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Research Report

The role of maritime chokepoints for German international trade

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The Role of Maritime Chokepoints for German International Trade

Study commissioned by the Federal Ministry for Economic Affairs and Energy (BMWE)

Philip Bodenschatz, Lukas Eberth, Katharina Erhardt, and Lisandra Flach

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The Role of Maritime Chokepoints for German International Trade

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Study commissioned by the Federal Ministry for Economic Affairs and Energy (BMWE)

Abstract

Maritime transportation is central to Germany's international trade, with about half of extra-EU imports and exports relying on sea transport. Much of this trade is routed indirectly through a small number of global hubs, leaving Germany highly exposed to disruptions at key maritime chokepoints. Using data on shipping routes, this report quantifies Germany's dependence on six major chokepoints: the Strait of Hormuz, the Strait of Bab el-Mandeb, the Strait of Malacca, the Strait of Taiwan, the Suez Canal, and the Panama Canal. Results show that in 2023, nearly ten percent of German imports passed through the Suez Canal, with similarly high reliance on the Bab el-Mandeb, Malacca, and Taiwan straits, while dependence on the Strait of Hormuz was below one percent. Dependence varies substantially across products, sectors, and trading partners: some products rely almost exclusively on a single chokepoint, while others are diversified; trade with certain countries can be affected by up to five chokepoints simultaneously. The analysis underscores Germany's vulnerability to disruptions in global maritime trade and the importance of accounting for product-, partner-, and sector-specific dependencies.

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Executive Summary

Maritime transportation plays a critical role in German trade, with approximately 50 percent of Germany's extra-EU imports and exports relying on sea transport. Furthermore, the majority of seaborne trade is shipped indirectly, and maritime trade routes are highly concentrated – around 90 percent of all indirect routes pass through at least one of just fifteen major global hubs (Ganapati et al., 2024). In light of recent geopolitical tensions and disruptions in maritime transportation, this concentration raises important questions about Germany's dependence on key maritime chokepoints.

This report uses large-scale data to quantify the extent to which German imports and exports depend on **six major maritime chokepoints**: the Strait of Hormuz, the Strait of Bab el-Mandeb, the Strait of Malacca, the Strait of Taiwan, the Suez Canal, and the Panama Canal. We summarize the main results as follows:

- **German trade flows pass through multiple critical chokepoints:** Global maritime trade is highly concentrated along a few major shipping routes and transshipment hubs. These routes often pass through strategic chokepoints, where disruptions — such as blockades — can lead to significant economic consequences.
- **A substantial share of German trade depends on specific straits:** In 2023, approximately 9.8 percent of all German imports passed through the Suez Canal, making it the most critical maritime chokepoint. Similar levels of dependence are observed for the Strait of Bab el-Mandeb (9.4 percent), the Strait of Malacca (8.7 percent), and the Strait of Taiwan (7.1 percent). By contrast, less than 1 percent of German imports directly relied on the Strait of Hormuz. Results for exports and for earlier years show comparable patterns.
- **Product-level imports and exports show large heterogeneity:** The dependence on chokepoints varies significantly across products. We offer examples by chokepoint, with additional information available upon request. For instance, in 2023, more than 90 percent of total imports of several relevant products relied on transport through the Suez Canal, while other products showed no or low dependence on this route. This variation is driven by differences in sourcing countries and in the share of trade transported by sea across products. This result emphasizes the importance of accounting for heterogeneity across pro-ducts and trade partners.
- **Dependency of German bilateral trade on major chokepoints varies substantially depending on the trade partner:** Our country-specific results are summarized using world maps by chokepoint. Based on the maritime route probabilities, we show that the dependency of German bilateral trade on each chokepoint varies significantly by trade partner. For instance, disruptions in the Strait of Hormuz would significantly affect imports from the United Arab Emirates but would have minimal impact on trade with India or China. On the other hand, trade with both China and India would be significantly affected by disruptions at the Bab el-Mandeb node.
- **Partners' trade flows might depend on up to five of six maritime chokepoints:** Whereas products coming from Asia are typically transported through multiple chokepoints (up to five), imports from North America and the western part of South America predominantly rely on a single key node - the Panama Canal. The degree of dependence varies also among African countries, reflecting their geographic position.

- **Results using input-output linkages reveal strong heterogeneity across sectors and chokepoints:** Our analysis includes heatmaps to visualize the dependency of industries on each maritime chokepoint. Results reveal that most agricultural and mining sectors rely heavily on the strait of Bab el-Mandeb and the Suez Canal, whereas in manufacturing industries there is a larger heterogeneity.

1 Introduction

Recent crises have vividly demonstrated the vulnerability of international trade to disruptions in maritime transport. Most recently, the attacks by Houthi rebels in the Red Sea have again underscored the importance of certain maritime routes for the global economy, as well as for the economic security of Germany and the European Union. Given that approximately 80 percent of global trade is transported by sea, such disruptions can have far-reaching consequences (UNCTAD,2024). For Germany, roughly 50 percent of Germany's extra-EU imports and exports are transported by sea. A key characteristic of maritime trade is that it is typically indirect and concentrated along a limited number of shipping routes and transshipment hubs. In fact, around 90 percent of indirect trade is channeled through a small number of hubs (Ganapati et al., 2024). These hubs are often located near strategic chokepoints, and a blockade of such chokepoints can result in severe economic impacts.

Although import statistics in Germany, the EU, and elsewhere clearly document the origin of traded goods, they do not provide any information about the maritime routes used in the transportation process. Thus, it is generally unknown to what extent imported products depend on the accessibility of specific maritime chokepoints. Moreover, there are currently no comprehensive estimates of how a blockade of a specific sea route might affect import flows or disrupt global maritime trade as a whole.

This report addresses that gap by quantifying the extent to which German imports and exports depend on six major maritime chokepoints: the Strait of Hormuz, the Strait of Bab el-Mandeb, the Strait of Malacca, the Strait of Taiwan, the Suez Canal, and the Panama Canal.

To this end, we draw on data from Ganapati et al. (2024), who estimate the probability of different containerized maritime routes being used, conditional on the origin and destination countries. These probabilities are derived from satellite-based AIS tracking data that record the actual movements of container ships. We combine this information with detailed product-level data on Germany's exports and imports, disaggregated by mode of transport.

The remainder of the report is structured as follows: we begin by describing the data sources and the methodology used to calculate these shares. We then illustrate how the provided data can be applied and present a series of descriptive analyses highlighting specific partner countries, products, and industries that are particularly dependent on these maritime bottlenecks.

2 Data

2.1 Maritime Trade Route Probabilities

The starting point of our analysis is a publicly available dataset by Ganapati et al. (2024). They provide estimates for the conditional probability that a trade flow between an origin country *i* and a destination country *j* is shipped via an intermediate leg from *k* to *l*.

[1] These probabilities are derived from observed container traffic using data from Automatic Identification System (AIS) transponders, combined with aggregate trade data sourced from the BACI International Trade Database.

A key insight from Ganapati et al. (2024) is that approximately 80 percent of trade is shipped indirectly, typically via additional countries. Therefore, to understand the actual routes and choke points that a shipment from origin *i* to destination *j* passes through, one cannot simply rely on the geographically shortest path. This is precisely the insight we aim to incorporate in this report. We use the data from Ganapati et al. (2024) to estimate the probability that a particular leg from *k* to *l* is used for imports to Germany, conditional on the origin being *i*, or for exports from Germany, conditional on the destination being *j*.[2]

We augment the data by assigning the straits and choke points that are traversed in each leg from *k* to *l*. The methodology is described in Section 3.1.

2.2 German Trade Data by Partner, Product, and Mode of Transport

The German export and import data used in this study are sourced from Eurostat (2025c), and include information on Germany's extra-EU trade, disaggregated by trade partner, mode of transport and product classification.[3] The differentiation by mode of transport enables us to attribute the trade value of a specific good exchanged with a partner country to a particular transportation mode, such as maritime transport. This distinction is crucial because the trade route probabilities we employ are based on containerized maritime trade. As such, they are less informative for imports primarily transported by air. Simply considering the total trade value of a product with a partner country would not provide an accurate assessment of its true dependence on specific straits. To account for this, for each product, we calculate and report the share of Germany's extra-EU trade flows transported by sea.

Additionally, the dataset offers varying degrees of product granularity. We utilize both HS2- and HS6-level data in our analysis to derive broader patterns as well as more detailed insights.

One important limitation of the dataset is that it only includes trade data with extra-EU countries. However, we argue that this does not pose a significant constraint for our study. The rationale is that German trade with EU member states is unlikely to involve the major chokepoints considered in this analysis — except for the Strait of Gibraltar, which we therefore exclude from our final results.

[1] The dataset is available at https://www.sganapati.com/data.html.
[2] Note that these probabilities are estimated and, as such, not all *i–j* pairs necessarily sum to 1. Additionally, the estimates are not constrained to be less than or equal to 1.
[3] The dataset is titled *"Extra-EU trade since 2002 by mode of transport, by HS2-4-6"*.

To capture potential trends over time, we use export and import values (measured in euros) for the years 2019 and 2023. These years were selected to highlight changes between the pre- and post-COVID periods.

The above data allow us to estimate the share of Germany's extra-EU shipments that pass through specific trade routes. To assess the importance of extra-EU shipments within Germany's total trade for any given product category we supplement this with a measure of the extent to which Germany's imports (or exports) of a particular product are sourced from (or destined for) extra-EU countries. For this purpose, we use product-level data on Germany's total exports and imports from Eurostat(2025b).[4]

2.3 Input-Output Data

The use of Inter-Country Input-Output Tables (ICIOTs) provides insights into the dependence of German industries on key maritime transport nodes. It allows us to distinguish between Imports used as inputs for production in Germany and German exports used as inputs in other countries. Using ICIOTs, we extend the analysis by mapping product-level dependencies to specific industries, thereby adding an additional layer of depth.

We use ICIOTs from the Organisation for Economic Co-operation and Development (OECD) (2023), which is available up to 2020 and covers a broad range of partner countries — large coverage is important for our analysis on global trade route probabilities. To minimize distortions from the COVID-19 pandemic's impact on global trade, we use data for the year 2019.

However, as other ICIOTs tables, the OECD ICIOTs do not contain information on the share of products transported by sea, which could lead to bias in the analysis. To address this, we combine ICIOTs data with the aforementioned product-level data from Eurostat (2025c), which include trade by mode of transport. We use correspondence tables from the United Nations Statistics Division (2025) to link product codes to ICIOT industry classifications. Once this mapping is applied, we can determine the share of Germany's industry-specific inputs and outputs transported by sea for each partner country. Using the trade route probability dataset, we then calculate the shares of input and output values that pass through various maritime straits for each industry. This enables the construction of a dataset capturing the dependence of German industries on key maritime transport nodes.

Input and output values in the OECD ICIOTs are reported in current US dollars. To ensure consistency and facilitate interpretation across datasets, we convert these values to euros using exchange rates provided by Eurostat (2025a).

[4] The dataset is titled *"EU trade since 1988 by HS2-4-6 and CN8"*.

3 Methodological Approach

3.1 Maritime Chokepoint Probabilities

Starting from the original dataset by Ganapati et al. (2024), we extract the conditional route probabilities for Germany's exports and imports. This dataset reports the conditional probability that a trade flow between Germany and a partner country passes through a specific leg from *k* to *l*.

We exclude all routes with a probability of less than 1 percent. Due to the estimation procedure applied by Ganapati et al. (2024), every route in the dataset has a non-zero probability by design, even if it was never actually observed. By excluding these low-probability routes, we avoid placing weight on statistical artifacts.

In the next step, we assign to each leg *k–l* the relevant maritime chokepoints — if any — through which the route passes. The chokepoints considered in our analysis are the Strait of Hormuz, Strait of Bab el-Mandeb, Strait of Malacca, Strait of Taiwan, the Suez Canal, and the Panama Canal.

This assignment is performed by grouping countries into geographic regions and determining which chokepoints are crossed when traversing a leg connecting two such regions. The assignment is based on the geographically shortest plausible route for each leg. While we account for the fact that different legs may be used to transport goods between a given origin and destination, we do not have information on the variation in chokepoint usage within a specific leg.

It is important to note that the route data is only provided at the country level, without any detail about the specific ports of origin or destination. This presents a challenge for our assignment, particularly for large countries such as the United States or China, which have multiple ports with varying dependencies on different straits. For example, maritime traffic from Germany to the U.S. via Belgium or the Netherlands may or may not require passing through the Panama Canal, depending on whether the destination port is New York, San Francisco, or Los Angeles. While such variation is indirectly reflected in the route probabilities, it could affect our estimates if port choice varies systematically by product.

The resulting dataset calculates the probability that a given chokepoint is traversed for any trade flow (import or export) between Germany and 185 partner countries and serves as the basis for all subsequent analyses.

3.2 Maritime Chokepoint Probabilities by Trade Flow

The chokepoint probabilities vary by Germany's trade partners, assigning the probability that a particular chokepoint is traversed for each bilateral trade flow. In the next step, we use Germany's trade data by partner country to assess the actual dependence on specific nodes.

To calculate Germany's dependence on individual chokepoints for imports and exports, we assign the chokepoint probabilities to each extra-EU trade flow transported by sea. This allows us to estimate the exposure of these flows to specific nodes. To properly account for the share of sea-transported extra-EU trade in Germany's overall trade, we use data on total German trade flows and on trade by mode of transport to compute two key shares: i) the share of extra-EU trade flows transported by sea in all extra-EU trade flows, and ii) the share of extra-EU trade in Germany's total trade. Using these two shares, we can appropriately weight the dependence on individual chokepoints.

This methodology can be applied both to aggregate trade data and to data disaggregated by product category. The results for aggregate German imports are graphically illustrated in Figure 3. Results by product category are discussed in Section 4.3.

The remainder of the report presents a series of stylized facts based on the described data and methodology.

4 Descriptive Analysis

4.1 Maritime Chokepoint Probabilities by Germany's Trade Partner

To gain an initial understanding of which bilateral trade relationships are most dependent on specific chokepoints, we generate world maps that illustrate the dependence on individual straits for German exports and imports with each partner country. In the main text, we focus on describing the results for German imports, while all corresponding maps and tables for exports are provided in the Appendix.

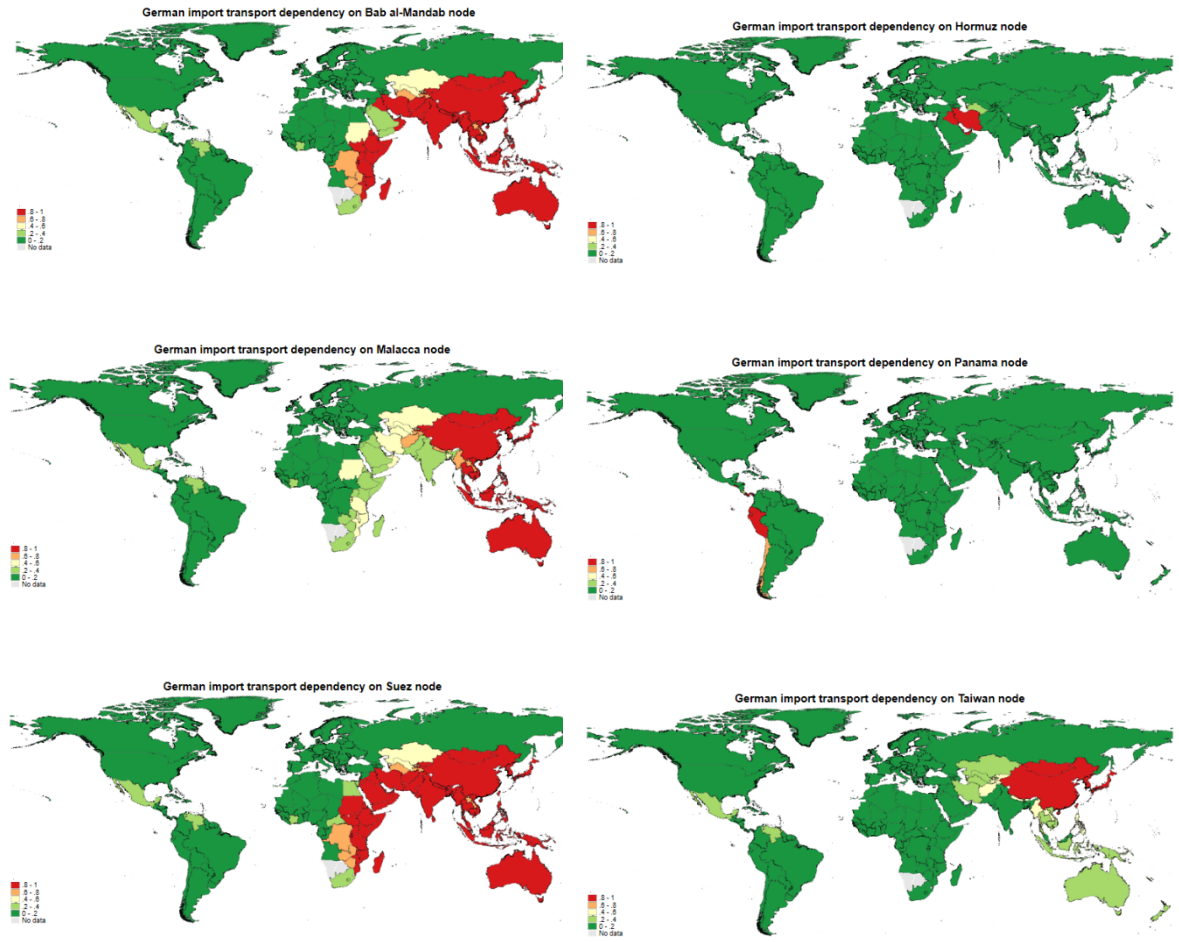
We create separate world maps for each of the six chokepoints considered in this report, as shown in Figure 1. In each of the six displayed maps, orange and red colors indicate a higher probability that maritime transport from the respective trade partner passes through the strait referenced in the map title, while green colors suggest that maritime transport is less dependent on that strait. As expected, the results are primarily driven by geographic factors. For example, disruptions to the Strait of Hormuz would significantly affect imports from the UAE but would have minimal impact on trade with India or China due to their geographic positions. However, political relationships also appear to influence transportation patterns. For instance, Venezuela's political ties with China may explain why some imported goods from Venezuela have a non-negligible probability of being transported via the Suez Canal or the Strait of Taiwan.

As with the import analysis, the corresponding maps for exports are presented in Figure A2 in the Appendix. Additionally, maps for the Strait of Gibraltar—which is excluded from the main analysis when incorporating Eurostat extra-EU trade data—are shown in Figures A3 and A4 in the Appendix.

To identify which import partners' trade flows are particularly dependent on any of the six straits analyzed, we aggregate the strait-specific probabilities and present an additional world map in Figure 2. This figure highlights the overall dependence of Germany's imports from each Partner country on at least one of these critical straits. Imports from Asia typically traverse multiple chokepoints (up to five), while imports from North America and the western part of South America predominantly rely on a single key node — the Panama Canal. Furthermore, the degree of dependence on maritime bottlenecks varies among African countries, reflecting their geographic positions along either the Atlantic coast or the Indian Ocean.

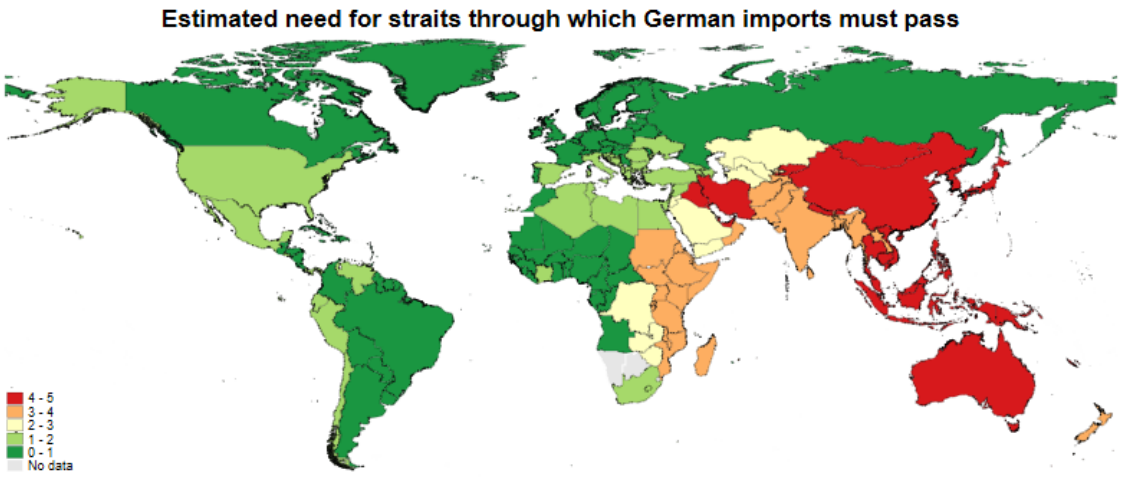
A corresponding map for exports is provided in Figure A1 in the Appendix. The import and export maps are nearly identical, which is expected, as maritime trade typically follows the same primary routes in both directions.

Figure 1 Dependence of German Imports on Maritime Chokepoints: Results by Chokepoint and Partner Country



Notes: The world map presents the estimated probability of passing through the considered node when importing from the displayed countries.
Source: Ganapati et al. 2024, own calculations.

Figure 2 German Imports and the *Number* of Maritime Chokepoints by Partner Country



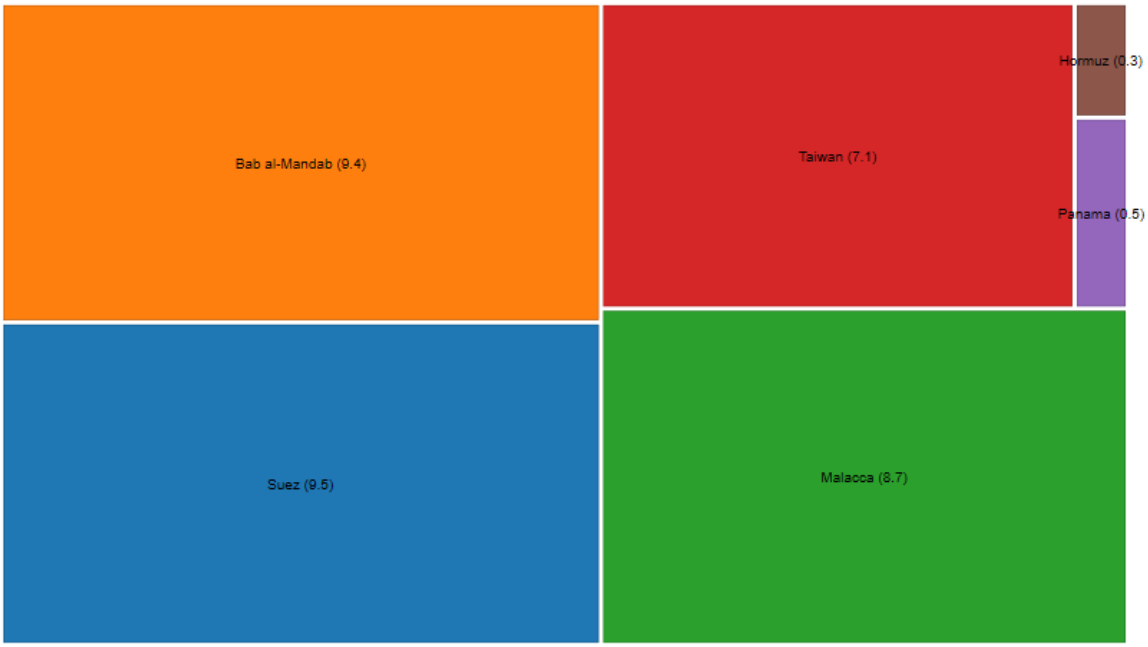
Notes: The index is calculated by summing the estimated probabilities of passing through each of the six considered straits for each bilateral trade pair.
Source: Ganapati et al. 2024, own calculations.

4.2 Dependence of German Trade on Maritime Chokepoints

The world maps visually illustrate the importance of the six straits and chokepoints for partner country-specific imports and exports. However, since countries differ in their overall significance to German trade flows — and in the types of products they trade — the main objective of the analysis is to quantify the extent to which German import and export flows depend on these individual straits.

First, we present results that highlight the dependence of Germany's aggregate imports and exports on specific maritime chokepoints, using the methodology outlined in Section 3.2. We illustrate the dependence on individual straits using treemaps: Figures 3 and 4 show results for imports in 2019 and 2023, respectively, while Figures A5 and A6 in the Appendix show the corresponding results for exports.

Figure 3 Share of German Imports Traversing Bottlenecks in 2019

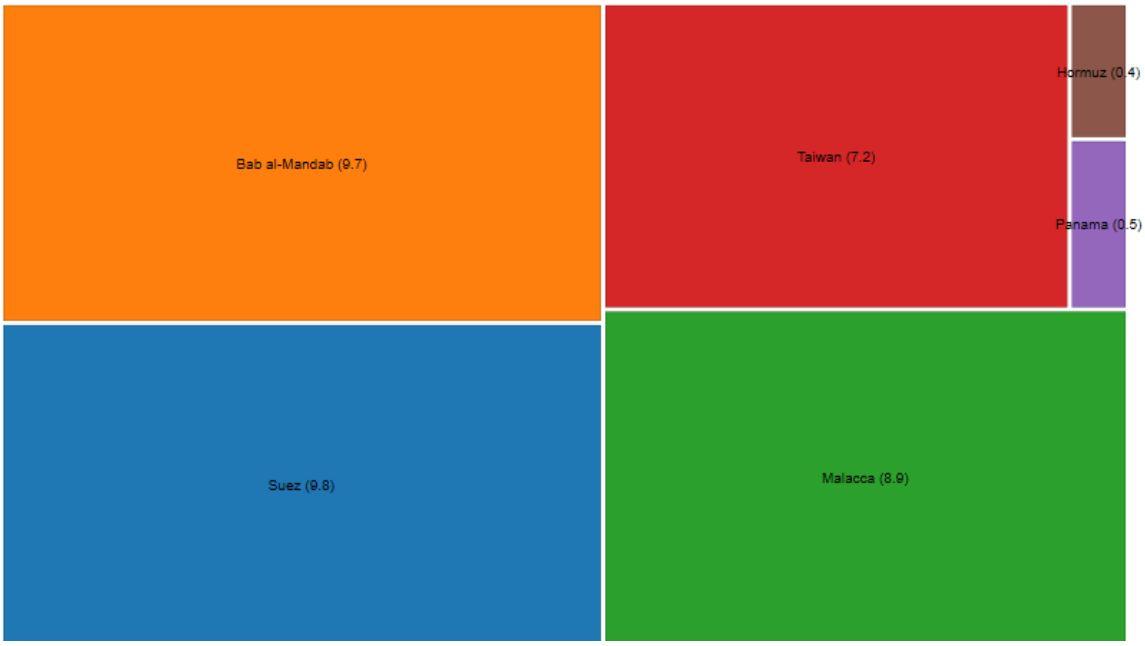


Notes: The displayed shares are calculated by multiplying the proportion of sea-transported extra-EU imports passing through the node by the share of imports from extra-EU countries transported by sea, and the share of Extra-EU imports in total German imports.
Source: Ganapati et al. 2024 and Eurostat, own calculations.

Figure 3 shows that in 2019, approximately 9.5 percent of all German imports passed through the Suez Canal, making it the most critical chokepoint for German seaborne imports. Notably, the Kiel Institute for the World Economy (2021) estimated that around 9 percent of Germany's import value depends on passage through the Suez Canal, reinforcing the plausibility of our methodology. We observe similarly high levels of importance for the Strait of Bab el-Mandeb, the Strait of Malacca, and the Strait of Taiwan. In contrast, the Panama Canal and the Strait of Hormuz are relatively less important. The limited significance of the Strait of Hormuz can be attributed to its Geographic location, as only a few, less relevant partner countries require passage through this node. It is also important to note that estimates for the Panama Canal depend on the final port of destination in the United States.

Figure 4 indicates that the relative importance of the different chokepoints has remained largely unchanged between 2019 and 2023. However, the shares of German exports passing through These chokepoints have decreased across the board during the same period (see Figures A5 and A6 in the Appendix). This decline can be explained by a shift in the destination of German sea-transported exports, with an increase in exports to the United States and a relative decrease in exports to Asian countries, such as China. However, it is difficult to determine whether this shift reflects a long-term trend or is driven by specific factors relevant to the years considered.

Figure 4 Share of German Imports Traversing Bottlenecks in 2023



Notes: The displayed shares are calculated by multiplying the proportion of sea-transported Extra-EU imports passing through the node by the share of imports from Extra-EU countries transported by sea, and the share of Extra-EU imports in total German imports.
Source: Ganapati et al. 2024 and Eurostat, own calculations.

4.3 Dependence of German Product-Level Trade on Maritime Chokepoints

This section provides examples of dependencies by product group. Data from Eurostat allow an analysis of bilateral trade flows at the product level by mode of transportation. Using this data, we identify German sectors and products that rely particularly heavily on transportation by containerships and on each of the chokepoints.

We start by showing the share of imports with high exposure to a particular chokepoint. Aggregating individual product-level imports to the industry they originate from, we calculate the share of Import value for which more than 20 percent depends on the respective chokepoint. Table 1 shows the top 10 sectors with the highest share of imports reliant on a chokepoint, along with the overall exposure by chokepoint (in brackets). For instance, it shows that 31.53 percent of all electrical equipment imported by Germany has at least one fifth of its import value reliant on the Bab el-Mandeb chokepoint. Overall, 16.6 percent of all imported value by Germany has at least one fifth of its value dependent on the Bab el-Mandeb chokepoint. The table highlights substantial heterogeneity in dependence across both chokepoints and sectors, emphasizing the importance of a more granular, product-level analysis.

To further illustrate the substantial heterogeneity across chokepoints and sectors, we provide examples of product categories that are particularly dependent on passage through specific maritime chokepoints. We show bar charts with the share of each product's imports that pass through a given strait. These products are characterized by (i) a substantial share being traded with countries outside the EU and transported by sea, and (ii) the trade routes likely involving one or more of the chokepoints analyzed in this report. For illustrative purposes, we follow the classification proposed by Baur et al. (2022) to identify relevant products. According to this study, a product is considered relevant if it belongs to an important sector and

serves as a key input. In addition, these products are typically characterized by limited possibilities for diversification, and any disruption in their Import supply cannot be easily offset by domestic production. This makes them particularly vulnerable to supply chain disruptions.

Figures 5 to 10 provide examples of imported products that are particularly vulnerable to a chokepoint. Similar figures for exports are provided in Figures A7 to A12 in the Appendix.

Figure 5 highlights that imports of several products rely substantially on the Suez Canal. For example, 97.2 percent of crude mica imports — a product used in the electronics and construction sectors — must pass through the Suez Canal. Overall, the bar charts for imports suggest that a non-negligible portion of raw materials and chemical inputs is transported by sea and sourced from countries whose trade routes involve maritime chokepoints. Notably, the most dependent relevant products for each strait remain largely consistent between 2019 and 2023, reinforcing the view that their reliance on these maritime routes is structural rather than temporary.

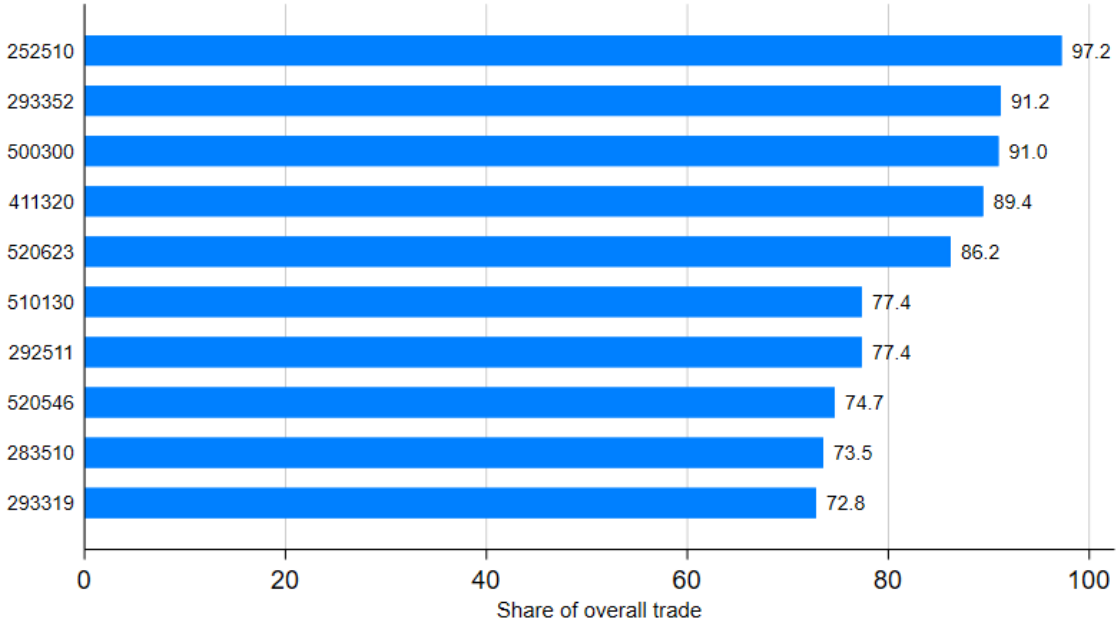
Unsurprisingly, the dependence of the most affected products varies significantly across different straits. For instance, far fewer relevant HS 6-digit products rely on the Strait of Hormuz (see Figure 7 in the Appendix). This is intuitive: no product classified as highly relevant for German industry is imported exclusively from countries like the UAE or Qatar, which would make passage through the Strait of Hormuz unavoidable. In contrast, many of Germany's major trading partners rely on shipping routes that pass through the Suez Canal, resulting in higher levels of dependency.

Another notable pattern is that products requiring passage through the Strait of Taiwan (see Figure 10 in the Appendix) also frequently appear in the charts for the Strait of Malacca, the Strait of Bab el-Mandeb, and the Suez Canal. This is to be expected, as the fastest shipping routes from countries like China and Japan typically pass through all of these chokepoints.

Table 1 Share of Imports with Import Exposure Above 20% on a Single Chokepoint: Top 10 Sectors With Highest Share by Chokepoint

Suez (16.62%)	**Bab-el-Mandeb (16.60%)**	**Malacca (14.59%)**
Textiles, leather, footwear: 69.64%	Textiles, leather, footwear: 69.64%	Textiles, leather, footwear: 51.51%
Electrical equipment: 31.53%	Electrical equipment: 31.53%	Electrical equipment: 30.52%
Energy-producing mining: 28.33%	Energy-producing mining: 28.33%	Energy-producing mining: 28.24%
Manufacturing nec & repair: 24.01%	Manufacturing nec & repair: 24.01%	Manufacturing nec & repair: 23.95%
Fabricated metal products: 22.84%	Fabricated metal products: 22.84%	Machinery and equipment: 20.01%
Machinery and equipment: 22.52%	Machinery and equipment: 22.40%	Other non-metallic mineral products: 19.25%
Other non-metallic mineral products: 20.05%	Other non-metallic mineral products: 20.05%	Chemical and chemical products: 16.64%
Chemical and chemical products: 18.13%	Chemical and chemical products: 18.04%	Fabricated metal products: 15.84%
Wood and products of wood and cork: 12.59%	Wood and products of wood and cork: 12.59%	Wood and products of wood and cork: 12.59%
Agriculture, hunting, forestry: 12.30%	Agriculture, hunting, forestry: 12.30%	Agriculture, hunting, forestry: 11.58%
Taiwan (9.84%)	**Panama (0.26%)**	**Hormuz (0.02%)**
Electrical equipment: 28.22%	Energy-producing mining: 25.17%	Chemical and chemical products: 0.12%
Textiles, leather, footwear: 23.30%	Food products, beverages and tobacco: 0.29%	Textiles, leather, footwear: 0.06%
Manufacturing nec & repair: 23.05%	Wood and products of wood and cork: 0.02%	Food products, beverages and tobacco: 0.02%
Other non-metallic mineral products: 17.03%	Textiles, leather, footwear: 0.01%	Basic metals: 0.01%
Fabricated metal products: 15.68%		Machinery and equipment: 0.01%
Wood and products of wood and cork: 11.35%		
Motor vehicles, trailers: 10.09%		
Machinery and equipment: 10.02%		
Computer and electronic equipment: 8.32%		
Other transport equipment: 7.15%		

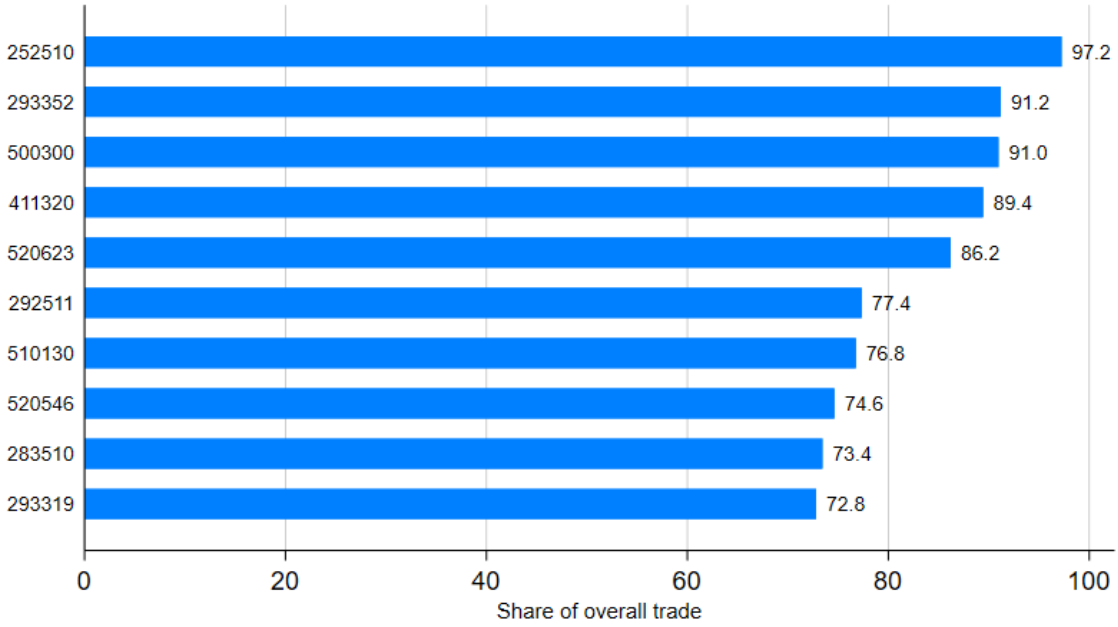
Figure 5 Examples of Imported Products Relying on the Suez Canal (2023)



Code-product transcriptions: 252510 = Crude mica; 293352 = Malonylurea and its salts; 500300 = Silk waste; 411320 = Leather further prepared; 520623 = Cotton yarn, < 85% cotton by weight; 510130 = Carbonised wool; 292511 = Saccharin and its salts; 520546 = Cotton yarn, with density of > 106.38 decitex; 283510 = Phosphinates and phosphonates; 293319 = Heterocyclic compounds

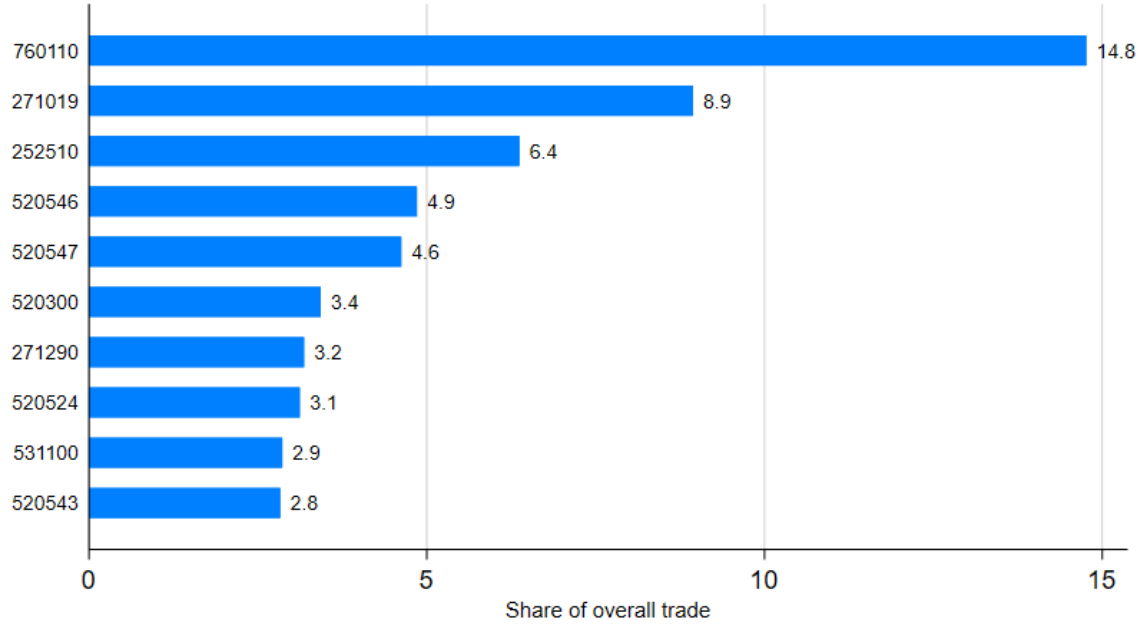
Notes: The displayed shares denote the overall proportion of German imports of the specific HS6-level product, which need to pass through the Suez Canal.
Source: Ganapati et al. 2024 and Eurostat, own calculations.

Figure 6 Examples of Imported Products Relying on the Strait of Bab el-Mandeb (2023)



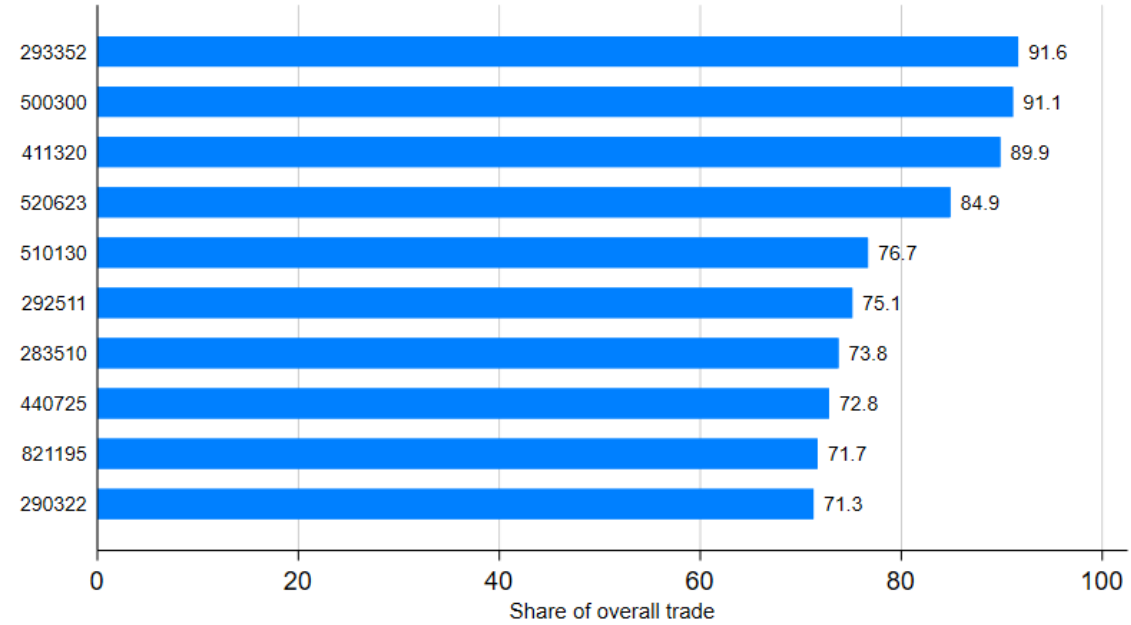
Code-product transcriptions: 252510 = Crude mica; 293352 = Malonylurea and its salts; 500300 = Silk waste; 411320 = Leather further prepared; 520623 = Cotton yarn, < 85% cotton by weight; 292511 = Saccharin and its salts; 510130 = Carbonised wool; 520546 = Cotton yarn, with density of > 106.38 decitex; 283510 = Phosphinates and phosphonates; 293319 = Heterocyclic compounds

Figure 7 Examples of Imported Products Relying on the Strait of Hormuz (2023)



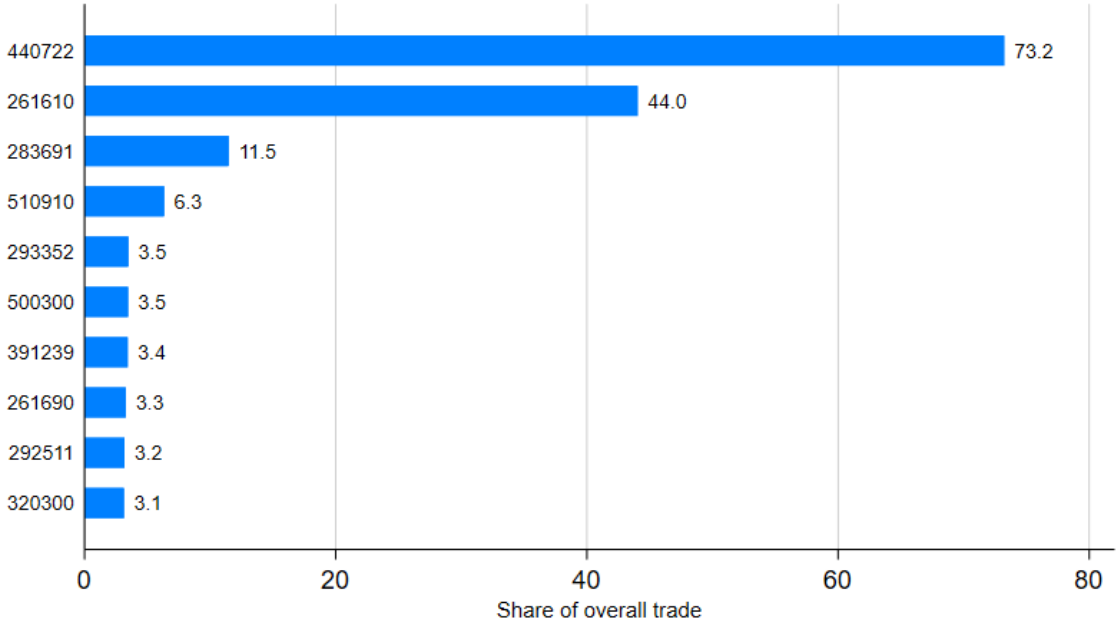
Code-product transcriptions: 760110 = Aluminium, not alloyed, unwrought; 271019 = Medium oils of petroleum n.e.s.; 252510 = Crude mica; 520546 = Cotton yarn, with density of > 106.38 decitex; 520547 = Cotton yarn, with density of < 106.38 decitex; 520300 = Cotton, carded or combed; 271290 = Paraffin wax; 520524 = Cotton yarn, with density of > 125 decitex; 531100 = Woven fabrics of paper yarn; 530543 = Cotton yarn, with density of > 192.31 decitex

Figure 8 Examples of Imported Products Relying on the Strait of Malacca (2023)



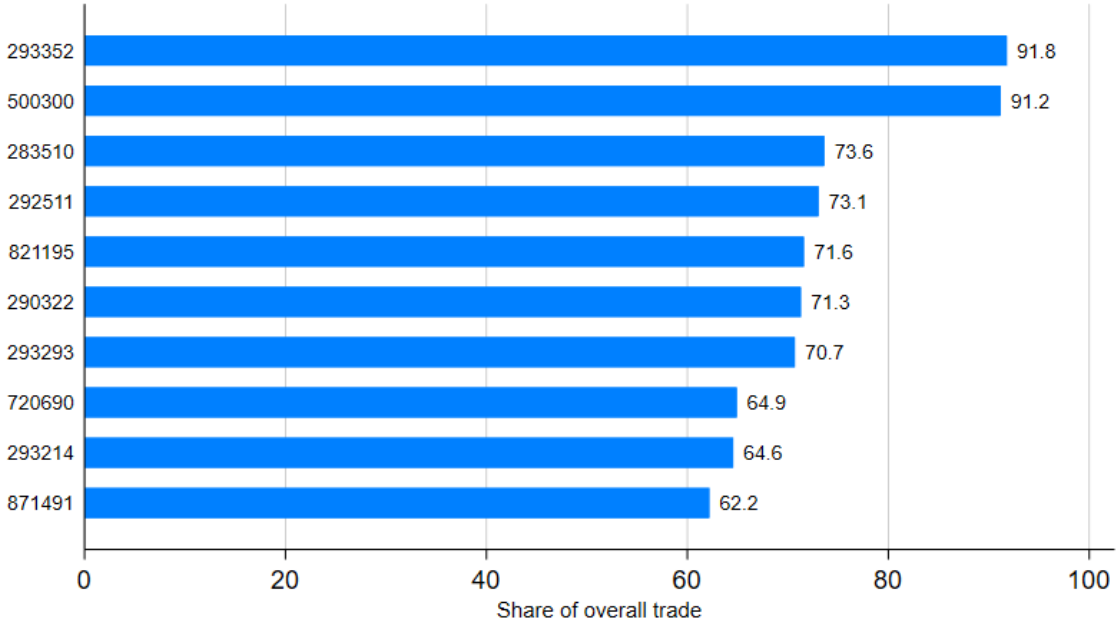
Code-product transcriptions: 293352 = Malonylurea and its salts; 500300 = Silk waste; 411320 = Leather further prepared; 520623 = Cotton yarn, < 85% cotton by weight; 510130 = Carbonised wool; 292511 = Saccharin and its salts; 283510 = Phosphinates and phosphonates; 440725 = Dark red meranti; 821195 = Handles of base metal for knives; 290322 = Trichloroethylene

Figure 9 Examples of Imported Products Relying on the Panama Canal (2023)



Code-product transcriptions: 440722 = Virola, imbuia and balsa; 261610 = Silver ores and concentrates; 283691 = Lithium carbonates; 510910 = Yarn containing animal hair; 293352 = Malonylurea and its salts; 500300 = Silk waste 391239 = Cellulose ethers, in primary forms; 261690 = Precious metal ores and concentrates; 292511 = Saccharin and its salts; 320300 = Colouring matter of vegetable or animal origin

Figure 10 Examples of Imported Products Relying on the Strait of Taiwan (2023)



Code-product transcriptions: 293352 = Malonylurea and its salts; 500300 = Silk waste; 283510 = Phosphinates and phosphonates; 292511 = Saccharin and its salts; 821195 = Handles of base metal for knives; 290322 = Trichloroethylene; 293293 = Piperonal 720690 = Iron and non-alloy steel in primary forms; 293214 = Sucralose; 871491 = Frames and forks for cycles, n.e.s.

On the export side, we observe that chemical products and machinery are particularly dependent on maritime routes involving multiple chokepoints (see Figures A7 to A12 in the Appendix).

4.4 Dependence of German Industries on Maritime Chokepoints - Analysis along the Value Chain

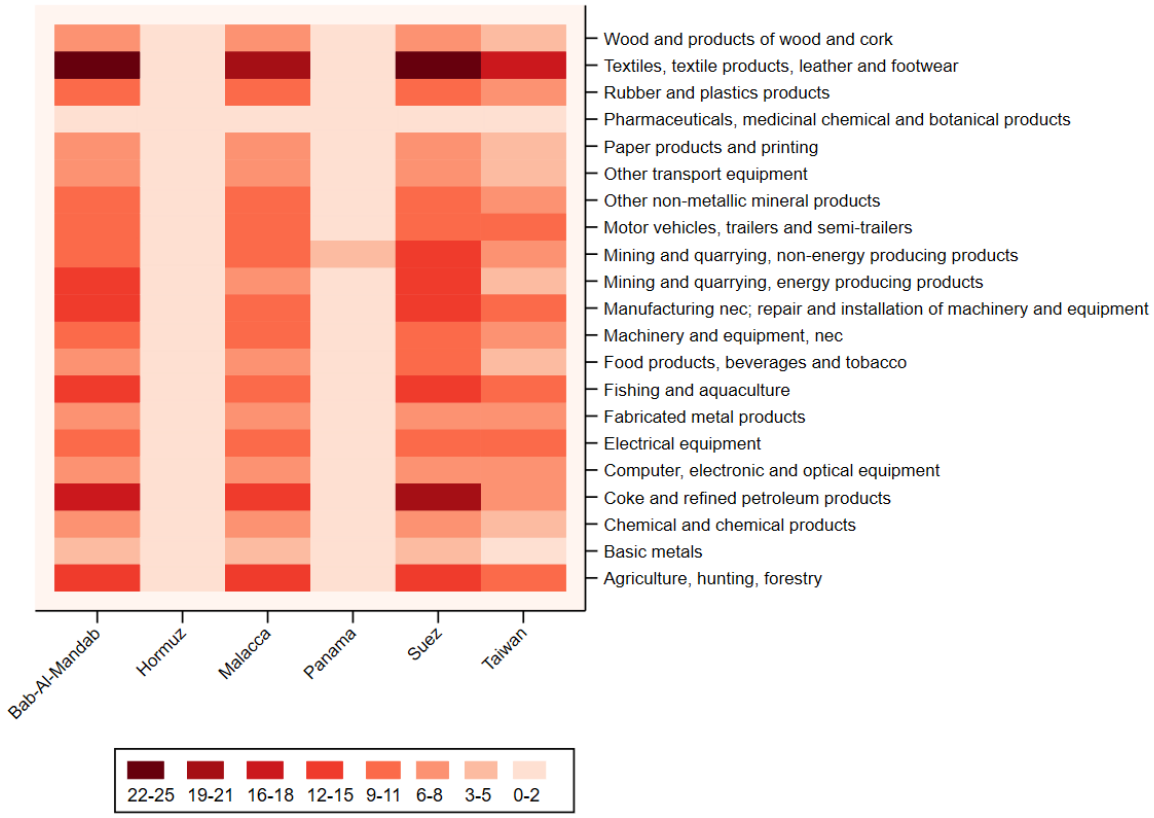
Using input-output data from the OECD, we extend the analysis by looking at the share of imported inputs and exported outputs that have to pass each key maritime chokepoint. Analogously to the analysis at the product level, we construct a table containing information on the share of sea transported input and output values of German industries passing relevant maritime bottlenecks.

To visualize the dependency of various industries on maritime chokepoints, we employ heat plots. These heat plots show the share of imported inputs that transit the six key maritime straits analyzed. The x-axis of each graph represents the chokepoints, while the y-axis lists German industries.

Figure 11 presents the share (in percent) of imported inputs passing through each chokepoint for every industry. For the coke and refined petroleum products industry, the share of Imports transiting the Suez Canal falls between 19–21 percent. The highest dependency is observed in the textiles, textile products, leather and footwear industry. For this sector, 22–25 percent of imported inputs pass through the Bab el-Mandeb Strait and the Suez Canal. Additionally, 19–21 percent pass through the Strait of Malacca, and 16–18 percent transit the Taiwan Strait.

Note that these dependencies do not reflect the relative importance of individual industries within German imports, nor do they account for the criticality of the inputs involved. For instance, although a higher share of imported inputs passes through the Suez Canal for the textiles, textile products, leather and footwear industry compared to the coke and refined petroleum industry, the latter imports a greater absolute volume of inputs via the Suez Canal due to its larger overall trade in inputs.

Figure 11 Share of Imported Inputs Passing Maritime Chokepoints



Notes: The displayed shares (in percent) denote the overall proportion of German imported inputs of an industry, which need to pass the maritime chokepoints.
Source: Ganapati et al. (2024), OECD ICIOT and Eurostat, own calculations.

For most industries, the Bab el-Mandeb Strait and the Suez Canal are of major importance, as they account for the highest shares of imported inputs passing through these chokepoints. Even in sectors with lower overall shares of imported inputs, dependency on maritime straits remains significant. For example, 6–8 percent of total imported inputs in the chemical and chemical products industry rely on the Bab el-Mandeb, Malacca, and Suez straits. Given that these figures represent aggregated import values, they may mask the criticality of specific inputs that are difficult to substitute. As such, even seemingly moderate dependencies can pose substantial risks.

Correspondingly, Figure A13 in the Appendix illustrates the importance of maritime chokepoints for outputs produced in Germany that are exported and used as inputs in other countries.

5 Conclusion

Geopolitical risks and recent disruptions in maritime transportation have raised important questions about the significance of key chokepoints for German trade. With approximately 50 percent of Germany's trade with non-EU countries being transported by sea, it is essential to evaluate the importance of these chokepoints for the German economy.

In this study, we have combined three data sources to evaluate the importance of key chokepoints. First, we create a data for the six main maritime chokepoints based on Ganapati et al. (2024), who provide estimates for conditional route probabilities derived from AIS worldwide observed container traffic data. Second, we combine this data with product-level bilateral trade data from Eurostat, which contains information on import and export flows by product, bilateral country pair, and transport mode (e.g. sea transportation). Third, we match this database with Input-Output tables to infer industry-level effects.

We show that a substantial share of German trade depends on specific chokepoints. In 2023, approximately 9.8 percent of German imports passed through the Suez Canal, making it the most critical chokepoint. But also other key chokepoints are critical for German trade, such as the Strait of Malacca (8.7 percent of imports), the Strait of Bab el-Mandeb (9.4 percent of imports) or the Strait of Taiwan (7.1 percent).

One key result from our study refers to the product-level heterogeneity of these dependencies. Along the report, we provide a full database containing the product-level dependencies by chokepoint. As an example, we show that roughly 97 percent of all German imports of crude mica or 30 percent of all German imports of printed circuits pass through the Suez Canal. At the same time, 92 percent of all German imports of malonylurea (chemical compound often used in herbicide formulations) is reliant on the Strait of Taiwan. This significant heterogeneity underscores the need for a thorough evaluation of German supply chains and their dependence on critical chokepoints.

This study provides an initial analysis of the importance of maritime chokepoints for the German economy. Using large-scale data, we highlight key dependencies on each chokepoint at the aggregate level and substantial heterogeneity across products and trade partners. Future work could build upon this foundation to evaluate the potential risks and vulnerabilities associated with each chokepoint and to assess the costs and feasibility of alternative shipping routes.

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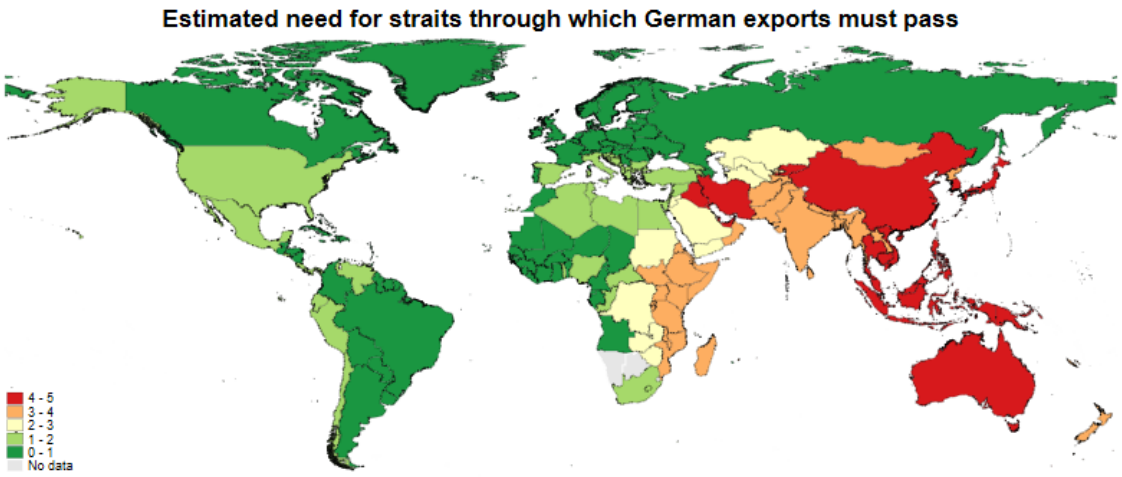
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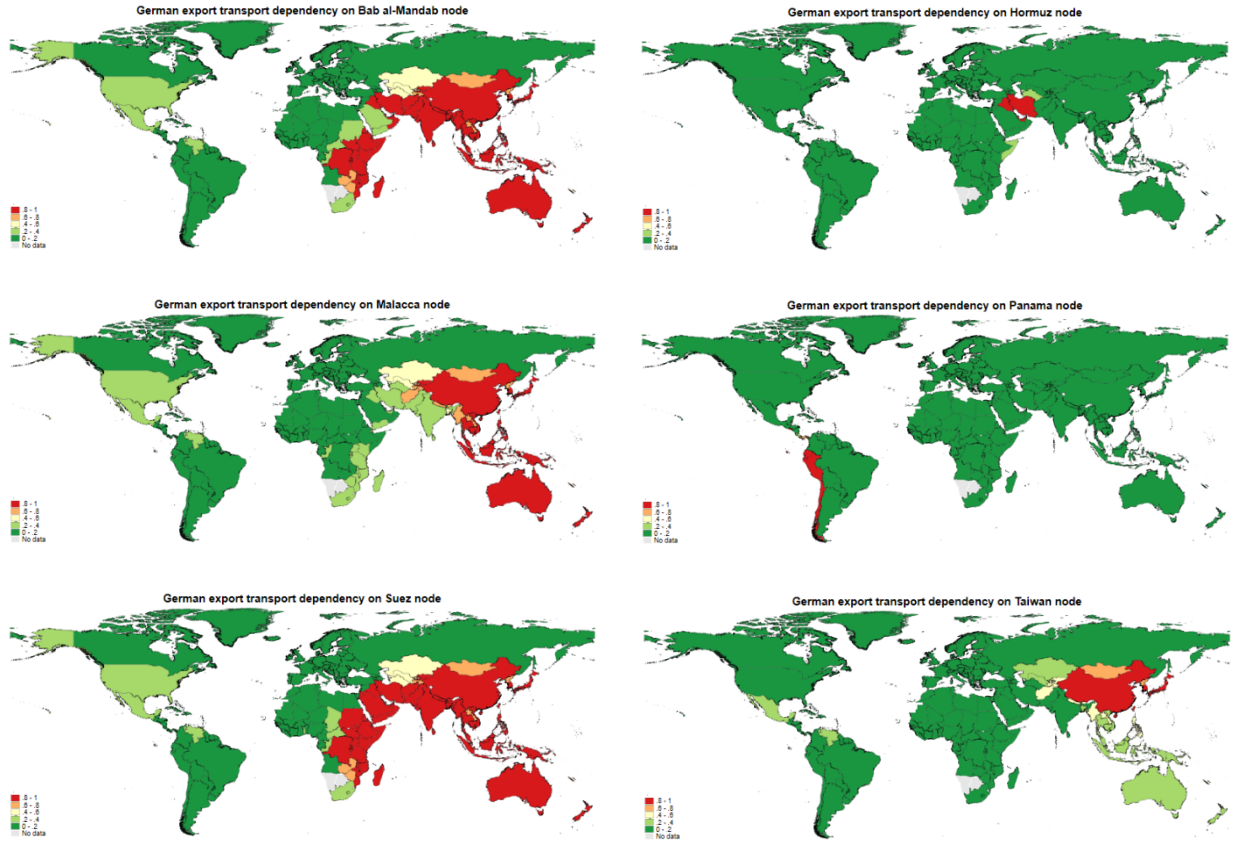
A Additional Figures

Figure A1 German Exports and Maritime Chokepoints



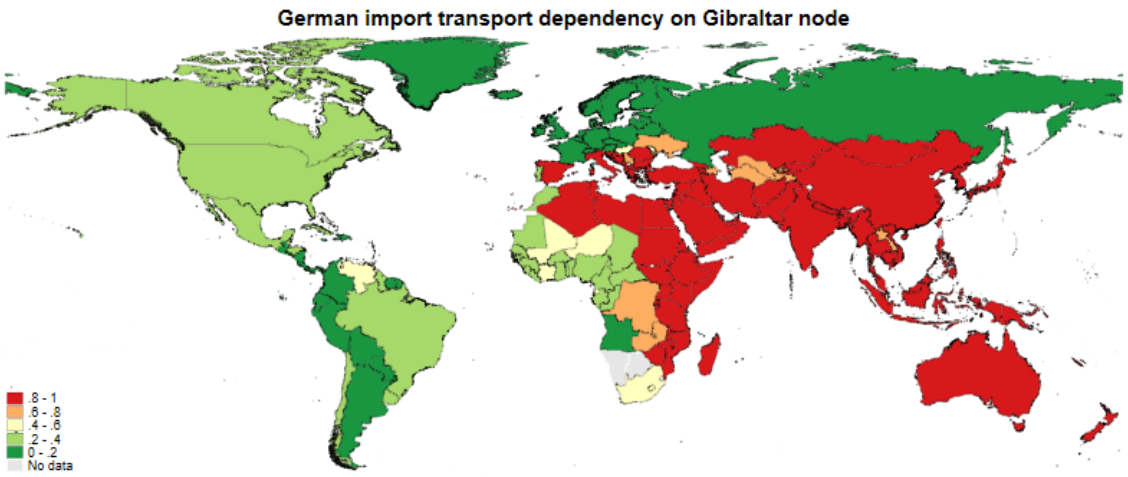
Notes: The index is calculated by summing the estimated probabilities of passing through each of the six considered straits for each bilateral trade pair.
Source: Ganapati et al. 2024, own calculations.

Figure A2 German Exports and Specific Maritime Chokepoint



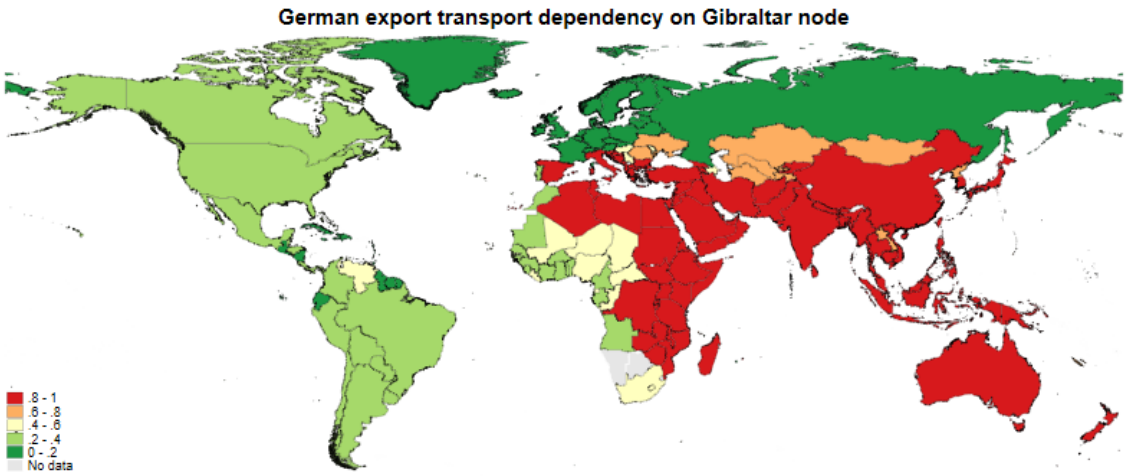
Notes: The world maps present the estimated probability of passing through the considered node when exporting to the displayed countries.
Source: Ganapati et al. 2024, own calculations.

Figure A3 German Imports and the Dependence on the Strait of Gibraltar



Notes: The world map presents the estimated probability of passing through the considered node when importing from the displayed countries.
Source: Ganapati et al. 2024, own calculations.

Figure A4 German Exports and the Dependence on the Strait of Gibraltar



Notes: The world map presents the estimated probability of passing through the considered node when exporting to the displayed countries.
Source: Ganapati et al. 2024, own calculations.

Figure A5 Share of German Exports Traversing Bottlenecks in 2019

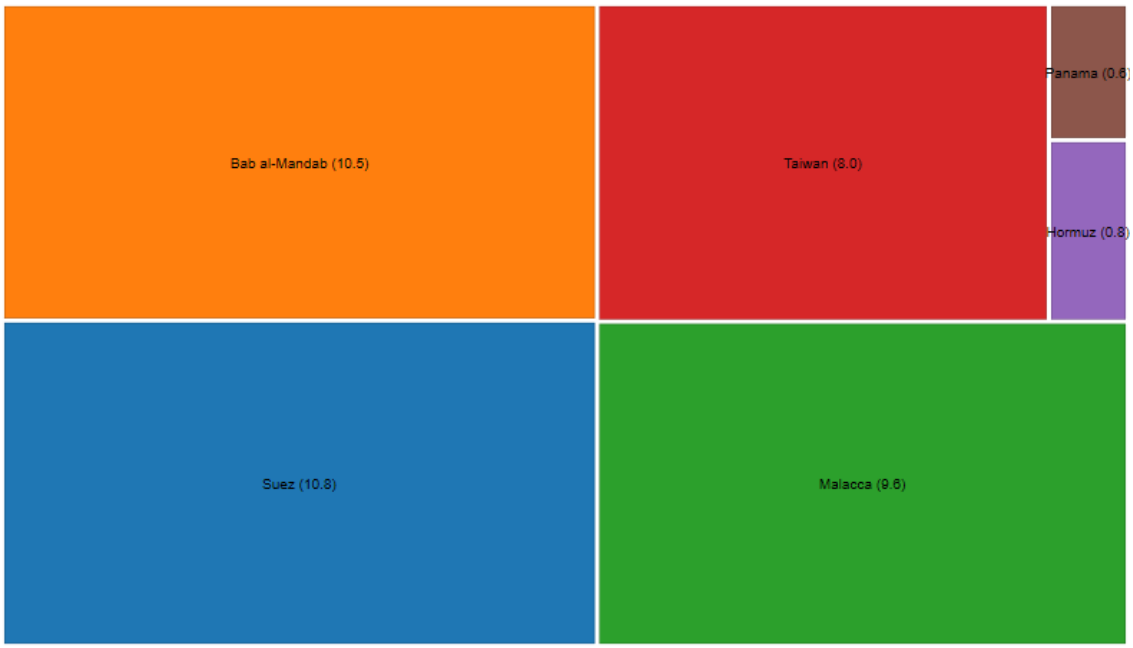


Figure A6 Share of German Exports Traversing Bottlenecks in 2023

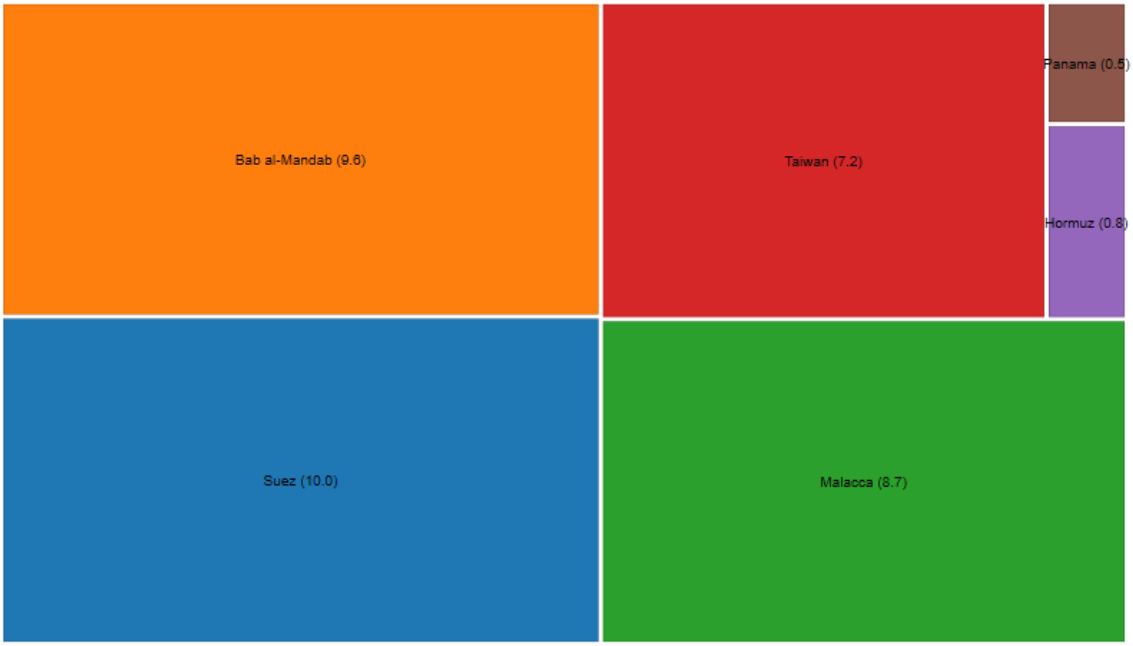
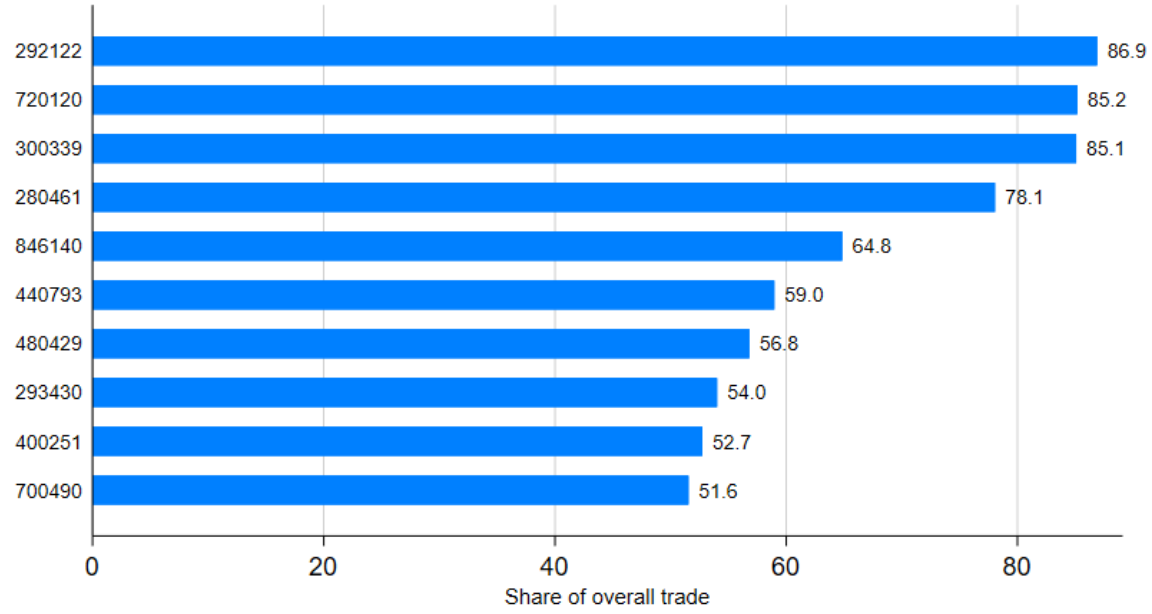


Table A1 Share of Exports With Export Exposure Above 20% on a Single Chokepoint: Top Ten Sectors With Highest Share by Chokepoint

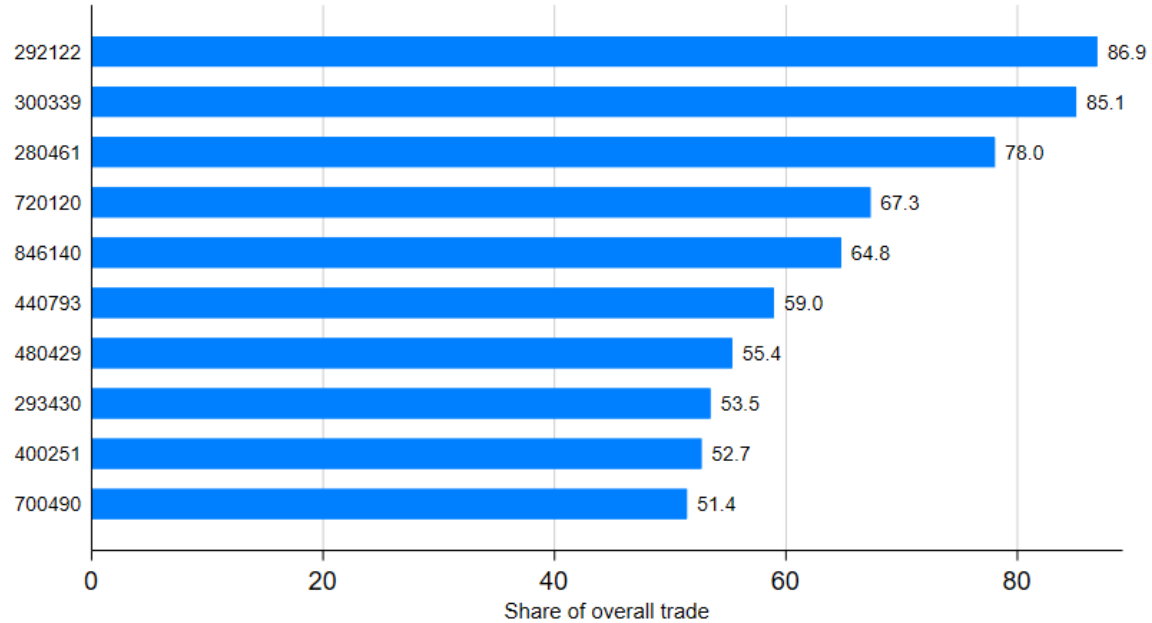
Suez (13.29%)	**Bab-el-Mandeb (12.23%)**	**Malacca (9.03%)**
Motor vehicles, trailers: 35.25%	Motor vehicles, trailers: 33.33%	Motor vehicles, trailers: 28.76%
Wood and products of wood and cork: 28.41%	Wood and products of wood and cork: 28.41%	Machinery and equipment: 11.24%
Machinery and equipment: 23.27%	Machinery and equipment: 20.19%	Energy-producing mining: 8.72%
Chemical and chemical products: 13.32%	Chemical and chemical products: 12.00%	Agriculture, hunting, forestry: 8.63%
Agriculture, hunting, forestry: 8.76%	Agriculture, hunting, forestry: 8.76%	Wood and products of wood and cork: 7.78%
Energy-producing mining: 8.72%	Energy-producing mining: 8.72%	Chemical and chemical products: 7.54%
Other non-metallic mineral products: 8.23%	Basic metals: 7.07%	Other non-metallic mineral products: 4.57%
Basic metals: 7.85%	Other non-metallic mineral products: 6.49%	Food products, beverages and tobacco: 4.39%
Electrical equipment: 5.76%	Electrical equipment: 5.72%	Basic metals: 4.34%
Paper products and printing: 5.66%	Food products, beverages and tobacco: 5.55%	Electrical equipment: 3.9%
Taiwan (7.56%)	**Hormuz (0.01%)**	**Panama (0.00%)**
Motor vehicles, trailers: 27.86%	Fishing and aquaculture: 0.74%	Food products, beverages and tobacco 0.01%
Agriculture, hunting, forestry: 8.21%	Fabricated metal products: 0.11%	
Machinery and equipment: 7.08%	Machinery and equipment: 0.06%	
Chemical and chemical products: 4.82%	Basic metals: 0.01%	
Other non-metallic mineral products: 3.86%		
Electrical equipment: 3.48%		
Basic metals: 2.80%		
Paper products and printing: 2.70%		
Wood and products of wood and cork: 2.37%		
Computer and electronic equipment: 1.71%		

Figure A7 Examples of Exported Products Relying on the Suez Canal (2023)



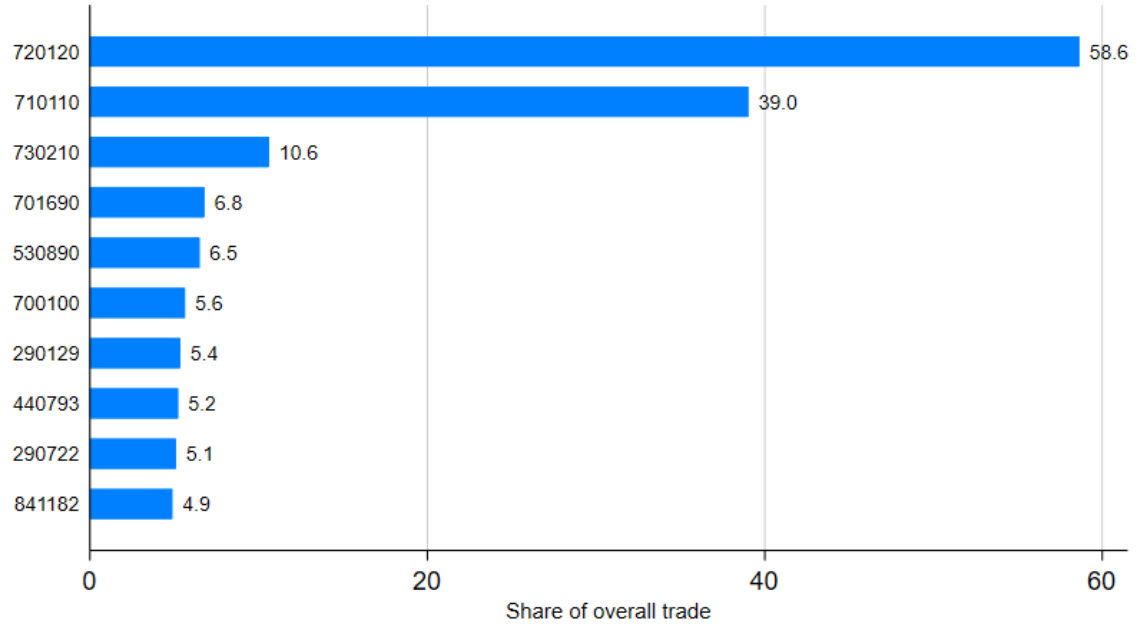
Code-product transcriptions: 292122 = Hexamethylenediamine and its salts; 720120 = Non-alloy pig iron containing > 0.5% phosphorus; 300339 = Medicaments containing hormones or steroids; 280461 = Silicon; 846140 = Gear cutting machines for metals or cermets; 440793 = Maple sliced or peeled; 480429 = Sack kraft paper; 293430 = Heterocyclic compounds; 400251 = Latex of acrylonitrile-butadiene rubber; 700490 = Sheets of glass;

Figure A8 Examples of Exported Products Relying on the Strait of Bab el-Mandeb (2023)



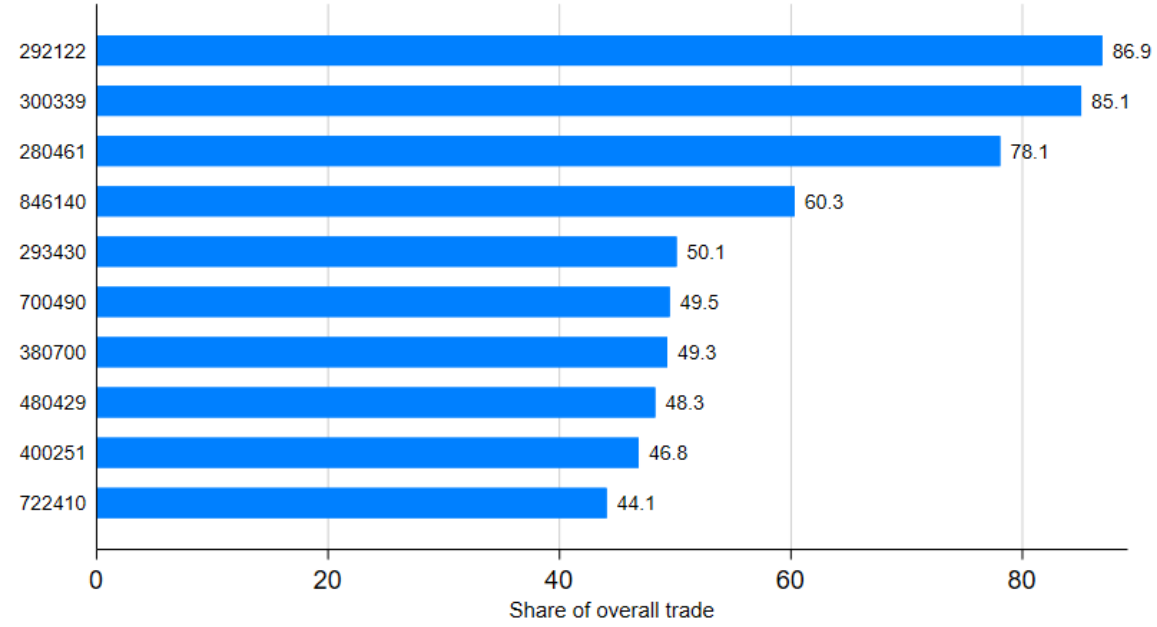
Code-product transcriptions: 292122 = Hexamethylenediamine and its salts; 300339 = Medicaments containing hormones or steroids; 280461 = Silicon; 720120 = Non-alloy pig iron containing > 0.5% phosphorus; 846140 = Gear cutting machines for metals or cermets; 440793 = Maple sliced or peeled; 480429 = Sack kraft paper; 293430 = Heterocyclic compounds; 400251 = Latex of acrylonitrile-butadiene rubber; 700490 = Sheets of glass;

Figure 12 Examples of Exported Products Relying on the Strait of Hormuz (2023)



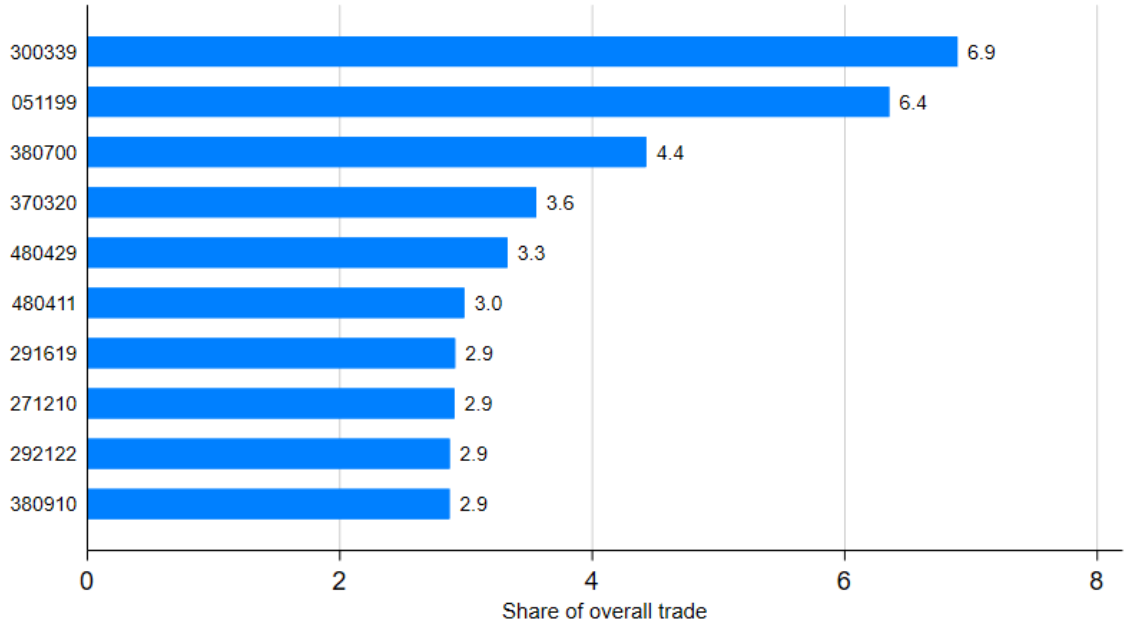
Code-product transcriptions: 720120 = Non-alloy pig iron containing > 0.5% phosphorus; 710110 = Natural pearls; 730210 = Rails of iron or steel; 701690 = Paving blocks or bricks for cosntruction; 530890 = Yam of vegetable textile fibres; 700100 = Cullet and waste of glass; 290129 = Hydrocarbons, acyclic, unsaturated; 440793 = Maple sliced or peeled; 290722 = Hydroquinone quinol and its salts; 841182 = Gas turbines of power > 5000kW

Figure A10 Examples of Exported Products Relying on the Strait of Malacca (2023)



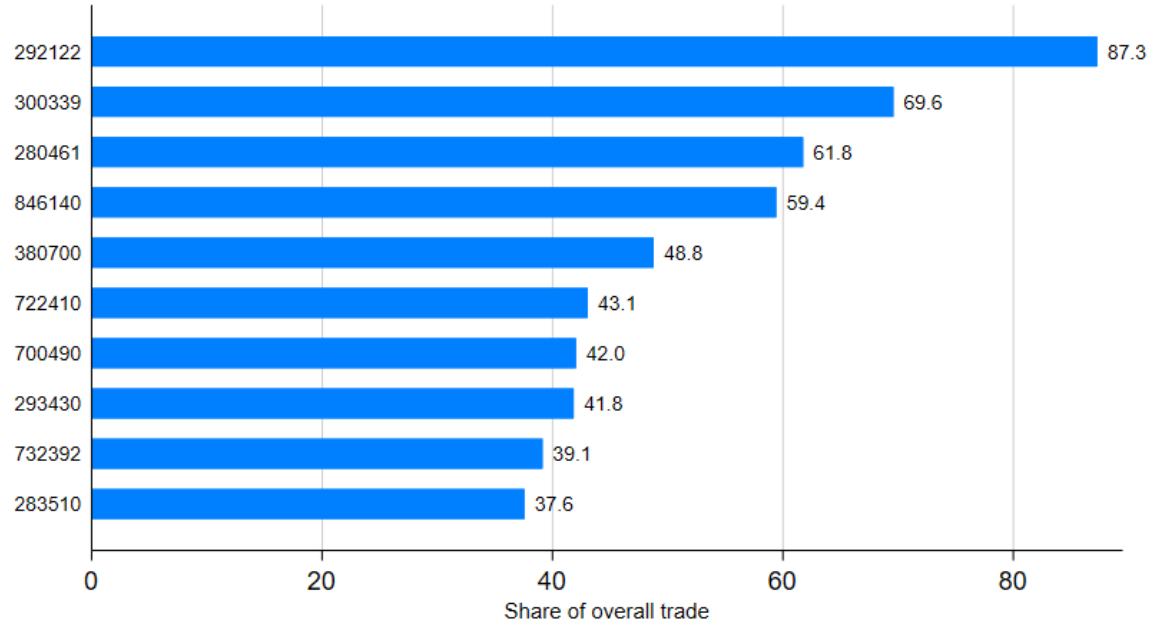
Code-product transcriptions: 292122 = Hexamethylenediamine and its salts; 300339 = Medicaments containing hormones or steroids; 280461 = Silicon; 846140 = Gear cutting machines for metals or cermets; 293430 = Heterocyclic compounds; 700490 = Sheets of glass; 380700 = Wood tar and oils; 480429 = Sack kraft paper; 400251 = Latex of acrylonitrile-butadiene rubber; 722410 = Steel, alloy in primary forms

Figure A11 Examples of Exported Products Relying on the Panama Canal (2023)



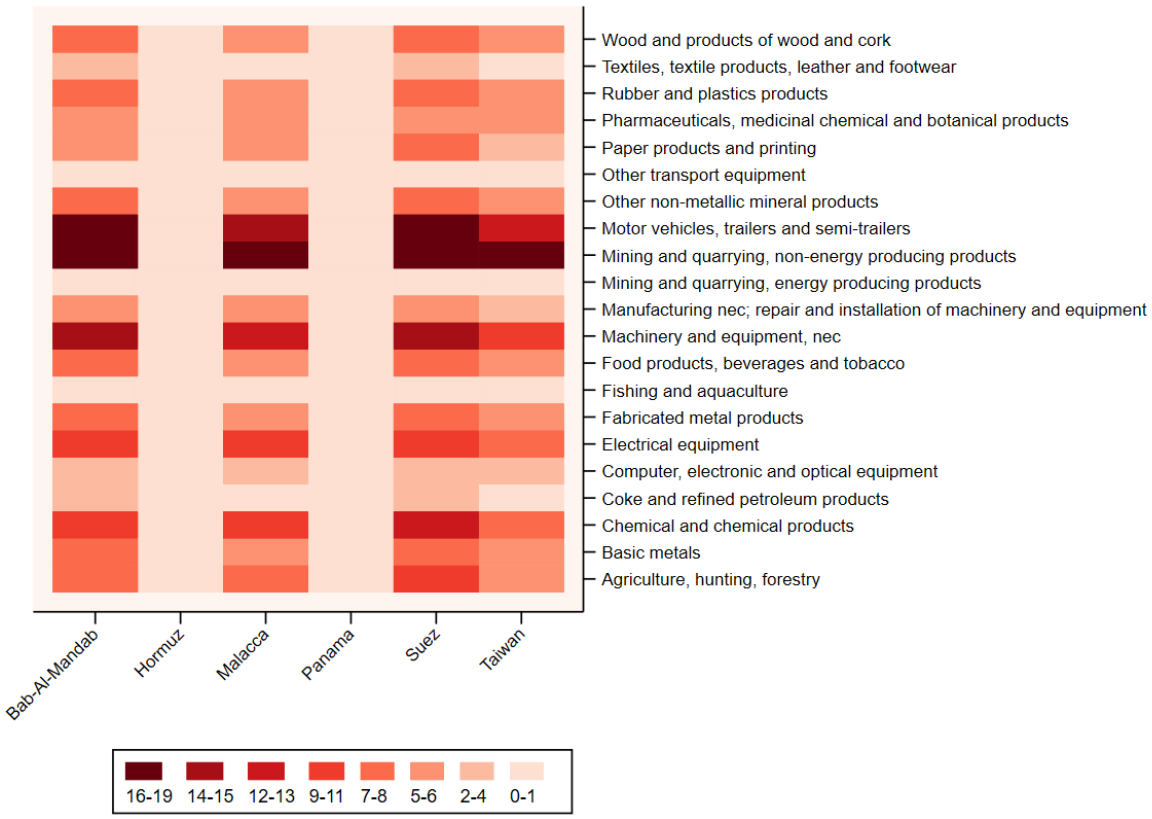
Code-product transcriptions: 300339 = Medicaments containing hormones or steroids; 051199 = Products of animal origin n.e.s.; 380700 = Wood tar and oils; 370320 = Photographic paper; 480429 = Sack kraft paper; 480411 = Unbleached kraftliner with width > 36cm; 291619 = Unsaturated acyclic monocarboxylic acids; 271210 = Petroleum jelly; 292122 = Hexamethylenediamine and its salts; 380910 = Dye carriers to accelerate the dyeing in the textile sector

Figure A12 Examples of Exported Products Relying on the Strait of Taiwan (2023)



Code-product transcriptions: 292122 = Hexamethylenediamine and its salts; 300339 = Medicaments containing hormones or steroids; 280461 = Silicon; 846140 = Gear cutting machines for metals or cermets; 380700 = Wood tar and oils; 722410 = Steel, alloy in primary forms; 700490 = Sheets of glass; 293430 = Heterocyclic compounds; 732392 = Table, kitchen or other household articles of iron; 283510 = Phosphinates and phosphonates

Figure A13 Share of Exported Outputs Passing Maritime Chokepoints



Notes: The displayed shares (in percent) denote the overall proportion of German exported inputs of an industry, which need to pass the maritime chokepoints.
Source: Ganapati et al. 2024, OECD ICIOT and Eurostat, own calculations.

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