

# The risk of maritime chokepoint disruption to Australian trade



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# 1. Background

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## Geopolitical risk

Geopolitical risks to individual companies are varied, complex, and often difficult to evaluate. Similarly to geopolitical risk that exists at a national or regional level, the specific components of geopolitical risk and the severity of the risk is context specific, fluid, and subject to significant change with little or no notice. For these reasons, the components of geopolitical risk cannot be consistently defined. Some examples of factors that may be relevant to an assessment of geopolitical risk include:

- Risks relating to the status of diplomatic relations between a company's home country and the countries from which it imports and to which it exports (or indeed other relevant countries).
- The risk of sanctions and prohibitive tariffs affecting a company's ability to sell its products and services or import products required for its operations.
- The risk of supply chain disruption because of, for example, political instability, conflict, national security concerns, weather, and other events.
- Risks relating to energy security.
- The risk of possibly severe macroeconomic responses to geopolitical or political events.

What is clear from the above list, and a consideration of other factors that may be relevant to an assessment of geopolitical risk, is that supply chains across most industries are exposed, to differing extents, to the risk. Using the above factors to illustrate the point:

- A breakdown of diplomatic relations between a company's home country and a country in which it does a significant amount of business may make such business difficult, or even impossible (even in the absence of sanctions or tariffs). For example, the complete and enduring breakdown of diplomatic relations between the Western world and Russia in 2022 resulted in significant shareholder and public pressure being placed on companies to cease all operations in Russia.
- The risk of sanctions and prohibitive tariffs is self-evident, particularly for those companies that are reliant on one international market for a large proportion of their revenue.
- For the above two reasons, political instability can also cause supply chain disruptions for companies along supply chains. As has been demonstrated by recent events, conflict, such as that in the Middle East, national security concerns, such as those raised in the context of chips imported to the United States from China, and other incidents, such as the blockage of the Suez Canal by the *Ever Given* in 2021, can also disrupt supply chains.
- Energy security concerns can result in export limits on coal and oil from certain countries, thereby raising energy prices and slowing some production process.

- Macroeconomic consequences of events such as the COVID-19 pandemic can add or remove participants from certain industries and increased demand for certain products can result in slower and more expensive shipping, among other things.

As a result of many of the mentioned events, the fragility of global supply chains has become evident in recent years. Both the current conflict in the Middle East and the blockage of the Suez Canal by the *Ever Given* resulted in the effective closure of a major maritime trade route, the effects of which have been well documented.<sup>1</sup>

## Maritime chokepoints

This paper is focused on a group of maritime passages, to which both the Suez Canal and the Red Sea belong, called maritime chokepoints. Maritime chokepoints can be loosely defined as passages of water through which major shipping routes run and which are of strategic significance to maritime trade and operations. The phrase is defined in further detail below. As evidenced by the current conflict in the Middle East, the *Ever Given* incident, the effects of a disruption to maritime chokepoints can be severe and widespread, and are often indirect. Although not a maritime chokepoint *per se*, the recent collision of the ship *The Dali* with the Francis Scott Key Bridge in Baltimore has further demonstrated the vulnerability of maritime infrastructure and passages to all manner of disruptions. Possible consequences of disruption to a maritime chokepoint include:

- Delays in shipping between jurisdictions that are ordinarily reliant on the particular chokepoint, and the associated increased shipping costs (e.g., the current disruption in the Red Sea is adding approximately two weeks to journeys between Asia and Northeast Europe as ships sail via the Cape of Good Hope rather than through the Red Sea and Suez Canal).<sup>2</sup>

<sup>1</sup> See, for example, Fingold, S. (2024, February 20) 'Red Sea attacks: What trade experts are saying about the shipping disruptions', *World Economic Forum*, <https://www.weforum.org/agenda/2024/02/red-sea-attacks-trade-experts-houthi-shipping-yemen/>; Cohen, A. (2024, February 7) 'The World is Going Into the Red from the Red Sea Crisis', *Forbes*, <https://www.forbes.com/sites/arielcohen/2024/02/07/the-world-is-going-into-the-red-from-the-red-sea-crisis/?sh=c02d39754a9b>; Salgado, A. (2024, February 2) 'Red Sea disruptions may drive port congestion, inflation', *Supply Chain Dive*, <https://www.supplychaindive.com/news/Red-sea-crisis-evaluated-house-transportation-committee-hearing/706172/>; United Nations Conference on Trade and Development (2024, January 26) 'Red Sea, Black Sea and Panama Canal: UNCTAD raises alarm on global trade disruptions', *United Nations*, <https://unctad.org/news/red-sea-black-sea-and-panama-canal-unctad-raises-alarm-global-trade-disruptions>; Beattie, A. (2024, January 15) 'The red ink that flows from the Red Sea attacks', *The Financial Times*, <https://www.ft.com/content/260479e1-8e69-47ad-b936-4a11aaa163df>; Wright, R. (2024, January 10) 'Red Sea security fears cut container shipments through Suez Canal', *The Financial Times*, <https://www.ft.com/content/007e8ec6-7124-4e11-b40f-9863bf64df0c>; Ramos, K. G., et al. (2021) 'Suez Canal blockage and its global impact on healthcare amidst the COVID-19 pandemic', *International Maritime Health*, 72(2), 76057; Yee, V., & Glanz, J. (2021, July 17) 'How one of the World's Biggest Ships Jammed the Suez Canal', *The New York Times*, <https://www.nytimes.com/2021/07/17/world/middleeast/suez-canal-stuck-ship-ever-given.html>; Chellel, K., Campbell, M., & Oanh Ha, K. (2021, June 24) 'Six Days in Suez: The Inside Story of the Ship that Broke Global Trade', Bloomberg, <https://www.bloomberg.com/news/features/2021-06-24/how-the-billion-dollar-ever-given-cargo-ship-got-stuck-in-the-suez-canal?embedded-checkout=true>; Segal, E. (2021, March 31) 'Impact of Suez Canal Crisis on Companies Around the World Could Last Weeks', *Forbes*, <https://www.forbes.com/sites/edwardsegal/2021/03/31/impact-of-suez-canal-crisis-on-companies-around-the-world-could-last-weeks/?sh=1b9a81c442d8>; Bell, M. (2021, March 26) 'After the Ever Given: what the ship wedged in the Suez Canal means for global trade', *The University of Sydney*, <https://www.sydney.edu.au/news-opinion/news/2021/03/26/what-the-ship-wedged-in-the-suez-canal-means-for-global-trade.html>; Russon, M-A. (2021, March 21) 'The cost of the Suez Canal blockage', *BBC News*, <https://www.bbc.com/news/business-56559073>.

<sup>2</sup> See, for example, Wright, R. (2024, February 12) 'Ships shun Red Sea and Suez Canal despite reduced Houthi menace', *The Financial Times*, <https://www.ft.com/content/1f0977aa-4b71-4e73-bf36-bf306ef4bbbe>.

- Delays in shipping between jurisdictions that are *not* ordinarily reliant on the particular chokepoint as a result of increased maritime traffic through other chokepoints or shipping channels.<sup>3</sup>
- Disruption to other parts of supply chains as a result of shipping delays (e.g., unavoidable slowdowns in production).
- Increased insurance costs, including in cases where the disruption is caused by conflict or piracy and the chokepoint remains accessible and where additional insurance is required because of longer or more treacherous journeys.

## This paper

A significant body of academic literature has sought to predict the effect of the closure or disruption of different maritime chokepoints on global trade, specific industries, and different countries.<sup>4</sup> This paper builds on that work by examining the exposure of the most commonly imported and exported products into and out of Australia to the risk of disruption to different maritime chokepoints. Given over 90% of Australia's trade is seaborne, this is an important consideration. Using trade data from a variety of sources,<sup>5</sup> this paper makes a number of findings in relation to the exposure of Australian trade to maritime chokepoint disruption. This paper shows that Australian trade is significantly exposed to the risk of disruption of maritime chokepoints in Asia, particularly the East China Sea. In respect of Middle Eastern maritime chokepoints, this paper shows that most trade to and from Australia that passes through the region traverses all of the Suez Canal, the Red Sea, and the Bab-el-Mandeb Strait. Only a small percentage of trade to and from the Middle East passes through the Strait of Hormuz. This paper also shows that the exposure of Australian trade to maritime chokepoint risks in Europe comes from utilisation of the English Channel and Gibraltar Strait, and that there are a number of maritime chokepoints which pose very little direct risk to Australian trade, namely the Danish Straits, the Turkish Straits, the Cape of Good Hope, and the Panama Canal (though there are, nevertheless, risks of indirect impacts from the disruptions of those chokepoints).

The impetus of this paper stems from work undertaken for the purpose of being able to better evaluate the geopolitical risk to potential and existing portfolio companies. This paper also demonstrates how the work can be used for that purpose. The broad concept of geopolitical risk is something that exists in respect of all companies. However, as explained above, the specific components of that risk and the severity of it are context dependent. When considering supply chain

<sup>3</sup> Pratson, L. F. (2023) 'Assessing impacts to maritime shipping from marine chokepoint closures', *Communications in Transportation Research*, 3, 10083, doi:10.1016/j.commtr.2022.10083

<sup>4</sup> See, for example, Wang, X., Du, D., & Peng, Y. (2024) 'Assessing the Importance of Marine Chokepoints: Evidence from Tracking the Global Marine Traffic', *Sustainability*, 16(1), 384, doi:10.3390/su16010384; Pratson, above n 3; Meza, A., et al (2022) 'Disruption of maritime trade chokepoints and the global LNG trade: An agent-based modelling approach', *Maritime Transport Research*, 3, 10071, doi:10.1016/j.martra.2022.10071; Alderson, D. L., Funk, D., & Gera, R. (2020) 'Analysis of the global maritime transportation system as a layered network', *Journal of Transportation Security*, 13, 291-325; Bailey, R., & Wellesley, L. (2017 June) 'Chokepoints and Vulnerabilities in Global Food Trade', *Chatham House*, The Royal Institute of International Affairs; Kitamura, T., & Managi, S. (2015) 'Energy security and potential supply disruption', *Energy Policy*, 110, 90-104, doi:10.1016/j.enpol.2017.08.008; Graham, E. (2015) 'Maritime Security and Threats to Energy Transportation in Southeast Asia', *The RUSI Journal*, 160(2), doi: 10.1080/03071847.2015.1031522; Emmerson, C., & Stevens, P. (2012, January) 'Maritime Chokepoints and the Global Energy System', *Chatham House*, The Royal Institute of International Affairs; Fu, X., Ng, A. K. Y., & Lau, Y-Y. (2010) 'The impacts of maritime piracy on global economic development: the case of Somalia', *Maritime Policy & Management*, 37(7), 677-697, doi: 10.1080/03088839.2010.524736.

<sup>5</sup> Set out on pages 10-14 below.

risk, for example, there is value in knowing the extent to which a particular company is exposed to the consequences of geopolitical events in different regions.

Whilst the results reported in this paper are static and reflect our assessment as at the time of writing, the underlying work, particularly that relating to identifying the import and export routes to and from Australia, can be used in the future in respect of specific industries and companies.

It is also important to note that the type of risk discussed in this report does not exist in isolation. Thus, even if a company's supply chain does not appear to be particularly exposed to the risks associated with maritime chokepoint disruption, the company could nevertheless have significant exposure to broader geopolitical risk. Moreover, as is discussed above, disruption to a maritime chokepoint can have flow-on effects to traders who do not use the relevant chokepoint and to other aspects of supply chains. Accordingly, indirect exposure must always be considered.

This paper proceeds as follows:

- Section 2 defines and identifies the maritime chokepoints considered in this paper.
- Section 3 sets out the data and method used.
- Section 4 sets out our findings of the exposure of Australian trade to the risk of disruption of maritime chokepoints and provides examples of how those findings can be applied to specific industries and companies.
- Section 5 concludes.

## 2. Identifying maritime chokepoints

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Maritime chokepoints are often defined as narrow passages of water through which major shipping routes run and which are of strategic significance to maritime trade and operations.<sup>6</sup> The significance of passages of water that may be defined as maritime chokepoints arises because of the volume of shipping, both merchant and defence, that passes through them, and because alternative routes, to the extent they exist at all, are significantly longer, meaning that avoiding a particular chokepoint makes shipping between two ports more time consuming and costly.<sup>7</sup> Although some passages of water are readily classified as maritime chokepoints (i.e., the Suez Canal and the Panama Canal), there is no one set list of all of the world's maritime chokepoints, as the significance of a particular passage of water can be context dependent. Also, whilst some definitions of maritime chokepoint specify that the passage of water must be narrow, certain large areas of water that are not surrounded by land are often classified as chokepoints because of their prominence in major shipping routes. Such areas of water include the East China Sea, the South China Sea, and the Cape of Good Hope. In this regard, Meza et al.'s definition of maritime chokepoints is arguably more useful: “[w]e may define chokepoints as places where regular sea transit is limited due to their physical capacity and characteristics, but they cannot be bypassed because there are few alternatives (if any) and other routes are way longer, leading to over costs and delays in the supply chain.”<sup>8</sup>

Adopting the broader definition, this paper examines 14 maritime chokepoints. Those chokepoints are shown on the map below. Note that two chokepoints, the Danish Straits and the Turkish Straits, are each a group of small straits. As each group collectively connects the same larger bodies of water, and disruption to one small strait within each group would effectively render the others useless, it is convenient to refer to each group as one individual chokepoint.

Table 1 below provides more information about those chokepoints.

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<sup>6</sup> See, for example, Marine Insight (2021, March 6) What are Maritime Chokepoints?, <https://www.marineinsight.com/marine-navigation/what-are-maritime-chokepoints/>.

<sup>7</sup> Meza et al, above n 7; Rogrigue, J-P. (2005) Straits, Passages and Chokepoints, A Maritime Geostrategy of Petroleum Distribution, *Cahiers de Geographie du Quebec*, vol 48(135), pp 357-274, doi: 10.7202/011797;

<sup>8</sup> Meza et al, above n 7.

Table 1: Global maritime chokepoints



<b>Maritime Chokepoint</b>	<b>Surrounding countries</b>	<b>Connection between (if applicable)</b>	<b>Possible causes of disruption</b>
<b>Danish Straits (Als, Fehmarn, Langeland, Lolland, and Zealand)</b>	Denmark, Sweden, and Germany	Baltic Sea and North Sea	Political decisions (likely targeted), navigational errors (e.g., ship groundings), major accidents, weather
<b>English Channel</b>	England and France	North Sea and Atlantic Ocean	Political decisions (likely targeted), weather, interference from unregulated vessels (e.g., migrant vessels), major accidents
<b>Gibraltar Strait</b>	Spain and Morocco	Atlantic Ocean and Mediterranean Sea	Collisions, interference from unregulated vessels (e.g., migrant vessels), major accidents
<b>Turkish Straits (Dardanelles and Bosphorus)</b>	Türkiye	Aegean Sea, Mediterranean Sea, and Black Sea	Navigational errors (e.g., ship groundings), major accidents, weather
<b>Suez Canal</b>	Egypt	Mediterranean Sea and Red Sea	GPS jamming, armed conflict, navigational errors (e.g., ship groundings), major accidents
<b>Red Sea</b>	Egypt, Sudan, Eritrea, Djibouti, Yemen, Saudi Arabia	Mediterranean Sea (via Suez Canal) and Indian Ocean (via Bab-el-Mandeb Strait)	Armed conflict, piracy
<b>Bab-el-Mandeb Strait</b>	Djibouti, Eritrea, and Yemen	Red Sea and Indian Ocean	Armed conflict, piracy, navigational errors, major accidents
<b>Strait of Hormuz</b>	Iran, Oman, and the United Arab Emirates	Persian Gulf and Indian Ocean (via the Strait of Oman)	Armed conflict, navigational errors (e.g., ship groundings), major accidents, piracy
<b>Cape of Good Hope</b>	South Africa	N/A, but secondary route if Suez Canal, Red Sea, or Bab-el-Mandeb Strait closed and transit passage for vessels travelling through both the Atlantic and Indian Oceans	Piracy, weather
<b>Malacca Strait</b>	Indonesia and Malaysia	Indian Ocean and South China Sea	Deterioration in diplomatic relations, armed conflict, piracy, major accidents, weather



<b>Ombai Strait</b>	Lesser Sunda Islands (Wetar, Atauro, and Timo and the Alor Archipelago)	Indian Ocean and Pacific Ocean	Piracy, weather, major accidents
<b>East China Sea</b>	China, South Korea, Japan, Taiwan, the Philippines	Sea of Japan, South China Sea, and Pacific Ocean (via the Philippine Sea)	Deterioration in diplomatic relations, armed conflict
<b>South China Sea</b>	China, Cambodia, Laos, Myanmar, Taiwan, the Philippines, and Indonesia	East China Sea and Pacific Ocean (via the Philippine Sea)	Deterioration in diplomatic relations, armed conflict, weather
<b>Panama Canal</b>	Panama	Atlantic Ocean and Pacific Ocean	Weather, piracy, navigational errors, major accidents

## 3. Data and method

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### Australia's imports and exports

Department of Foreign Affairs and Trade (DFAT) data was used to identify Australia's top 25 imports and exports for the 2021-22 financial year, being the latest year for which such data is available.<sup>9</sup> Given the purpose of this paper, imported and exported services (e.g., education-related travel services and professional services) were excluded from the data set. For reasons related to data availability, the category "gold coin & legal tender coin" was also later removed from the list of Australia's top exports. This left 20 imported products and 19 exported products.

### Australia's trading partners

Data from the UN Comtrade Database, a database which "aggregates detailed global annual and monthly trade statistics by product and trading partners" and which covers over 99% of global trade,<sup>10</sup> was then used to identify the countries with which Australia trades each product included in the DFAT data and the value of the trade of those products with each relevant partner country. It was decided to use the trade value between Australia and its partner countries, as opposed to the volume of products traded, to enable a consistent analysis across different types of products. The UN Comtrade Database uses the calendar, not financial, year, and 2022 data was used for this paper. It is not, therefore, the case that the UN Comtrade data exactly reflects the statistics on which the DFAT data is based.<sup>11</sup>

In order to match the DFAT data with UN Comtrade data, it was necessary to assign a classification code to each product category. The UN Comtrade Database utilises three different classification systems, the Harmonized System (HS), Broad Economic Categories (BEC), and the Standard International Trade Classification (SITC). The description of products in the DFAT data most closely resembles that used in the SITC system, and so this system was used. The classification of Australia's top imports and exports are shown in Tables A1 and A2 in the Appendix. Given the nature of SITC codes, there is some risk that the classification of the products in the DFAT data is not entirely accurate. However, for the purpose of this paper, such errors are likely to be relatively immaterial.

Some peculiarities and instances of incompleteness in the UN Comtrade Database meant that slightly different searches were used to find data for Australian imports and exports. The search parameters used for imports and exports are shown in Table 2 below:

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<sup>9</sup> Australian Government (2023, March 6) 'Australia's top 25 imports, goods & services (a)(b) (A\$ million)', Department of Foreign Affairs and Trade, [www.dfat.gov.au/sites/default/files/australias-goods-services-by-top-25-imports-2021-22.pdf](http://www.dfat.gov.au/sites/default/files/australias-goods-services-by-top-25-imports-2021-22.pdf); Australian Government (2023, March 6) 'Australia's top 25 exports, goods & services (a) (A\$ million)', Department of Foreign Affairs and Trade, <https://www.dfat.gov.au/sites/default/files/australias-goods-services-by-top-25-exports-2021-22.pdf>.

<sup>10</sup> United Nations (2022) UN Comtrade Database, <https://comtradeplus.un.org/>.

<sup>11</sup> This is likely also the case for other reasons, such as different reporting and accounting methods etc.

**Table 2: Search parameters used on ComTrade database**

Search parameter	Imports	Exports
SITC Commodity Code	As assessed from DFAT data	As assessed from DFAT data
Periods (year, month)	2022	2022
Reporters	Australia	All [being all countries included in the database]
Partners	All [being all countries included in the database]	Australia
Trade Flows	Import	Import [given the 'Reporters' were importing from Australia]
Modes of Transport	Sea	All

The variation in the search parameters used for imports and exports will inevitably have resulted in some inconsistencies and inaccuracies. As this paper looks at imports and exports separately, the lack of comparability is not an issue. Inaccuracies most likely arise in respect of the value of trade transported by sea. In respect of Australian imports, the total value of different products transported by sea largely aligned with other data sets and estimates. However, when Australian exports were categorised by mode of transport, this was not the case. There was far more consistency when exports by all modes of transport were included. Given approximately 99% of Australia's trade is carried by sea, it is unlikely that including all modes of transport for Australia's exports will have resulted in a significant inaccuracy in the ultimate findings of this paper.<sup>12</sup> Whilst using entirely accurate data would of course be preferable, the nature of global trade data is such that accuracy and consistency is almost impossible to achieve.<sup>13</sup>

In respect of each imported and exported product included in this study, searches of the UN Comtrade Database resulted in a list of countries with which Australia traded the product in 2022 and the trade value (in USD) between the two countries. An example of the data collected from the UN Comtrade Database is shown in Table A3 in the Appendix.

## Shipping routes

Once all the countries with which Australia traded the included products in 2022 were identified, the Fluent Cargo routing tool was then used to identify the maritime chokepoints through which goods traded by sea between Australia and any of the identified partner countries would ordinarily travel. The Fluent Cargo routing tool was used because rather than providing hypothetical routes (as do some other routing tools), Fluent Cargo shows the actual routes between ports that are served by

<sup>12</sup> Pratson, L. F. (2023) 'Assessing impacts to maritime shipping from marine chokepoint closures', *Communications in Transportation Research*, 100083, doi: 10.1016/j.commtr.2022.100083.

<sup>13</sup> Ortiz-Ospina, E., & Beltekian, D. (2018, June 5) 'International trade data: why doesn't it add up?', *Our World in Data*, University of Oxford, <https://ourworldindata.org/trade-data-sources-discrepancies>.

commercial shipping companies (e.g., Maersk, COSCO, MSC, etc.). This is an important point as the nature of commercial shipping operations means that ships do not always take the most direct route between ports and there is some time spent backtracking. This can mean that sea trade between two countries can be exposed to risks relating to maritime chokepoints that do not in fact lie in the waters directly between the relevant countries. For example, some routes between Melbourne and ports in Southern Europe and Northwest Africa traverse the Gibraltar Strait and at least part of the English Channel before turning around and calling at ports to the south (e.g., Limassol in Cyprus).

Consistent with related and similar studies,<sup>14</sup> the following assumptions are made:

1. All trade in and out of any country with more than one seaport occurs through the same principal port, generally being the largest port (by value) in the country. In cases where the Fluent Cargo routing tool did not show routes between Australia and a country's biggest seaport, the route to the country's port closest to its largest port was used. In respect of Australia, it is assumed that all sea trade takes place in and out of Melbourne, being the port that handles the largest volume (by value) of Australia's trade.
2. If there is more than one route or shipping option between Melbourne and a partner country, the fastest route will be used.
3. In respect of landlocked countries, trade takes place through the seaport offering the quickest route to Melbourne (as revealed by the Fluent Cargo routing tool).

Obviously, these assumptions introduce some level of superficiality into the analysis. For example, the effect of the first assumption is to ignore Port Headland in the context of Australia's iron ore exports. The assumptions also do not account for the fact that in some cases, overall transport times for certain products may be reduced by using other means (e.g., road transport or pipelines) to transport products to smaller ports or even seaports in other countries and therefore reduce the amount of time required to transport by sea. This issue is of relevance to African and South American countries, as utilising other forms of transport can reverse the direction of seaborne transport and therefore completely change the chokepoints through which products will travel. That said, a review of alternative transportation routes to and from a selection of partner countries in Africa and South America suggests that, on the whole, the assumption does not cause any significant error in the subsequently estimated exposure of different Australian industries to disruption of different maritime chokepoints.<sup>15</sup>

As shipping routes are complex and rarely direct, separate route searches were conducted for imports from and exports to each partner country.

An example of the results of a search conducted on the Fluent Cargo routing tool is shown in Figure A1 in the Appendix.

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<sup>14</sup> See, for example, Wellesley, L., Preston, F., Lehne, J., & Bailey, R. (2017) 'Chokepoints in global food trade: Assessing the risk', *Research in Transportation Business & Management*, 25, 15-28; Bailey, R., & Wellesley, L. (2017 June) 'Chokepoints and Vulnerabilities in Global Food Trade', *Chatham House*, The Royal Institute of International Affairs.

<sup>15</sup> See Part 2.1 and Appendix A3 in Pratson, above n 3 for a further explanation of these assumptions and their effect on the accuracy of the conclusions in that paper.

## Exposure of Australian trade to maritime chokepoints

The DFAT, UN Comtrade, and Fluent Cargo data was collectively used to ascertain the exposure of Australian trade to the risk that one or more maritime chokepoints is disrupted. Exposure was assessed on a product-by-product basis and by reference to the percentage of total trade value of each included product imported to and exported from Australia that passes through a particular chokepoint. The results are shown in Tables 3 and 4 in the next section. Table 5 shows the percentage of total imports and exports that pass through at least one chokepoint in one of five geographic regions, being Asia, Central America, Europe, the Middle East, and Southern Africa.

Owing to the geographic nature of the Suez Canal, the Red Sea, and the Bab-el-Mandeb Strait, and the fact that ships that traverse all three will not traverse the remaining two if one is closed, where the exact same proportion of a particular product passes through all three areas, the area is considered as the one chokepoint (and referred to below as the Red Sea). However, as there are ports between entrances to the Suez Canal and the Bab-el-Mandeb Strait, not all ships and products that pass through one area will pass through all three. For example, whilst ~14% of barley exported from Australia traverses the Bab-el-Mandeb Strait and the Red Sea, only ~1% passes through the Suez Canal. This is because ~13% of Australia's exported barley is imported by Jordan which, along with some smaller importers, lies south of the Suez Canal. Where different proportions of a product are shipped through the Suez Canal, the Red Sea, and the Bab-el-Mandeb Strait, the areas are dealt with as three separate chokepoints.

The key below shows the risk classification used in Tables 3 and 4. Whilst this is a relatively arbitrary classification used to highlight the different exposure between maritime chokepoints, the volume of seaborne trade into and out of Australia is such that disruption to even a small percentage of the volume of a particular traded good can have significant effects, particularly in relation to costs.

**Key, based on % of imported or exported product that travels through a particular maritime chokepoint**

<b>0%</b>
<10%
10-25%
25-50%
50-75%
>75%

## 4. Exposure of Australian trade to maritime chokepoint risk

### Imports

Table 3: % of products imported into Australia that travel through global maritime chokepoints

Product	Danish Straits	English Channel	Gibraltar Strait	Turkish Straits	Suez Canal	Red Sea	Bab-el-Mandeb Strait	Strait of Hormuz	Cape of Good Hope	Malacca Strait	Ombai Strait	East China Sea	South China Sea	Panama Canal	No chokepoint
Refined petroleum	0.03	0.2	0.2	0.0006	0.3	0.5	0.6	0.001	44.2	33.4	41.8	13.0	0	0.2	
Passenger vehicles	0.4	12.9	14.8	0.2	17.9	0.02	1.5	4.5	4.2	65.5	40.9	0	7.4		
Misc. manufactured items	1.0	7.8	8.0	0.06	10.8	11.2	11.6	0.06	0.8	8.8	4.2	64.8	7.1	0.007	9.1
Goods vehicles	2.4	8.0	8.7	0	12.3	0.02	1.6	5.4	4.3	28.8	64.2	0	13.0		
Telecom equipment	1.0	2.8	3.0	0.1	4.1	0.009	0.04	8.3	2.2	68.2	13.1	0	3.7		
Computers	0.1	0.6	0.6	0.001	0.7	0.003	0.007	3.2	0.5	90.4	2.4	0.002	0.8		
Pharm products (excl. medicaments)	7.8	18.1	20.9	0.1	29.6	0	0.5	22.5	21.9	23.0	2.2	0.4	24.4		
Medicaments (incl. veterinary)	8.6	44.3	48.6	0.2	69.6	0.1	3.2	34.4	29.5	2.4	1.7	0.004	8.4		
Crude petroleum	3.4	3.4	3.4	3.4	17.5	3.4	4.2	39.6	0	0	22.3	0	16.5		

Gold	1.0	1.2	13.8	0	13.8	0.01	4.2	8.2	5.3	0.007	4.7	0	64.6		
Civil engineering equipment	7.4	15.5	15.8	0.03	23.8	0.5	4.1	10.5	7.4	41.7	18.4	0.1	22.4		
Furniture	1.5	3.4	4.5	0.1	8.9	8.9	0.1	0.1	13.3	50.8	72.7	8.3	0.002	1.8	
Electrical equipment	0.4	6.6	6.5	0.3	11.0	0.02	0.05	9.8	4.6	63.5	5.1	0.03	0.6		
Fertiliser	1.5	2.0	9.9	0	10.1	12.0	13.5	36.0	0.06	65.3	5.6	0.2	2.1	2.2	9.4
Prams, toys, games & sporting goods	0.01	1.4	1.4	0.01	3.3	2.7	0.001	0.03	2.8	1.0	78.4	0.3	0.002	0.4	
Plastic articles	1.2	9.4	10.0	0.04	13.5	0.1	0.3	11.3	4.3	62.0	7.8	0.01	7.1		
Household equipment	0.6	10.9	11.6	0.9	18.8	0.01	0.005	15.0	4.8	53.0	13.2	0	1.7		
Misc chemicals	2.1	19.8	21.1	0.04	28.6	0.2	2.0	17.5	8.0	33.2	7.6	0	19.2		
Measuring instruments	5.8	19.9	20.7	0.3	27.6	0.03	0.3	12.9	9.7	40.4	8.5	0.002	18.7		
Medical instruments	3.4	13.5	15.2	0.1	21.1	0.003	0.009	22.1	10.2	42.2	7.1	0.6	18.4		

## Exports

Table 4: % of products exported from Australia that travel through global maritime chokepoints

Product	Danish Straits	English Channel	Gibraltar Strait	Turkish Straits	Suez Canal	Red Sea	Bab-el-Mandeb Strait	Strait of Hormuz	Cape of Good Hope	Malacca Strait	Ombai Strait	East China Sea	South China Sea	Panama Canal	No chokepoint
Iron ore	0	0.1	0.1	0.02		0.1		0	0	0.3	84.1	88.4	84.0	0.01	8.2
Coal	0.7	5.1	5.0	1.3		8.0		0	2.6	29.2	7.4	12.9	0.05	0.6	42.9
Natural gas	0	0.3	0.3	0		0.3		0	0	8.4	21.9	41.9	21.6	0	37.1
Gold	14.0	14.6	14.6	0.5		15.2		1.9	0	35.9	71.5	41.1	56.9	0	4.5
Crude petroleum	0	0	0	0		0		0.9	0	46.2	17.9	42.5	17.9	0	10.5
Wheat	0	0.04	0.1	0		1.4		3.4	0.3	16.2	42.2	28.9	45.2	0	29.5
Aluminium ores and concentrates (incl alumina)	0.5	5.9	3.4	0.3		7.0		38.4	2.4	56.0	32.6	27.8	27.2	0	16.3
Beef	0.4	1.9	1.9	0.002	1.9		2.1	2.7	0.2	9.8	27.7	40.6	26.1	0.1	42.6
Copper Ores	3.6	9.9	11.1	0.4		11.5		0	0	19.6	18.3	22.3	11.9	0	41.8
Meat ex Beef	0.6	4.5	4.5	0.002	3.9		4.9	70.5	0.03	22.9	24.0	27.0	20.8	0.9	46.5
Oil seeds	0	43.3	43.3	0		54.3		13.4	0	69.5	44.0	4.1	3.5	8.2	18.1
Aluminium	0.2	2.1	1.8	0.1		4.5		0.1	2.5	19.0	10.4	18.1	9.1	0.4	47.0
Crude minerals nes	0	1.0	1.0	1.0		2.3		0.5	2.8	46.4	42.4	0.02	23.4	0.01	29.9
Other ores	0.2	4.4	8.2	0.03		8.4		0.2	0.1	17.0	57.2	67.9	53.8	0.3	13.0
Copper	0.002	0.07	0.04	0.03		0.03		0.03	0.09	31.6	49.8	46.8	49.8	0.03	3.3
Refined petroleum	0.04	0.1	0.1	0.003		0.2		0.1	0.1	57.8	11.8	13.9	11.6	0.001	26.1
Wool	1.05	5.0	5.0	1.6		7.0		0.04	2.8	40.2	2.9	1.1	1.4	0.003	58.3
Barley	0.001	13.8	13.8	0	1.1	13.8	13.9	27.0	0	42.9	18.7	1.8	17.6	0	36.9



**Table 5: % of total imports and exports that travel through different geographic regions**

Geographic region (and included maritime chokepoints)	% of total imports that pass through one maritime chokepoint in region	% of total exports that pass through one maritime chokepoint in region
Asia (East China Sea, Malacca Strait, Ombai Strait, South China Sea)	76.8	66.5
Central America (Panama Canal)	0.08	0.3
Europe (Danish Straits, English Channel, Gibraltar Strait, Turkish Straits)	8.1	3.7
Middle East (Suez Canal, Red Sea, Bab-el-Mandeb Strait, Strait of Hormuz)	12.9	6.2
Southern Africa (Cape of Good Hope)	1.0	0.8

## Discussion

### Australian trade

#### Exposure to Asian chokepoints

Tables 3 and 4 provide some useful insights into the exposure of Australian trade to the risk of disruption at different maritime chokepoints.

In respect of both imports and exports, Australian trade is, on the whole, significantly more exposed to the risk of disruption in Asia than in any other part of the world. Overall, ~77% of products imported into and ~66% of products exported out of Australia traverse at least one of the chokepoints in Asia. As shown in Table 5, this is significantly more than the proportion of imports and exports that travel through maritime chokepoints in other regions.

The risk of disruption to Asian maritime chokepoints is most pertinent in respect of the East China Sea. More than 50% of 9 of the top 20 products imported through Australia pass through the East China Sea, along with between 23 and 50% of a further 7 products. Collectively 46% of the top 20 imported products into Australia travel through the East China Sea. The individual product types of which the highest proportions are imported through the South China Sea are computers (~90%), prams, toys, games & sporting goods (~78%), furniture (~73%), telecommunications equipment (~68%), passenger vehicles (~66%), miscellaneous manufactured items (~65%), electrical equipment (~64%), other plastic articles (~62%), and household equipment (~53%). Conversely, none of the crude petroleum imported into Australia travels through the East China Sea. Other products of which only a small proportion travel in the East China Sea include medicaments (~2%), fertiliser (<1%), and gold (<1%).

Although fewer exported products have such significant direct exposure to the East China Sea, 45% of the top 19 exported products still pass through the Sea. These products include, most relevantly, iron ore (~88%), other ores (~68%), copper (~47%), crude petroleum (~43%), and natural gas (~42%). Less than 5% of exported oil seeds, crude minerals (not otherwise specified), wool, and barely ordinarily travel through the East China Sea.

In respect of other Asian maritime chokepoints, the second largest exposure for imports is from the Malacca Strait (~22%), followed by the South China Sea (~18%), and the Ombai Strait (>1%). Fertiliser is the imported product with the most direct exposure to the risk of disruption in the Malacca Strait (~65%), whilst the import of goods vehicles (~64%) and refined petroleum (~33%) are most exposed to that risk in the context of the South China Sea and Ombai Strait respectively.

The exposure is different for exports, of which ~40% pass through the Ombai Strait. The third biggest exposure for exports is the South China Sea (~37%), followed by the Malacca Strait (~18%). Iron ore is the exported product with the largest exposure to both the Ombai Strait and the South China Sea, and ~84% of exported iron ore passes through both areas (mostly en route to China). The largest exposure of exported products to the Malacca Strait arises in the case of oil seeds (~70%).

These findings make clear the exposure of Australian trade to physical conflict involving China (which exists alongside all other risks to Australia and its trade from such events). At least three of the major maritime chokepoints in Asia are at risk of disruption if conflict involving China breaks out (the East China Sea, the South China Sea, and the Malacca Strait). Whilst there are differing views on the likelihood of such conflict occurring in the foreseeable future,<sup>16</sup> the risk exposure ought not be ignored.

### **Exposure to Middle Eastern chokepoints**

In relation to those products that travel through the Middle East, approximately 87% of imports and ~75% of exports traverse each of the Suez Canal, the Red Sea, and the Bab-el-Mandeb Strait. Although this constitutes a relatively small proportion of Australian seaborne trade, the volume of trade that uses those chokepoints is large enough that any disruption to them will have a noticeable effect, as has recently been seen.

In the case of imports, the risk is most severe in respect of medicaments (~70%), pharmaceutical products (~30%), miscellaneous chemicals (~29%), and measuring instruments (~28%), though a not insignificant risk also exists in respect of numerous other products. In the case of exports, the risk is most severe in respect of oil seeds, of which 54.3% of exports pass through the Red Sea. Unlike imports, less than 10% of most other exported products also pass through the Red Sea, the exception being gold (~15%).

As seen in Tables 3 and 4, even when the proportion of a particular product that travels through the Suez Canal, the Red Sea, and the Bab-el-Mandeb Strait differs, the difference is generally negligible. One exception to this is imported fertiliser, of which ~10% passes through all three areas, whilst ~14%

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<sup>16</sup> See, for example, Kuper, S. (2024, February 16), 'All signs point to conflict: Chinese risk factors reveal a bumpy future', *Defence Connect*, <https://www.defenceconnect.com.au/geopolitics-and-policy/13615-all-signs-point-to-conflict-chinese-risk-factors-reveal-a-bumpy-future>; cf. Nye, J. S. (2023, October 3), 'China and America are not destined for war, The Strategist, *Australian Strategic Policy Institute*, <https://www.aspistrategist.org.au/china-and-america-are-not-destined-for-war/>.

passes through the Bab-el-Mandeb Strait (with ~12% passing through just the Red Sea and the Bab-el-Mandeb Strait). The reason for this is the proportion of fertiliser imported from Jordan and Oman.

### **Exposure to European maritime chokepoints**

Vis-à-vis other geographic regions, the exposure of Australian trade to the risk of disruption in European maritime chokepoints is comparatively low. In respect of both imports and exports, the exposure generally stems from utilisation of the English Channel and the Gibraltar Strait, the latter of which is a necessary passage for ships travelling from parts of Eastern Europe, Northern Europe, and Northwest Africa to the Red Sea. Medicaments (~44% and ~49% respectively), pharmaceutical products (~18%, ~21%), and passenger vehicles (~13%, ~15%) are the imported products with the most exposure to disruption in both the English Channel and Gibraltar Strait. The exported products with the most exposure to those areas are oil seeds (~43%), gold (~15%), and barley (~14%), all of which have the same exposure to both chokepoints. Less than 10% of the majority of imported and exported products travel through the English Channel, the Gibraltar Strait, the Turkish Straits, and the Danish Straits, the latter two of which are discussed in the following section.

### **Low risk exposure**

It is clear from Tables 3 and 4 that Australian trade has little exposure to the risk of disruption to the Danish Straits, the Turkish Straits, the Cape of Good Hope, or the Panama Canal. As discussed above, however, a disruption to these chokepoints could have flow-on effects to other chokepoints or the production of materials and other goods used in the manufacturing of products in the form in which that are imported to or exported from Australia.

Similarly, a significant proportion of Australia's exports do not flow through any maritime chokepoint. Much of this trade is with Japan and South-East Asian nations. Again, although there is no direct risk from potential maritime chokepoint disruption to these exports, indirect risk nevertheless exists. For example, although ships travelling from Australia's east coast to Japan do not pass through the East China Sea, conflict in that area may result in an increase in goods travelling into and out of Japan or necessitate ships having to take a wider berth of the East China Sea, both of which would add time and costs to the ordinary journey.

### **Individual industries and companies**

As discussed above, the purpose of the work underlying this paper was to inform the assessment of geopolitical risk to individual industries and companies. The findings are informative in that regard.

By way of example, it is evident that healthcare companies operating in Australia have relatively significant exposure to the risk of disruption to numerous maritime chokepoints in different geographic regions. Relevantly, a significant proportion of imported products used by healthcare companies pass through various maritime chokepoints:

- **Pharmaceutical products:** ~30% pass through the Red Sea, between ~21-23% pass through the Malacca Strait, the Ombai Strait, and the East China Sea, and ~18-21% pass through the Gibraltar Strait and English Channel.
- **Medicaments:** ~70% pass through the Red Sea, ~44-49% pass through the English Channel and Gibraltar Strait, and ~29-34% pass through the Ombai and Malacca Straits.

- **Medical instruments:** ~42% pass through the East China Sea, ~21% pass through the Red Sea, and ~13-15% pass through the English Channel and Gibraltar Strait.

Based on this information, a conclusion that there is a reasonably significant geopolitical risk to the supply chain of healthcare companies in Australia is warranted. Of course, the magnitude of the risk will change over time based on the happening (or not) of events that are likely to disrupt maritime chokepoints. Such companies are also exposed to the indirect risks of disruption to the above discussed and other chokepoints.

Some examples of ASX-listed companies with exposure to the risk of disruption to specific maritime chokepoints are shown in the table below. Note, this table is intended to be illustrative only, it does not reflect our assessment of the entirety of the risk to any given company of disruption to maritime chokepoints, geopolitical events, or any other matter. Moreover, as demonstrated above, individual companies can be, and often are, exposed to risks relating to multiple maritime chokepoints, not all of which may be reflected in Table 6 below.

**Table 6: Examples of companies' exposure to different maritime chokepoints**

Company	Maritime chokepoints	Explanation of exposure
Telstra Group, TPG	East China Sea	Importers of telecommunications equipment
Rio Tinto, BHP, Fortescue	Ombai Strait, South China Sea, East China Sea	Exporters of iron ore
CAR Group Limited	East China Sea, South China Sea, English Channel, Gibraltar Strait	Seller of used cars
Baby Bunting	East China Sea	Importer of prams, toys etc.
Ramsay Healthcare, CSL, Sonic Healthcare	English Channel, Gibraltar Strait, Red Sea, Ombai Strait, Malacca Strait, East China Sea	Importers of pharmaceutical products, medicaments, and medical instruments
BHP	Malacca Strait	Exporter of coal
Northern Star Resources, Newmont Mining	Ombai Strait, South China Sea	Exporter of Gold
Elders	Strait of Hormuz	Indirect exposure relating to the export of meat
Graincorp	English Channel, Suez Canal, Red Sea, Bab-el-Mandeb Strait, Malacca Strait	Exporter of oil seeds
Alumina	Malacca Strait, Ombai Strait, South China Sea, East China Sea	Exporter of alumina
JB Hi Fi, Harvey Norman	East China Sea	Importers of computers and household equipment

## 5. Conclusion

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As noted in the Background section, the impetus for this paper was work undertaken for the purpose of bettering the process by which geopolitical risk to potential and existing portfolio companies is assessed. The underlying work will be used for this purpose going forward.

Beyond that use, this paper has demonstrated the different exposure of Australian imports and exports to the direct risks of disruption to maritime chokepoints. However, indirect risks and other relevant components of geopolitical risk must not be ignored. Geopolitical risk is not static, and must be considered in light of all of the relevant circumstances at the time in question.

This paper has highlighted, in particular, the direct exposure of physical Australian trade to the risk of conflict involving China. Whilst physical disruption to maritime chokepoints is only one facet of this risk, it is, on its own, a material risk to Australian industries and companies, and therefore worthy of ongoing assessment and monitoring.

## Appendix

**Table A1: Classification of Australia's Top 25 Imports (2021-22) According to SITC Classification**

<b>Product</b>	<b>SITC Division Code</b>
Refined petroleum	334
Passenger motor vehicles	781
Freight	89
Telecommunications equipment and parts	764
Goods vehicles	782
Computers	752
Professional services	N/A
Pharmaceutical products (excluding medicaments)	541
Medicaments (including veterinary)	542
Crude petroleum	333
Personal travel (excluding education-related) services	N/A
Gold	971
Furniture, mattresses & cushions	723
Telecommunications, computer & information services	N/A
Technical & other business services	N/A
Charges for the use of intellectual property	N/A
Electrical machinery & parts, nes	771
Fertilisers (excluding crude)	562
Prams, toys, games & sporting goods	894
Plastics articles, new	893
Household type equipment, new	775
Miscellaneous chemical products, new	598
Measuring & analysing instruments	874
Medical instruments (including veterinary)	872

**Table A2: Classification of Australia's Top 25 Exports (2021 -22) According to SITC Classification**

<b>Product</b>	<b>SITC Division Code</b>
Iron ore and concentrates	281
Coal	321
Natural gas	343
Gold	971
Education-related travel expenses	N/A
Crude petroleum	222
Wheat	041
Aluminium ores & concentrates (including alumina)	285
Beef	011
Copper ores & concentrates	283
Telecommunications, computer & information services	N/A
Professional services	N/A
Meat (excluding beef)	012
Personal cultural and recreational services	N/A
Oil-seed & oleaginous fruits, soft	222
Aluminium	684
Technical & other business services	N/A
Crude minerals, nes	272
Other ores & concentrates	287
Copper	682
Financial services	N/A
Refined petroleum	334
Wool & other animal hair (including tops) 651	872
Barley	43
Gold coin and legal tender coin	961

**Table A3: Example of data collected from the ComTrade database**

Results of search for fertiliser (SITC Division 562) imported into Australia by sea in 2022

Period	Flow	Reporter	Partner	Mode	Commodity Code	Trade Value (US\$)
2022	M	Australia	Argentina	Sea	562	\$546,504
2022	M	Australia	Australia	Sea	562	\$770,132
2022	M	Australia	Bahrain	Sea	562	\$80,676,989
2022	M	Australia	Belgium	Sea	562	\$30,031,111
2022	M	Australia	Bolivia (Plurinational State of)	Sea	562	\$34,639
2022	M	Australia	Brazil	Sea	562	\$928,139
2022	M	Australia	Brunei Darussalam	Sea	562	\$34,572,432
2022	M	Australia	Belarus	Sea	562	\$19,661,449
2022	M	Australia	Canada	Sea	562	\$116,357,482
2022	M	Australia	Chile	Sea	562	\$8,018,481
2022	M	Australia	China	Sea	562	\$634,792,715
2022	M	Australia	Colombia	Sea	562	\$125,349
2022	M	Australia	Croatia	Sea	562	\$168,620
2022	M	Australia	Czechia	Sea	562	\$2,550,016
2022	M	Australia	Denmark	Sea	562	\$5,686
2022	M	Australia	Estonia	Sea	562	\$39,209,494
2022	M	Australia	Finland	Sea	562	\$1,371,222
2022	M	Australia	France	Sea	562	\$1,918,471
2022	M	Australia	Germany	Sea	562	\$84,195,090
2022	M	Australia	Greece	Sea	562	\$264,681
2022	M	Australia	China, Hong Kong SAR	Sea	562	\$1,331,444
2022	M	Australia	Indonesia	Sea	562	\$284,702,172
2022	M	Australia	Israel	Sea	562	\$32,996,335
2022	M	Australia	Italy	Sea	562	\$3,290,955
2022	M	Australia	Japan	Sea	562	\$9,541,409
2022	M	Australia	Jordan	Sea	562	\$85,033,910
2022	M	Australia	Rep. of Korea	Sea	562	\$26,114,498
2022	M	Australia	Lao People's Dem. Rep.	Sea	562	\$20,101
2022	M	Australia	Lebanon	Sea	562	\$30,609
2022	M	Australia	Latvia	Sea	562	\$22,730
2022	M	Australia	Lithuania	Sea	562	\$4,799,896
2022	M	Australia	Malaysia	Sea	562	\$342,283,670
2022	M	Australia	Mexico	Sea	562	\$40,131,359
2022	M	Australia	Other Asia, nes	Sea	562	\$13,256,999
2022	M	Australia	Morocco	Sea	562	\$218,363,834



2022	M	Australia	Oman	Sea	562	\$67,971,219
2022	M	Australia	Netherlands	Sea	562	\$27,374,085
2022	M	Australia	New Zealand	Sea	562	\$492,161
2022	M	Australia	Norway	Sea	562	\$27,225,713
2022	M	Australia	Peru	Sea	562	\$820,986
2022	M	Australia	Philippines	Sea	562	\$232,052
2022	M	Australia	Poland	Sea	562	\$1,656,322
2022	M	Australia	Portugal	Sea	562	\$4,783,169
2022	M	Australia	Qatar	Sea	562	\$396,500,105
2022	M	Australia	Russian Federation	Sea	562	\$188,531,639
2022	M	Australia	Saudi Arabia	Sea	562	\$776,481,811
2022	M	Australia	Serbia	Sea	562	\$3,844,495
2022	M	Australia	India	Sea	562	\$4,112,721
2022	M	Australia	Singapore	Sea	562	\$22,316,129
2022	M	Australia	Slovakia	Sea	562	\$976,484
2022	M	Australia	Viet Nam	Sea	562	\$24,458,332
2022	M	Australia	South Africa	Sea	562	\$1,323,583
2022	M	Australia	Spain	Sea	562	\$2,849,506
2022	M	Australia	Sweden	Sea	562	\$382,272
2022	M	Australia	Switzerland	Sea	562	\$291,683
2022	M	Australia	Thailand	Sea	562	\$18,023,650
2022	M	Australia	Trinidad and Tobago	Sea	562	\$96,080,542
2022	M	Australia	United Arab Emirates	Sea	562	\$336,657,350
2022	M	Australia	Türkiye	Sea	562	\$231,508
2022	M	Australia	Ukraine	Sea	562	\$14,815
2022	M	Australia	United Kingdom	Sea	562	\$2,602,156
2022	M	Australia	USA	Sea	562	\$287,879,687


Figure A1: Example of search results from Fluent Cargo

ORIGIN		DESTINATION					
Hamburg (DEHAM)		Melbourne (AUMEL)		Advanced		Search	
<b>Filters</b>							
<b>Ocean Routes</b> 10							
<b>DEWVN</b> Wilhelmshaven		<b>AUMEL</b> Melbourne	34 days 17h Every 1-2 weeks	1 transfer 2+ routes	 1.61t CO <sub>2</sub> Low		▼
<b>DEHAM</b> Hamburg		<b>AUMEL</b> Melbourne	36 days 23h 2-4 times a week	1 transfer 5+ routes	 1.72t CO <sub>2</sub> Low		▼
<b>DEWVN</b> Wilhelmshaven		<b>AUFRE</b> Fremantle	33 days 16h 1-2 times a week	1 transfer 3+ routes	 3.97t CO <sub>2</sub> High		▼
<b>DEWVN</b> Wilhelmshaven		<b>AUBNE</b> Brisbane	40 days 1-2 times a week	1 transfer 2+ routes	 2.9t CO <sub>2</sub> Average		▼
<b>DEWVN</b> Wilhelmshaven		<b>AUSYD</b> Sydney	41 days 2h 1-2 times a week	1 transfer 2+ routes	 2.31t CO <sub>2</sub> Below avg.		▼
<b>DEHAM</b> Hamburg		<b>AUSYD</b> Sydney	44 days 9h Every 1-2 weeks	1 transfer PAROD	 2.85t CO <sub>2</sub> Average		▼
<b>DEHAM</b> Hamburg		<b>AUBNE</b> Brisbane	44 days 21h Every 2-4 weeks	1 transfer PAROD	 3.53t CO <sub>2</sub> High		▼




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