. e., over fifty percent of such imports originated outside the EU bloc, exposing them to global export restrictions and shocks.

Figure 6: External Dependencies



72 We can focus on the import data reported by the EU countries since we do not compare this data with the export shares by other countries to the world. The methodological issues described above therefore do not apply.

Among the rest of the twenty-seven at-risk products, thirteen were sourced mainly from other EU countries (intra-regional imports) with intra-EU imports comprising a share of seventy percent or more. This indicates that at most 30 percent of imports of these thirteen products are sourced from outside the EU. This group of products, including hydrogen peroxide, disinfectants, dressings, and a range of antibiotics, insulin, alkaloids, vitamins, and anti-malaria medicaments are therefore the least exposed to global shocks or export restrictions as they continue to be sourced from inside the single market and customs union of the EU.[73]

6. Connectedness of EU's Extra-Regional Demand

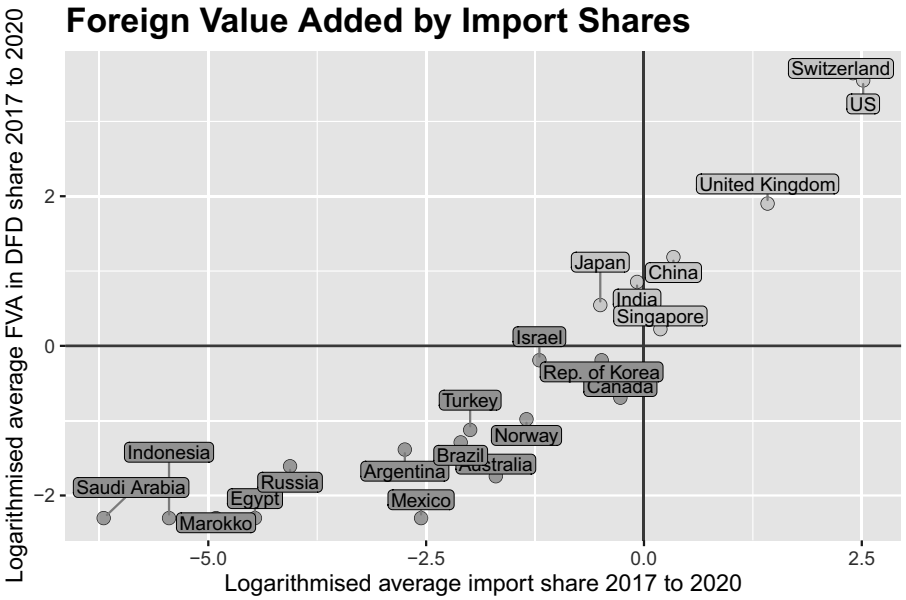
The last measure to determine the risk associated with supply chains is the import partner shares in foreign value added embodied in domestic final demand (DFD_FVApSH) from the OECD Trade in Value Added (TiVA) database.[74] This indicator provides a value-added perspective of the EU's relative connectedness to production in other countries and regions. A high value indicates a higher dependence on foreign industries to meet domestic demand. Due to the paucity of data, this section of the analysis only focuses on the pharmaceutical industry and is therefore not displayed in the summary table. The pharmaceutical products analysed include vitamins, antibiotics, hormone derivatives, vaccines, and other medicaments[75] that are usually highly complex and sophisticated products. Any external shock would disrupt supplies to the EU in the short run as these products require imported specialised equipment and raw materials to be produced; however, in the long run, the EU could develop production capabilities to reduce external supply chain risk. The FVA in DFD is plotted against the import shares of the commodities in Figure 7.

73 European Commission, *Trade: Towards Open and Fair World-Wide Trade*, available at <https://european-union.europa.eu/priorities-and-actions/actions-topic/trade_en>, last access 12 November 2025.

74 The complete guide to the database and the methodologies used by OECD can be found here: <https://web-archive.oecd.org/2023-11-24/644737-TiVA_2023_Indicators_Guide.pdf>, last access 12 November 2025.

75 This is based on the ISIC Rev 4 classification of products based on industrial activity. For this analysis, chapter Division 21 was chosen for the time-period 2017-2020. UN Department of Economic and Social Affairs, 'International Standard Industrial Classification of All Economic Activities Revision 4', Series M No. 4/Rev.4 Statistics Division, <https://unstats.un.org/unsd/publication/seriesm/seriesm_4rev4e.pdf>, last access 12 November 2025.

Figure 7: Supply-Chain Connectedness



When the FVA in DFD share is plotted against the average import share of the same products[76] over the same period of 2017-2020, we find highly concentrated dependence on foreign value added through imports from Japan, Singapore, India, China, the United Kingdom, the United States, and Switzerland to meet EU's final consumer demand of pharmaceutical products. This dependence can be interpreted as high-risk in the event of a supply-side shock originating in these countries.

IV. Limitations and Further Research

Our analysis is based on several assumptions that introduce limitations to the results. First, we assume a constant trade volume with partner countries, as well as a stable EU demand for the respective commodities across years. This assumption restricts the model's ability to account for variations arising from changes in demand. It may be violated in the event of demand surges within the EU or external supply shocks. Therefore, the empirical findings

76 The concordance between ISIC Rev 4 and HS2017 was developed by the OECD STAN Databases Team. HS to ISIC to End-Use Conversion Key, <https://www.oecd.org/sti/ind/ConversionKeyBTDIxE4PUB.xlsx>, last access 12 November 2025.

derived from our RFA would need to be revisited and updated in response to significant shifts in demand or supply structures, as these may alter the list of identified at-risk commodities.

Second, we assume perfect substitutability of commodities across different countries. For example, we do not distinguish between vaccines imported from the US and those from the UK. While the available data does not permit a more detailed analysis of substitutability, this assumption imposes notable limitations. In practice, a measles vaccine cannot be substituted for a whooping cough vaccine – particularly where intellectual property rights are involved. Moreover, a trading partner capable of manufacturing a specific commodity, such as measles vaccine doses, is likely also capable of producing other generic vaccines, even if they are not doing so currently.

Third, the UN Comtrade trade data used in this analysis may obscure real economic dependencies when goods are imported indirectly through intermediary countries rather than directly from their country of origin. For instance, a product manufactured in China might first be imported into the UK and then re-exported to the EU. In trade statistics, this could appear as an import from the UK, thereby masking the EU's actual reliance on Chinese manufacturing. Such re-routing complicates efforts to trace supply chains and accurately assess strategic dependencies. Addressing this issue requires more granular trade data (not available through UN Comtrade) that can track whether specific commodities, such as measles vaccines, were first imported by a country before being re-exported to the EU.

The limitations discussed above also translate into constraints when drawing political conclusions. Nevertheless, the analysis still offers valuable insights into how critical dependencies can be evaluated, as well as which key parameters and indicators may support such assessments. In other sectors, there are often well-established approaches for defining criticality.[77] For example, in the context of food security, criticality is traditionally linked to achieving a high degree of self-sufficiency. In contrast, the EU defines the criticality of raw materials based on supply risks and recyclability.[78] Each of these approaches has its own limitations, and while different sectors exhibit unique production patterns, comparing various methodologies for assessing criticality can provide a richer foundation for future analyses.

77 Jennifer Clapp, 'Food Self-Sufficiency: Making Sense of It, and When It Makes Sense', Food Policy 66 (2017), 88-96.

78 Joint Research Center: EU Science Hub, Study on the Critical Raw Materials for the EU 2023, <https://publications.jrc.ec.europa.eu/repository/handle/JRC136041>, last access 12 November 2025.

V. Results

Following the onset of the COVID-19 pandemic, the EU Commission unveiled plans for an EHU. The creation of this EHU also demanded the fortification of medical and pharmaceutical supply chains to ensure the availability of medical goods for European citizens and healthcare systems. This makes it even more surprising that the EU has thus far only developed strategies to other sectors outside the medical sector like to secure its supply for raw materials and semi-conductors, while mostly neglecting medical commodities. Further, previous research has also rarely addressed the sector-specific resilience of the EU's medical supply chains. Against this background we raised the following questions: What are the existing WTO rules to secure supplies and access to medical goods? How can economic strategies to assess dependencies secure access?

The WTO legal framework allows for a broad application of export restrictions, which – as illustrated by their extensive use in the food sector – demonstrates how even in a heavily traded essential sector countries retain wide discretion; by analogy, similar risks arise for medical supplies with potentially severe implications for global availability and prices. However, such measures may be counterproductive on a global scale, posing significant risks for countries that rely heavily on imports – particularly when exporting countries frequently impose these restrictions. Thus, the EU must assess and overcome critical dependencies in its import of medical goods. To this end, we designed a risk-assessment framework (RFA) to identify commodities and suppliers that may reduce critical dependencies. This RFA was based on six steps, including 1) At-risk commodity identification, 2) import diversification potential analysis, 3) production complexity assessment, 4) export restriction evaluation, 5) domestic demand analysis, and 6) extra-regional supply-chain exposure assessment.

Although developing tailored strategies for more resilient supply chains was not the primary aim of this study, the application of our RFA provides some initial insights into potential strategic approaches for different commodity groups. Using our RFA, we found that medical equipment showed particularly high level of criticality. This criticality is based on systematically higher levels of product complexity as well as external dependencies. On a positive note, however, apart from MRI scanners, our trade flow analysis showed great diversification potential for the EU, which could be further explored to reduce the risk imposed by the complexity and external dependency. Among the medicaments, immunological products and antibiotics showed the highest import concentration for the EU on one to three coun-

tries. The high production complexity involved in developing immunological products further increase the risk associated with this commodity.

Antibiotics excluding penicillin are another critical medical commodity, as import diversification is essentially not possible now. For these products, a strategic political approach would be to ensure stable trade relations, as many countries may compete for a highly concentrated supply. Further, domestic production could be supported to enhance security. However, the situation for medicaments is very nuanced: while certain criticalities were identified, the combined scores suggest that other medical commodities may be equally or even more important. This is especially true for specific PPE supplies – such as gloves, syringes, catheters, and cannulas — which show particularly high levels of criticality. These commodities are often overlooked in other analyses, which limits the development of sound policy recommendations. Our findings highlight the need for trade diversification, especially for these products. Other items, such as face masks, also show high overall criticality. However, we found limited potential for import diversification in this case. Therefore, a trade strategy for such products should focus on maintaining stable import relationships and agreements, while also considering domestic production and strategic stockpiling.

VI. Policy Recommendations and Conclusion

Although the supply chains of medical and agricultural products differ in key characteristics – such as the role of research and development, territorial production dependencies, and perishability – valuable lessons can be drawn from the longstanding experience in regulating and responding to trade restrictions in the agricultural sector. A monitoring system (Agricultural Market Information System AMIS) has been initiated in one of the younger so-called global food price crises in 2011 by the G20. It informs on actual global supply and price of major products including inputs and stocks. This approach helps identify actual and potential shortage risks and may support efforts to avoid export restrictions – which are often counterproductive at the global level – when no global shortages are evident. Other monitoring systems focus specifically on export restrictions, such as the IFPRI-tracker.[79] A similar tracking system could be designed to measure global supply, prices, and stocks of medical products and inform of any shortages so that import-

79 Food and Fertilizer Export Restrictions Tracker, Food Security Portal IFPRI, <https://www.foodsecurityportal.org/tools/COVID-19-food-trade-policy-tracker>, last access 12 November 2025.

dependent countries could find short-term solutions through diversification or stockpiling to meet domestic demand.

Another possible solution could be linked to awareness-raising activities or programmes on the risks of export restrictions. These have already been pursued increasingly since the pandemic. To this end, the WTO and IMF jointly called for refraining from applying export restrictions to avoid price peaks and reduced supply.[80] During the Russian invasion of Ukraine and the induced price rises, various WTO decisions of 2022 stressed on refraining from export restrictions in food products to ensure smooth functioning of humanitarian food programmes.[81] Such awareness-raising programmes could be replicated for medical goods.

Although the WTO system is currently weakened with a limited settlement procedure and global trade protectionism is on the rise, economically, pursuing open trade through international cooperation remains the first-best option. Therefore, convincing trade partners to refrain from applying restrictions on medical products is still relevant. Another approach may be to sign bilateral cooperation agreements or future-proof new free trade agreements to dis-incentivise the application of new trade-restricting measures.[82] According to our analysis relevant new partners might be the Republic of Korea for hydrogen peroxide, India for vaccines, or Uganda for alkaloids.

Current political discussion also heavily centre around dependencies on Asian countries, especially China. The dominant role of China identified by us for certain commodities (e. g., Antibiotics and blood antisera, see Table A.2.1) underscores the merit of this focus. However, our proposed framework treats by design all countries alike. This is because it is – as with other critical commodities – not only about China but critical dependencies in general. The import tariffs raised by the second Trump administration underscore that any market concentration be it with a country perceived as an 'ally' or a 'strategic rival' potentially threatens the EU's open strategic autonomy. Therefore, we also recommend that an evaluation of existing strategic dependencies as proposed by us should move beyond a mere focus on singular countries (be it China or Russia).

Regardless of the legal framework that allows for export restrictions, economic strategies play a crucial role in securing supply chains for medical products. The decision for strategies would depend on the time frame being considered. In the short run, any disruption in supply chains could be met

80 International Monetary Fund, WTO and IMF heads call for lifting trade restrictions on medical supplies and food, 24 April 2020, Press Release No. 20/287, <https://www.imf.org>, last access 12 November 2025.

81 WTO, WT/MIN(22)/29, WT/L/1140 of 22 June 2022.

82 World Bank Group and World Trade Organization (n. 9).

with import diversification options that can be identified in advance using a risk-assessment framework such as proposed in this paper. Simultaneous stockpiling often is targeted to meet domestic demand for import-dependent countries in commodities that are most at-risk, however, as seen during the pandemic, stockpiling by net exporters of medical goods led to further shortages and price hikes that impacted many import-dependent countries across the world. Here again, experiences from the food sector can help highlight potential trade-offs. Existing WTO rules on subsidies – as well as those related to stockholding – aim to prevent international market disruptions both when building up reserves and when releasing them.[83] Import diversification in the long run is a recommended option for increased security of supplies. This would require negotiating new and sustainable supplier contracts.

The EU has also thus far refrained from establishing plurilateral agreements (so-called 'clubs')[84] to address medical supply-chain bottlenecks, albeit embracing this approach for critical raw materials.[85] The EU's reluctance to pursue plurilateral agreements in the medical goods sector may stem from sensitivities around national health sovereignty and regulatory divergence, further undermined by the erosion of trust during the pandemic due to vaccine nationalism and export restrictions, which made deeper cooperation politically and practically more difficult. But an important real difference to CRM alliances is that the EU can – in theory – produce medical commodities with less foreign inputs. Therefore, own production could be increased – eventually by financial incentives. Due to the economic downsides of these approaches, the EU should also explore the possibility of plurilateral agreements in the medical sector[86] Such a trade-link is relevant as well to the issue of re-shoring of supply chains in the aftermath of the pandemic, was also based on the need to secure supply of essential goods. However, re-shoring is only advised when it aligns in an economically sound manner with domestic production capabilities. In the long-run countries can move to domestic production of certain at-risk commodities that have few substitutes or only limited options for import diversification, however, this will require high value investments, supportive economic policies embedded in general strategies, and human capital to develop production capacity and capability.

83 Rudloff, *Trade Rules* (n. 18).

84 Bernard Hoekman, 'COVID-19 Trade Policy Measures, G20 Declarations and WTO Reform' in: Simon Evenett and Richard Baldwin (eds), *Revitalising Multilateralism Pragmatic Ideas for the New WTO Director-General* (CEPR Press 2020), 63-69.

85 Bayerlein, 'EU's Open Strategic Autonomy' (n. 10).

86 Bernard Hoekman, Matteo Fiorini and Aydin Yildirim, 'COVID-19: Export Controls and International Cooperation' in: Richard Baldwin and Simon Evenett (eds), *COVID-19 and Trade Policy: Why Turning Inward Won't Work* (CEPR Press 2020), 77-87.

Appendix

Table A.1: At-Risk Medical Commodities Description

Category	HS Code	WTO Description
Medicaments	300215	Immunological products, … for retail sale
	300220	Vaccines for human medicine
	300320	Medicaments containing antibiotics, … not for retail sale
	300410	Medicaments containing penicillin or derivatives thereof … for retail sale
	300431	Medicaments containing insulin but not antibiotics, … for retail sale
	300432	Medicaments containing corticosteroid hormones, … for retail sale
	300439	Medicaments containing hormones or steroids … for retail sale
	300441	Medicaments containing ephedrine or its salts, … for retail sale
	300460	Medicaments containing any of the following antimalarial active principles … for retail sale
	300490	Medicaments consisting of mixed or unmixed products … for retail sale
Supplies	284700	Hydrogen peroxide, whether or not solidified with urea
	300212	Antisera and other blood fractions
	300510	Adhesive dressings and other articles … put up for retail sale for medical, surgical, dental or veterinary purposes
	300590	Wadding, gauze, bandages and the like put up for retail sale for medical, surgical, dental or veterinary purposes
	350400	Peptones and their derivatives; other protein substances and their derivatives, n. e. s.; …
	350790	Enzymes and prepared enzymes, n. e. s.
	380894	Disinfectants, put up in forms or packings for retail sale
	382200	Diagnostic or laboratory reagents on a backing, prepared diagnostic or laboratory reagents and certified reference materials
	392620	Articles of apparel and clothing accessories produced by the stitching or sticking together of plastic sheeting
	401511	Surgical gloves, of vulcanised rubber
	401519	Gloves, mittens and mitts, of vulcanised rubber
	901831	Syringes, with or without needles, used in medical, surgical, dental or veterinary sciences
	901839	Needles, catheters, cannulas and the like, used in medical, surgical, dental or veterinary sciences
Equipment	841920	Medical, surgical or laboratory sterilizers
	901812	Ultrasonic scanning apparatus
	901813	Magnetic resonance imaging apparatus
	901819	Other electro-diagnostic apparatus
	901920	Ozone therapy, oxygen therapy, aerosol therapy, artificial respiration or other therapeutic respiration apparatus
	902212	Computer tomography apparatus
	902214	Apparatus based on the use of X-rays, for medical, surgical or veterinary uses
	902290	X-ray generators, high tension generators, control panels and desks, screens, …
	902519	Thermometers and pyrometers, not combined with other instruments
	940290	Operating tables, examination tables, and other medical, dental, surgical or veterinary furniture
PPE	340220	Other cleaning products
	392690	Plastic face masks
	630790	Textile face masks

Table A.2.1: Trade in Medicament Commodities (Weight)

			Current EU Import Partners			Top World Exporters		Scenarios: EU Import Partners		
Rank	HS Code	Product	Country	%	HHI	Country	%	Country	%	HHI
1			China	68,51		China	61,75			
2			Rep. of Korea	16,02		Rep. of Korea	13,92			
3			USA	9,67		USA	13,84			
4			Switzerland	3,42		Switzerland	5,35			
5	300215	Blood Antisera (packed)	United Kingdom	1,17	0,51	United Kingdom	1,23	None	None	None
6			Japan	0,43		Japan	1,14			
7			Türkiye	0,18		Türkiye	0,68			
8			Russian Federation	0,17		India	0,37			
9			India	0,15		Costa Rica	0,22			
10			Singapore	0,13		Mexico	0,21			
1			USA	63,54		USA	35,26	USA	28,54	
2			United Kingdom	18,37		India	21,60	India	25,00	
3			South Africa	5,42		China	10,73	United Kingdom	18,37	
4			Switzerland	4,33		United Kingdom	7,84	China	11,24	
5	300220	Vaccines	Singapore	2,48	0,44	Rep. of Korea	3,94	South Africa	5,42	0,20
6			Canada	1,52		United Arab Emirates	3,13	Switzerland	4,33	
7			China	1,24		Canada	2,53	Singapore	2,48	
8			Rep. of Korea	1,06		Russian Federation	2,34	Canada	1,52	
9			Australia	0,97		Uganda	2,06	Rep. of Korea	1,06	
10			India	0,42		Indonesia	1,99	Australia	0,97	
1			China	97,63		China	91,48			
2			USA	0,86		Canada	1,77			
3			United Kingdom	0,65		USA	1,60			
4			Canada	0,25		Thailand	1,01			
5	300320	Antibiotics	India	0,21	0,95	Saudi Arabia	0,86	None	None	None
6			Switzerland	0,15		United Kingdom	0,68			
7			Saudi Arabia	0,09		Switzerland	0,50			
8			Japan	0,05		Rwanda	0,38			
9			United Arab Emirates	0,04		India	0,25			
10			Morocco	0,02		China, Hong Kong SAR	0,23			
1			India	37,63		China	36,01			
2			United Kingdom	24,61		India	27,60			
3			China	19,64		United Kingdom	5,94			
4			Canada	4,77		Canada	5,65			
5	300410	Penicillin	Morocco	3,08	0,25	USA	3,27	None	None	None
6			Pakistan	2,21		Türkiye	2,29			
7			USA	2,09		Indonesia	1,96			
8			Türkiye	1,29		Russian Federation	1,71			
9			United Arab Emirates	0,97		China, Hong Kong SAR	1,60			
10			Russian Federation	0,95		Pakistan	1,42			

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Table A.2.2: Trade in Medicament Commodities (Weight) Continued

Rank	HS Code	Product	Current EU Import Partners			Top World Exporters		Scenarios: EU Import Partners		
			Country	%	HHI	Country	%	Country	%	HHI
1			China	35,70		USA	29,52	USA	27,48	
2			USA	22,48		India	27,89	China	25,70	
3			India	20,18		Brazil	13,96	India	25,18	
4			Brazil	17,40		China	12,62	Brazil	17,40	
5	300431	Insulin	United Kingdom	1,41	0,25	Malaysia	4,38	United Kingdom	1,41	0,24
6			Russian Federation	0,99		United Arab Emirates	2,59	Russian Federation	0,99	
7			Malaysia	0,69		Ukraine	2,45	Malaysia	0,69	
8			Indonesia	0,31		South Africa	1,74	Indonesia	0,31	
9			Türkiye	0,20		United Kingdom	1,35	Türkiye	0,20	
10			United Arab Emirates	0,19		Jordan	0,58	United Arab Emirates	0,19	
1			United Kingdom	51,01		India	22,62	United Kingdom	21,01	
2			USA	9,72		United Kingdom	18,18	India	18,05	
3			Switzerland	8,87		China	17,18	China	15,00	
4			Canada	7,94		USA	10,14	USA	9,72	
5	300432	Corticosteroids	Australia	5,35	0,29	Canada	6,45	Switzerland	8,87	0,13
6			Brazil	5,24		Switzerland	3,18	Canada	7,94	
7			Singapore	3,64		Australia	3,16	Australia	5,35	
8			India	3,05		Brazil	1,95	Brazil	5,24	
9			Russian Federation	1,08		Singapore	1,60	Singapore	3,64	
10			Serbia	1,07		China, Hong Kong SAR	1,56	Russian Federation	1,08	
1			Brazil	31,44		Pakistan	21,57	Brazil	23,44	
2			Switzerland	25,66		Brazil	13,14	Switzerland	21,66	
3			United Kingdom	25,31		Switzerland	10,63	United Kingdom	21,31	
4			USA	8,86		United Kingdom	9,53	Pakistan	13,30	
5	300439	Hormones	China	2,57	0,24	USA	9,07	USA	8,86	0,18
6			Tunisia	2,48		India	7,94	India	4,33	
7			India	1,33		Indonesia	3,16	China	2,57	
8			Japan	0,58		China	2,85	Tunisia	2,48	
9			Pakistan	0,30		Argentina	2,84	Japan	0,58	
10			United Arab Emirates	0,29		Türkiye	2,55	United Arab Emirates	0,29	
1			Malaysia	99,19		Malaysia	90,10	Malaysia	62,19	
2			United Kingdom	0,64		Uganda	8,10	Uganda	37,00	
3			United Arab Emirates	0,12		United Arab Emirates	0,62	United Kingdom	0,64	
4			Chile	0,03		Indonesia	0,38	United Arab Emirates	0,12	
5	300441	Alkaloids	Kenya	0,01	0,98	USA	0,19	Chile	0,03	0,52
6			Switzerland	0,01		Oman	0,15	Kenya	0,01	
7			South Africa	0,00		Chile	0,11	Switzerland	0,01	
8			New Zealand	0,00		United Kingdom	0,10	South Africa	0,00	
9			Australia	0,00		Kazakhstan	0,07	New Zealand	0,00	
10			Ukraine	0,00		Japan	0,04	Australia	0,00	

Table A.2.3: Trade in Medicament Commodities (Weight) Continued

Rank	HS Code	Product	Current EU Import Partners			Top World Exporters		Scenarios: EU Import Partners		
			Country	%	HHI	Country	%	Country	%	HHI
1			United Kingdom	55,28		China	29,18	United Kingdom	30,28	
2			India	16,94		India	28,71	India	25,94	
3			China	13,39		Ukraine	26,71	China	21,39	
4			Ukraine	7,50		United Kingdom	12,58	Ukraine	15,50	
5	300460	Antimalarial	Switzerland	5,41	0,36	Switzerland	1,77	Switzerland	5,41	0,23
6			Morocco	1,28		Morocco	0,30	Morocco	1,28	
7			Canada	0,11		South Africa	0,14	Canada	0,11	
8			Malaysia	0,04		USA	0,14	Malaysia	0,04	
9			Ghana	0,02		Malaysia	0,08	Ghana	0,02	
10			USA	0,02		Canada	0,06	USA	0,02	
1			United Kingdom	43,53		India	19,17	United Kingdom	29,53	
2			Switzerland	18,93		China	13,60	Switzerland	18,93	
3			India	11,01		United Kingdom	10,23	India	16,01	
4			USA	5,18		USA	6,41	USA	5,18	
5	300490	Medicaments, n. e. c.	Serbia	3,38	0,24	Switzerland	4,77	Serbia	3,38	0,17
6			Singapore	3,14		China, Hong Kong SAR	3,29	Singapore	3,14	
7			Türkiye	2,35		Colombia	3,12	Türkiye	2,35	
8			China	2,25		Singapore	2,91	China	11,25	
9			Morocco	1,46		Malaysia	2,69	Morocco	1,46	
10			North Macedonia	1,40		Canada	2,67	North Macedonia	1,40	

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Table A.3.1: Trade in Medical Supplies Commodities (Weight)

			Current EU Import Partners			Top World Exporters		Scenarios: EU Import Partners		
Rank	HS Code	Product	Country	%	HHI	Country	%	Country	%	HHI
1			Norway	35,95		Thailand	16,77	Norway	15,95	
2			United Kingdom	30,69		Rep. of Korea	16,42	USA	13,44	
3			USA	13,44		Brazil	16,12	Thailand	10,00	
4			Israel	8,65		Canada	11,09	Rep. of Korea	10,00	
5	284700	Hydrogen peroxide	Japan	3,00	0,25	USA	10,13	Brazil	10,00	0,10
6			Brazil	2,09		Kazakhstan	7,21	Canada	10,00	
7			Switzerland	1,92		Japan	4,29	United Kingdom	10,69	
8			Türkiye	1,60		China	3,14	Israel	8,65	
9			Canada	0,67		Indonesia	2,47	Japan	3,00	
10			China	0,38		Kuwait	1,58	Brazil	2,09	
1			USA	67,75		USA	45,13	USA	54,75	
2			United Kingdom	21,15		United Kingdom	13,67	United Kingdom	21,15	
3			Switzerland	5,29		Argentina	10,77	Argentina	7,00	
4			Türkiye	2,63		Canada	8,25	Canada	6,00	
5	300212	Blood Antisera	Iran	1,00	0,51	Türkiye	4,57	Switzerland	5,29	0,36
6			Canada	0,65		Switzerland	2,56	Türkiye	2,63	
7			Brazil	0,28		Brazil	2,54	Iran	1,00	
8			Australia	0,25		Chile	2,29	Canada	0,65	
9			Rep. of Korea	0,22		Uruguay	2,17	Brazil	0,28	
10			Japan	0,15		Paraguay	1,99	Australia	0,25	
1			China	43,42		China	36,82	Malaysia	21,49	
2			United Kingdom	15,25		Malaysia	24,45	China	18,42	
3			USA	14,26		USA	9,60	United Kingdom	15,25	
4			Japan	9,08		Japan	8,75	USA	14,26	
5	300510	Dressings and adhesive	Thailand	4,27	0,25	United Kingdom	4,30	Japan	14,08	0,15
6			Egypt	4,17		Brazil	1,92	Thailand	4,27	
7			Switzerland	2,49		Thailand	1,75	Egypt	4,17	
8			Rep. of Korea	1,94		Rep. of Korea	1,48	Switzerland	2,49	
9			Türkiye	1,55		Mexico	1,45	Rep. of Korea	1,94	
10			South Africa	1,49		Türkiye	1,16	Türkiye	1,55	
1			China	76,78		China	71,06	China	71,78	
2			United Kingdom	7,46		Malaysia	6,96	United Kingdom	7,46	
3			Thailand	3,74		USA	4,72	Malaysia	5,00	
4			USA	3,42		United Kingdom	2,92	Thailand	3,74	
5	300590	Wadding, gauze, and bandages	India	3,09	0,60	India	2,60	USA	3,42	0,53
6			Türkiye	1,61		Mexico	1,36	India	3,09	
7			Switzerland	1,17		Rep. of Korea	1,27	Türkiye	1,61	
8			Morocco	0,92		Thailand	1,25	Switzerland	1,17	
9			Rep. of Korea	0,29		Türkiye	1,22	Morocco	0,92	
10			Bosnia Herzegovina	0,21		Singapore	0,73	Rep. of Korea	0,29	

Table A.3.2: Trade in Medical Supplies Commodities (Weight) Continued

Rank	HS Code	Product	Current EU Import Partners			Top World Exporters		Scenarios: EU Import Partners		
			Country	%	HHI	Country	%	Country	%	HHI
1			China	47,48		China	59,16	China	40,62	
2			USA	22,41		USA	18,92	USA	22,41	
3			Switzerland	10,18		Brazil	5,65	Switzerland	10,18	
4			Australia	4,16		Canada	3,15	Brazil	6,86	
5	350400	Peptones and derivatives	Brazil	3,65	0,29	Australia	2,95	Australia	4,16	0,24
6			Canada	3,56		Switzerland	2,01	Brazil	3,65	
7			United Kingdom	3,36		India	1,15	Canada	3,56	
8			Norway	0,98		Chile	0,99	United Kingdom	3,36	
9			India	0,97		New Zealand	0,69	Norway	0,98	
10			New Zealand	0,76		Rep. of Korea	0,65	India	0,97	
1			USA	43,19		China	42,39	USA	43,19	
2			China	43,04		USA	29,83	China	38,04	
3			United Kingdom	3,78		Singapore	6,17	Singapore	5,00	
4			Japan	3,49		Türkiye	3,03	United Kingdom	3,78	
5	350790	Enzymes	India	1,61	0,38	Brazil	2,73	Japan	3,49	0,34
6			Canada	1,01		Japan	2,01	India	1,61	
7			Brazil	0,76		Malaysia	1,70	Canada	1,01	
8			Mexico	0,74		United Kingdom	1,66	Brazil	0,76	
9			Türkiye	0,62		Canada	1,59	Mexico	0,74	
10			Malaysia	0,47		India	1,41	Türkiye	0,62	
1			United Kingdom	52,39		China	36,84	United Kingdom	33,39	
2			China	19,61		USA	14,18	USA	24,58	
3			Türkiye	9,37		United Kingdom	6,87	China	21,61	
4			USA	7,58		Canada	4,88	Türkiye	9,37	
5	380894	Disinfectants	Switzerland	7,28	0,33	Mexico	4,34	Switzerland	7,28	0,23
6			Norway	1,18		Guatemala	3,96	Norway	1,18	
7			Canada	0,79		India	3,65	Canada	0,79	
8			China, Hong Kong SAR	0,40		Costa Rica	3,26	China, Hong Kong SAR	0,40	
9			Morocco	0,16		Türkiye	3,08	Morocco	0,16	
10			Tunisia	0,13		Argentina	2,90	Tunisia	0,13	
1			USA	57,98		USA	36,72	USA	53,46	
2			United Kingdom	15,56		China	19,90	United Kingdom	15,56	
3			China	8,99		Japan	7,20	China	8,99	
4			Switzerland	3,00		Singapore	6,75	Japan	3,82	
5	382200	Reagents	Japan	2,92	0,37	China, Hong Kong SAR	6,40	Singapore	3,62	0,32
6			Rep. of Korea	2,50		United Kingdom	4,90	Switzerland	3,00	
7			China, Hong Kong SAR	2,14		Rep. of Korea	3,23	Rep. of Korea	2,50	
8			Canada	1,46		Canada	2,89	China, Hong Kong SAR	2,14	
9			Türkiye	1,15		Brazil	2,50	Canada	1,46	
10			South Africa	1,00		Malaysia	1,36	Türkiye	1,15	

DOI 10.17104/0044-2348-2025-4-1119

Table A.3.3: Trade in Medical Supplies Commodities (Weight) Continued

			Current EU Import Partners			Top World Exporters		Scenarios: EU Import Partners		
Rank	HS Code	Product	Country	%	HHI	Country	%	Country	%	HHI
1			China	90,43		China	90,83			
2			Viet Nam	2,95		Viet Nam	1,67			
3			United Kingdom	2,76		Canada	1,54			
4			Türkiye	0,82		Thailand	0,88			
5	392620	Plastics	Thailand	0,79	0,82	USA	0,63	None	None	None
6			Indonesia	0,31		Malaysia	0,59			
7			USA	0,29		United Kingdom	0,46			
8			India	0,27		Türkiye	0,43			
9			Tunisia	0,25		China, Hong Kong SAR	0,26			
10			Malaysia	0,20		Indonesia	0,20			
1			Malaysia	36,78		Malaysia	34,59			
2			China	23,47		China	29,81			
3			Thailand	19,46		Thailand	17,84			
4			Sri Lanka	6,00		Sri Lanka	4,61			
5	401511	Surgical gloves	Türkiye	5,27	0,24	India	3,60	None	None	None
6			India	3,82		Türkiye	2,27			
7			United Kingdom	2,32		Oman	1,33			
8			Indonesia	0,98		Indonesia	1,31			
9			Viet Nam	0,65		USA	1,10			
10			USA	0,19		United Kingdom	0,61			
1			Thailand	61,05		Thailand	69,35			
2			Malaysia	28,73		Malaysia	22,22			
3			China	4,44		China	4,23			
4			Indonesia	2,03		Indonesia	1,61			
5	401519	Other gloves	Sri Lanka	1,68	0,46	Sri Lanka	0,74	None	None	None
6			Viet Nam	0,96		Viet Nam	0,66			
7			United Kingdom	0,75		USA	0,47			
8			Pakistan	0,06		United Kingdom	0,12			
9			USA	0,06		Canada	0,10			
10			Singapore	0,05		India	0,05			
1			Rep. of Korea	33,08		China	32,89			
2			China	25,38		Rep. of Korea	24,50			
3			USA	16,65		USA	19,51			
4			Japan	7,83		Japan	7,03			
5	901831	Syringes	Norway	4,71	0,21	China, Hong Kong SAR	4,35	None	None	None
6			China, Hong Kong SAR	3,78		Norway	3,07			
7			United Kingdom	2,83		Malaysia	1,42			
8			Malaysia	1,86		Singapore	1,39			
9			Switzerland	1,19		United Arab Emirates	1,12			
10			Singapore	0,69		United Kingdom	0,90			

Table A.3.3: Trade in Medical Supplies Commodities (Weight) Continued

			Current EU Import Partners			Top World Exporters		Scenarios: EU Import Partners		
Rank	HS Code	Product	Country	%	HHI	Country	%	Country	%	HHI
1			China	50,30		China	55,19	United Kingdom	26,91	
2			United Kingdom	32,91		Mexico	19,01	Mexico	25,78	
3			Thailand	3,33		United Kingdom	7,50	China	25,30	
4			Belarus	2,71		Costa Rica	6,23	Costa Rica	8,37	
5	901839	Catheters and cannulas	Türkiye	2,63	0,37	Thailand	5,06	Thailand	3,33	0,21
6			Japan	2,42		Japan	2,14	Belarus	2,71	
7			Costa Rica	2,37		Türkiye	1,46	Türkiye	2,63	
8			Morocco	0,89		Rep. of Korea	0,69	Japan	2,42	
9			Mexico	0,78		Belarus	0,61	Morocco	0,89	
10			Switzerland	0,46		Dominican Rep.	0,32	Switzerland	0,46	

Table A.4.1: Trade in Medical Equipment Commodities (Weight)

			Current EU Import Partners			Top World Exporters		Scenarios: EU Import Partners		
Rank	HS Code	Product	Country	%	HHI	Country	%	Country	%	HHI
1			China	42,03		China	48,93	China	36,03	
2			USA	25,24		USA	15,79	USA	25,24	
3			Switzerland	8,05		Canada	5,12	Canada	8,44	
4			Türkiye	5,88		Mexico	4,88	Switzerland	8,05	
5	841920	Sterilizers	United Kingdom	5,79	0,26	Türkiye	4,44	Türkiye	5,88	0,22
6			Israel	4,80		Japan	3,50	United Kingdom	5,79	
7			Canada	2,44		Rep. of Korea	2,78	Israel	4,80	
8			Rep. of Korea	1,77		Australia	2,49	Rep. of Korea	1,77	
9			Japan	0,76		United Kingdom	2,37	Japan	0,76	
10			Norway	0,74		Switzerland	2,32	Norway	0,74	
1			Rep. of Korea	33,08		China	32,89			
2			China	25,38		Rep. of Korea	24,50			
3			USA	16,65		USA	19,51			
4			Japan	7,83		Japan	7,03			
5	901812	Ultrasonic scanning apparatus	Norway	4,71	0,21	China, Hong Kong SAR	4,35	None	None	None
6			China, Hong Kong SAR	3,78		Norway	3,07			
7			United Kingdom	2,83		Malaysia	1,42			
8			Malaysia	1,86		Singapore	1,39			
9			Switzerland	1,19		United Arab Emirates	1,12			
10			Singapore	0,69		United Kingdom	0,90			
1			United Kingdom	64,08		China	51,32			
2			China	27,21		United Kingdom	34,17			
3			USA	3,79		USA	4,21			
4			Switzerland	1,52		United Arab Emirates	1,84			
5	901813	MRI apparatus	India	0,69	0,49	Rep. of Korea	1,27	None	None	None
6			Japan	0,47		Japan	1,12			
7			Türkiye	0,43		Türkiye	1,09			
8			Rep. of Korea	0,26		China, Hong Kong SAR	1,05			
9			Norway	0,25		Switzerland	0,96			
10			China, Hong Kong SAR	0,22		India	0,80			
1			USA	46,19		USA	27,52	USA	26,24	
2			China	14,46		China	17,80	China	14,46	
3			United Kingdom	12,61		Japan	9,33	United Kingdom	12,61	
4			Japan	5,29		Dominican Rep.	6,77	Japan	10,29	
5	901819	Electro-diagnostic apparatus	Tunisia	2,82	0,26	Thailand	5,86	Dominican Rep.	8,02	0,20
6			Israel	2,78		Mexico	5,25	Thailand	6,94	
7			China, Hong Kong SAR	2,30		United Kingdom	3,79	Tunisia	2,82	
8			Costa Rica	2,17		Israel	3,51	Israel	2,78	
9			Malaysia	1,77		Costa Rica	2,66	China, Hong Kong SAR	2,30	
10			Rep. of Korea	1,66		Indonesia	2,51	Costa Rica	2,17	

DOI 10.17104/0044-2348-2025-4-1119

Table A.4.2: Trade in Medical Equipment Commodities (Weight) Continued

			Current EU Import Partners			Top World Exporters		Scenarios: EU Import Partners		
Rank	HS Code	Product	Country	%	HHI	Country	%	Country	%	HHI
1			China	38,91		China	47,87	China	23,70	
2			United Kingdom	17,28		Mexico	12,15	United Kingdom	17,28	
3			USA	13,41		USA	9,43	Mexico	15,21	
4			Singapore	8,43		Singapore	8,29	USA	13,41	
5	901920	Therapeutic respiration apparatus	Malaysia	7,19	0,22	United Kingdom	4,62	Singapore	8,43	0,16
6			Australia	4,57		Malaysia	4,11	Malaysia	7,19	
7			New Zealand	3,50		Australia	3,12	Australia	4,57	
8			Switzerland	3,09		New Zealand	2,48	New Zealand	3,50	
9			Türkiye	1,57		Türkiye	1,50	Switzerland	3,09	
10			Canada	0,60		Dominican Rep.	1,03	Türkiye	1,57	
1			China	39,57		China	34,17	Japan	32,46	
2			USA	26,37		USA	25,64	USA	21,37	
3			Japan	13,46		Japan	19,23	China	20,57	
4			United Kingdom	9,18		Israel	7,57	Israel	12,85	
5	902212	X-rays (all use, incl. CT)	Israel	7,85	0,26	United Kingdom	4,58	United Kingdom	9,18	0,22
6			Switzerland	1,47		United Arab Emirates	2,68	Switzerland	1,47	
7			Rep. of Korea	0,37		Rep. of Korea	1,46	Rep. of Korea	0,37	
8			Norway	0,36		Mexico	0,98	Norway	0,36	
9			United Arab Emirates	0,18		Singapore	0,56	United Arab Emirates	0,18	
10			India	0,17		Switzerland	0,50	India	0,17	
1			USA	29,27		USA	32,40	United Kingdom	25,15	
2			United Kingdom	29,15		China	20,57	China	21,88	
3			China	21,88		United Kingdom	13,00	USA	20,27	
4			Japan	8,14		Rep. of Korea	12,84	Rep. of Korea	14,59	
5	902214	X-rays (medical, excl. CT)	Rep. of Korea	5,59	0,23	Japan	10,74	Japan	8,14	0,18
6			India	1,75		India	2,23	India	1,75	
7			Switzerland	1,35		United Arab Emirates	2,10	Switzerland	1,35	
8			Norway	0,54		Mexico	1,34	Norway	0,54	
9			Serbia	0,33		Türkiye	0,61	Serbia	0,33	
10			Malaysia	0,32		China, Hong Kong SAR	0,55	Malaysia	0,32	
1			China	48,87		China	54,81	China	45,37	
2			United Kingdom	15,18		USA	8,74	United Kingdom	15,18	
3			USA	11,87		United Kingdom	8,22	USA	11,87	
4			India	6,50		Japan	5,14	Japan	6,80	
5	902290	X-ray parts and accessories	Switzerland	4,75	0,28	India	4,90	India	6,50	0,25
6			Japan	3,30		Rep. of Korea	4,21	Switzerland	4,75	
7			Rep. of Korea	2,24		Singapore	2,50	Rep. of Korea	2,24	
8			Canada	1,53		Switzerland	2,44	Canada	1,53	
9			Israel	1,53		Malaysia	1,87	Israel	1,53	
10			Singapore	1,02		Israel	1,70	Singapore	1,02	

DOI 10.17104/0044-2348-2025-4-1119

DOI 10.17104/0044-2348-2025-4-1119

Table A.4.3: Trade in Medical Equipment Commodities (Weight) Continued

			Current EU Import Partners			Top World Exporters		Scenarios: EU Import Partners		
Rank	HS Code	Product	Country	%	HHI	Country	%	Country	%	HHI
1			China	72,64		China	61,75	China	59,76	
2			United Kingdom	7,27		Thailand	14,20	Thailand	12,88	
3			USA	6,36		USA	6,15	United Kingdom	7,27	
4			China, Hong Kong SAR	3,55		Rep. of Korea	3,61	USA	6,36	
5	902519	Thermometers and pyrometers	Rep. of Korea	2,70	0,54	China, Hong Kong SAR	2,69	China, Hong Kong SAR	3,55	0,39
6			Switzerland	2,37		Mexico	1,76	Rep. of Korea	2,70	
7			Türkiye	1,07		United Kingdom	1,12	Switzerland	2,37	
8			Serbia	0,84		Singapore	0,94	Türkiye	1,07	
9			Canada	0,53		Viet Nam	0,89	Serbia	0,84	
10			Norway	0,49		Japan	0,80	Canada	0,53	
1			China	58,12		China	64,61			
2			USA	17,51		USA	12,84			
3			Türkiye	10,73		Türkiye	5,24			
4			United Kingdom	7,99		Mexico	3,10			
5	940290	Medicial furniture	Switzerland	0,97	0,39	Canada	3,06	None	None	None
6			Australia	0,67		United Kingdom	2,60			
7			Viet Nam	0,57		Indonesia	1,45			
8			Israel	0,46		Viet Nam	1,33			
9			North Macedonia	0,35		Japan	0,60			
10			Thailand	0,33		Thailand	0,54			

Table A.5: Trade in Medical PPE Commodities (Weight)

Rank	HS Code	Product	Current EU Import Partners			Top World Exporters		Scenarios: EU Import Partners		
			Country	%	HHI	Country	%	Country	%	HHI
1			United Kingdom	62,19		China	15,76	United Kingdom	42,19	
2			Türkiye	12,07		USA	12,98	Türkiye	12,07	
3			Serbia	11,36		Türkiye	8,55	USA	11,99	
4			Switzerland	4,16		United Kingdom	7,53	China	11,46	
5	340220	Washing and cleaning preparations	USA	1,99	0,42	Mexico	6,58	Serbia	11,36	0,24
6			Norway	1,86		Russian Federation	6,12	Switzerland	4,16	
7			China	1,46		Saudi Arabia	4,46	Norway	1,86	
8			Russian Federation	1,38		Indonesia	4,06	Russian Federation	1,38	
9			Mauritius	0,68		Thailand	3,03	Mauritius	0,68	
10			Israel	0,62		Canada	2,32	Israel	0,62	
1			China	52,58		Mexico	62,85	Mexico	30,00	
2			United Kingdom	11,46		China	21,22	China	22,58	
3			USA	8,04		USA	3,77	United Kingdom	11,46	
4			Türkiye	4,20		India	1,85	USA	8,04	
5	392690	Plastics, n. e. c.	Switzerland	3,78	0,30	Malaysia	1,49	Türkiye	4,20	0,17
6			India	3,56		Rep. of Korea	0,81	Switzerland	3,78	
7			Tunisia	1,97		China, Hong Kong SAR	0,79	India	3,56	
8			Malaysia	1,66		United Kingdom	0,71	Tunisia	1,97	
9			Rep. of Korea	1,44		Thailand	0,69	Malaysia	1,66	
10			Japan	1,17		Japan	0,63	Rep. of Korea	1,44	
1			China	74,89		China	76,66	China	70,89	
2			Türkiye	5,37		USA	5,03	USA	5,84	
3			United Kingdom	3,00		Viet Nam	2,35	Türkiye	5,37	
4			Viet Nam	2,69		India	2,18	United Kingdom	3,00	
5	630790	Textiles, n. e. c.	Tunisia	2,62	0,57	Mexico	2,06	Viet Nam	2,69	0,51
6			Morocco	2,17		Türkiye	1,95	Tunisia	2,62	
7			USA	1,84		Chile	1,54	Morocco	2,17	
8			India	1,27		China, Hong Kong SAR	0,71	India	1,27	
9			Thailand	0,95		United Kingdom	0,65	Thailand	0,95	
10			China, Hong Kong SAR	0,80		Rep. of Korea	0,60	China, Hong Kong SAR	0,80	

DOI 10.17104/0044-2348-2025-4-1119