

# International Trade: Revenue & Cost Analysis

Australian Trade 1988-2023

Cyrus Kwan

ID:25466929 Tutor: Dhruv Punjwani

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## EXECUTIVE SUMMARY

### **Purpose**

This report analyses Australian trade import and export commodities from 1988 to 2023 to provide an actionable recommendation with the goal of increasing export revenue and decreasing import costs.

### **Method**

#### **Preprocessing**

New features were created to measure commodity volatility and total trade distribution.

#### **Analysis**

General overview of main trade commodities was conducted identifying machinery as the main import. Further investigation was conducted to determine which sub-commodity most influenced machinery trade. A dashboard was created to evaluate the relationship between vehicle and transport equipment trade. Finally a storyboard was created determining that transport equipment imports responded to declining vehicle exports in 2017.

### **Findings**

1. Australia has a poor/declining manufacturing industry
2. Australia exports large quantities of coal, natural gas, and uranium
3. Australia produces insufficient oil such that it requires additional imports
4. Crude material and mineral fuels are highly volatile and financially risky imports/exports
5. Manufactured goods are some of Australia's most stable imports due to the poor manufacturing industry
6. Australia is a global leader in organic agricultural exports
7. Machinery is the country's largest import while crude materials and mineral fuels are its largest export
8. Vehicles make up a disproportionate amount of Australia's machinery imports
9. Australia saw two sharp declines in vehicle exports in 2009 and 2017
10. Vehicle and transport equipment imports are not correlated. Likewise, vehicle and transport equipment exports are not correlated
11. Aggregated telecommunications, electrical appliances, and industrial machinery overtook vehicle exports in 2017
12. There was a response to the decline of vehicle exports in 2017 from transport equipment imports

### **Conclusion**

Mineral fuels and crude materials are highly volatile and financially risky for international trade. There was a complete closure of domestic automotive manufacturing in 2017.

### **Recommendation**

Reintroduce automotive manufacturing to Australia as the infrastructure has since developed and it would reduce the reliance on international imports.

## INTRODUCTION

This report investigates: Which trade import and export commodities significantly contribute to Australian spending and revenue spanning from 1988 to 2023? International trade is a complex issue that spans across multiple dimensions of data. As such, it is difficult to definitively form solutions that generate capital. This work aims to evaluate various commodities to identify the specific sub-commodities with the greatest correlation to import and export valuation and produce a recommendation with the goal of increasing Australian capital. The data dictionary section provides a description of what the series measures, the source, and its format. In the preprocessing stage, feature engineered data series are described and used further in the document. General data visualization techniques are present in all subsequent charts. This paper uses Tableau to analyse general trade commodities, sub-commodities with the focus on machinery, it then produces a

dashboard evaluating vehicle trade to transport equipment, and a storyboard presenting the history of Australian vehicle exports, correlations, and import responses to specific events. Finally, the reflection section compares and contrasts the advantages and disadvantages of dashboards and storyboards in Tableau.

## DATA DICTIONARY

The following table lists the data format and header description for all data series used in this report.

<b>Category</b>	<b>Format</b>	<b>Description</b>
Time	Discrete (Interval)	Year of the recorded data point
Trade	Categorical (Nominal)	Australian commodities import or export
Commodity	Continuous (Ratio)	The general type of commodity
Sub-commodity	Continuous (Ratio)	Specific commodity as a subset of a commodity
Raw Dollar Value	Discrete (Ratio)	Amount spent or earned (valuation) at a specific year

## PREPROCESSING

<b>Category</b>	<b>Format</b>	<b>Description</b>
Analytical	Continuous (Interval)	Change in commodity valuation from the previous year. $Analytical_n = \frac{Commodity_n}{Commodity_{n-1}}$
Statistical	Continuous (Interval)	Distribution of commodity valuation against total at a specific year. A sub-commodity is a subset of a commodity as a commodity is a subset of the total. $Statistical_n = \frac{Subset_n}{Set_n}$
Increase/Decrease	Continuous (Ratio)	The percentage change in commodity valuation from the previous year. $Increase/Decrease_n = Analytical_n - 1$

## VISUALIZATION TECHNIQUES

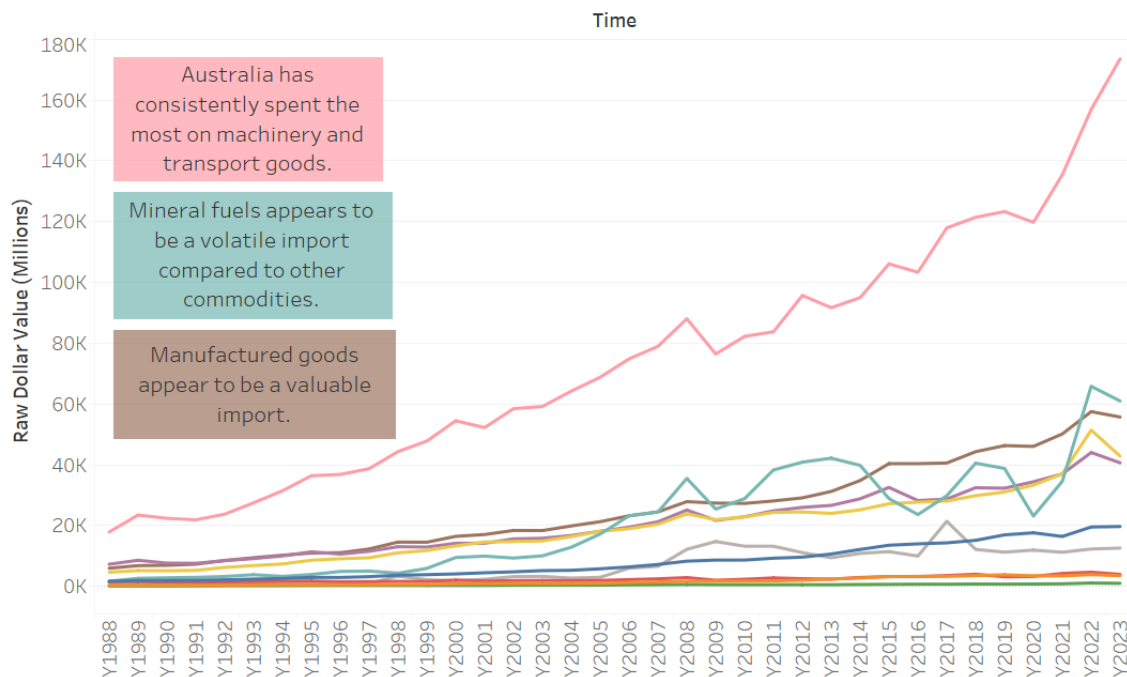
The following describes the justification behind common data visualization techniques that are used in almost all graphs in the [analysis](#) section.

<b>Technique</b>	<b>Justification</b>
Chart Title	Provides a brief description of the contents of the chart and the information it intends to convey
Axis Title	Defines the units used to measure and evaluate the difference between data points
Legend	Indicates what each visual component in a plot relates to
Data Labels	Shows both the numeric and categorical differences between points in the dataset
Annotations	Summarizes insights and notable data points in the chart that may require readers more time or effort to identify

## ANALYSIS

### RAW IMPORT

## Raw Trade Import



### Trade Commodity

- 0 Food and live animals ;
- 1 Beverages and tobacco ;
- 2 Crude materials, inedible, except fuels ;
- 3 Mineral fuels, lubricants and related materials ;
- 4 Animal and vegetable oils, fats and waxes ;
- 5 Chemicals and related products, nes ;
- 6 Manufactured goods classified chiefly by material ;
- 7 Machinery and transport equipment ;
- 8 Miscellaneous manufactured articles ;
- 9 Commodities and transactions not classified elsewhere in the SITC ;

### Description

Comparison of all commodities imports relative to the raw dollar from 1988 to 2023.

### Analysis

Data Points Used	Justification
Time	Used to plot time-series trends of data points.
Trade	Filtered for only import data to evaluate spending.
Commodity	Comparison of all main commodities.
Raw Dollar Value	Show relative values across entire time series.

### Visualization Techniques

Line Chart	Compares the trends of each category and shows the trends across the time series.
Annotations	Summarizes trends that may not be immediately obvious.

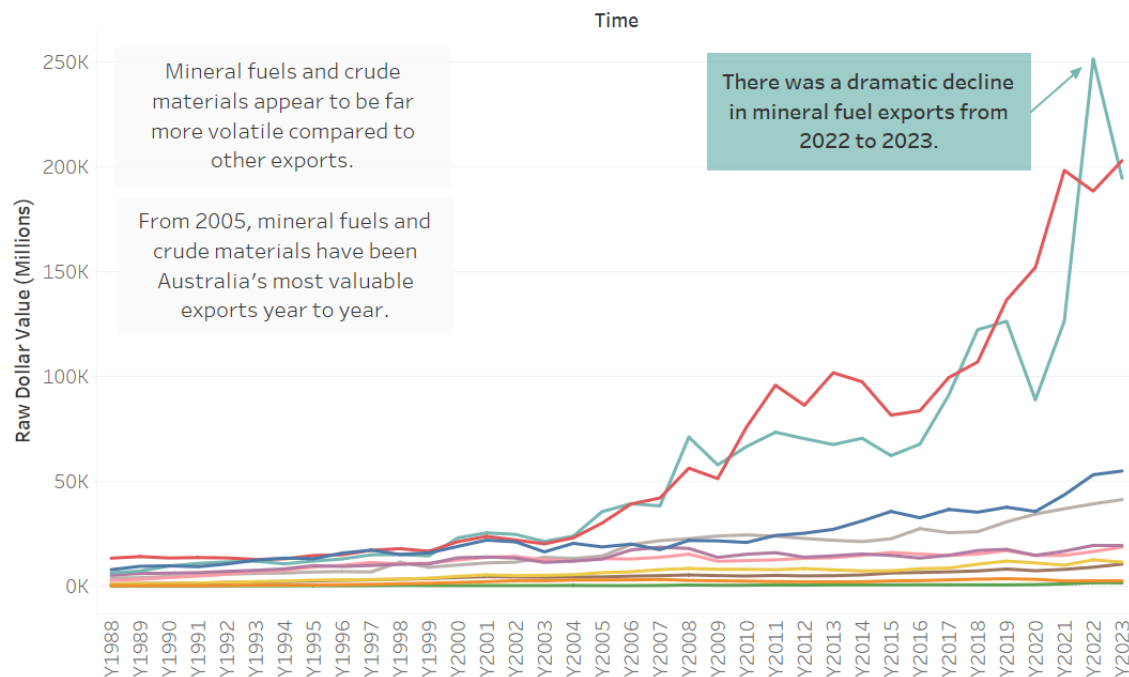
### Findings/Trends

Historically, Australia has spent an overwhelmingly large amount on road vehicle imports. Additionally, chemicals, manufactured goods, and miscellaneous manufactured article imports have steadily increased over time indicating that Australia has a declining manufacturing industry (Aftab et al., 2021).

The plot also highlights the volatile import of mineral fuels. Although the Australian landscape is rich in coal, natural gas, and uranium resources, it relies on oil imports due to insufficient domestic production (Marquand et al., 1993).

## RAW EXPORT

### Raw Trade Export



#### Trade Commodity

- 0 Food and live animals ;
- 1 Beverages and tobacco ;
- 2 Crude materials, inedible, except fuels ;
- 3 Mineral fuels, lubricants and related materials ;
- 4 Animal and vegetable oils, fats and waxes ;
- 5 Chemicals and related products, nes ;
- 6 Manufactured goods classified chiefly by material ;
- 7 Machinery and transport equipment ;
- 8 Miscellaneous manufactured articles ;
- 9 Commodities and transactions not classified elsewhere in the SITC ;

#### Description

Comparison of all commodities exports relative to the raw dollar from 1988 to 2023.

#### Analysis

Data Points Used	Justification
Time	Used to plot time-series trends of data points.
Trade	Filtered for only export data to evaluate profit.
Commodity	Comparison of all main commodities.
Raw Dollar Value	Show relative values across entire time series.

#### Visualization Techniques

Line Chart	Compares the trends of each category and shows the trends across the time series.
Annotations	Summarizes trends that may not be immediately obvious.
Data Labels	Indicates notable information at a specific data point.

#### Findings/Trends

In accordance with the findings in [raw import](#), mineral fuels such as oil, gas, and minerals are highly volatile trade commodities (Frankel, 2017). The plot demonstrates that crude materials and mineral fuels are two of Australia's largest exports.

From 2019 to 2021, Australia saw a sharp increase in mineral fuel exports that may have been influenced by the COVID-19 pandemic where it was hypothesized that international economic slowdown would significantly impact the global mining sector (Jowitt, 2020).

## ANALYTICAL IMPORT

## Import Change from Previous Year





**Description**

Illustrates the import volatility of each commodity relative to its price from the previous year from 1988 to 2023.

**Analysis**

Data Points Used	Justification
Time	Used to plot time-series trends of data points.
Trade	Filtered for only import data to evaluate spending.
Commodity	Comparison of all main commodities.
Increase/Decrease	Evaluates the volatility of a commodity.

**Visualization Techniques**

Column Chart	Shows numerical difference between each year of import volatility.
Multi Chat	Comparison of multiple commodities to show volatility.

**Findings/Trends**

Closer inspection confirms that relative to import pricing from the previous year, mineral fuels are the most volatile import commodity along-side animal fats/wax and vegetable oils, and crude materials.

In contrast, chemicals, machinery, manufactured goods, and miscellaneous manufactured articles are some of Australia's most consistent imports; further supporting the conclusion of Australia's declining manufacturing industry (Aftab et al., 2021).

**ANALYTICAL EXPORT**

## Export Change from Previous Year



### Description

Illustrates the export volatility of each commodity relative to its price from the previous year from 1988 to 2023.

### Analysis

Data Points Used	Justification
Time	Used to plot time-series trends of data points.
Trade	Filtered for only export data to evaluate profit.
Commodity	Comparison of all main commodities.
Increase/Decrease	Evaluates the volatility of a commodity.

### Visualization Techniques

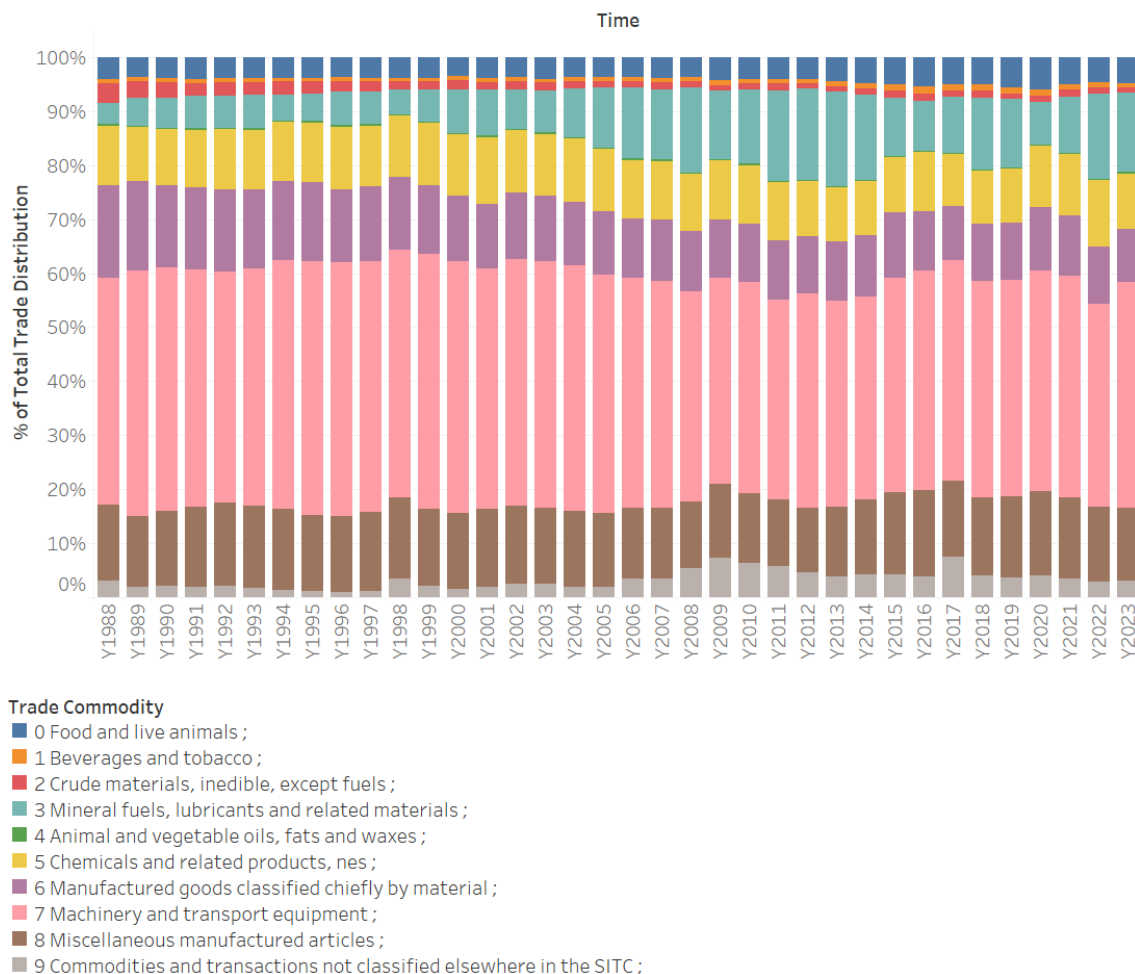
Column Chart	Shows numerical difference between each year of export volatility.
Multi Chat	Comparison of multiple commodities to show volatility.

### Findings/Trends

Although [raw export](#) findings show that mineral fuels and crude materials are Australia's largest exports, their volatility jeopardizes the country's financial stability (Bouri, 2019). In contrast, Australia's third highest export valuation commodities are food and live animals demonstrating the strong agricultural industry positioning itself as a global leader in organic agriculture (Paull, 2019).

## STATISTICAL IMPORT

### Import Distribution



### Description

Distribution of main commodities against the total imports for each year from 1988 to 2023.

### Analysis

Data Points Used	Justification
Time	Used to plot time-series trends of data points.
Trade	Filtered for only import data to evaluate spending.
Commodity	Comparison of all main commodities.
Statistical	Shows the market share distribution of main commodities.

### Visualization Techniques

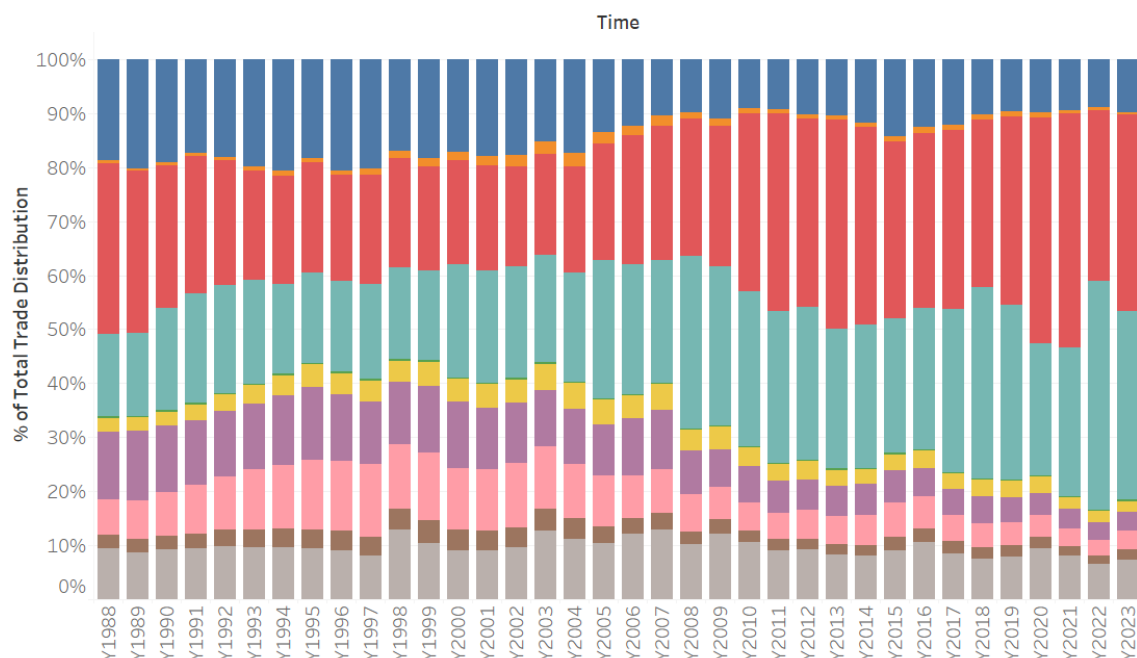
100% Stacked Column Chart	Shows changes in import distribution across each year.
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### Findings/Trends

The plot shows that machinery is overwhelmingly Australia's largest import where the distribution of import valuation has remained consistent across the entire time series.

## STATISTICAL EXPORT

### Export Distribution



### Description

- Distribution of main commodities against the total exports for each year from 1988 to 2023.

### Description

Distribution of main commodities against the total exports for each year from 1988 to 2023.

### Analysis

Data Points Used	Justification
Time	Used to plot time-series trends of data points.
Trade	Filtered for only export data to evaluate profit.

Commodity	Comparison of all main commodities.
Statistical	Shows the market share distribution of main commodities.

### Visualization Techniques

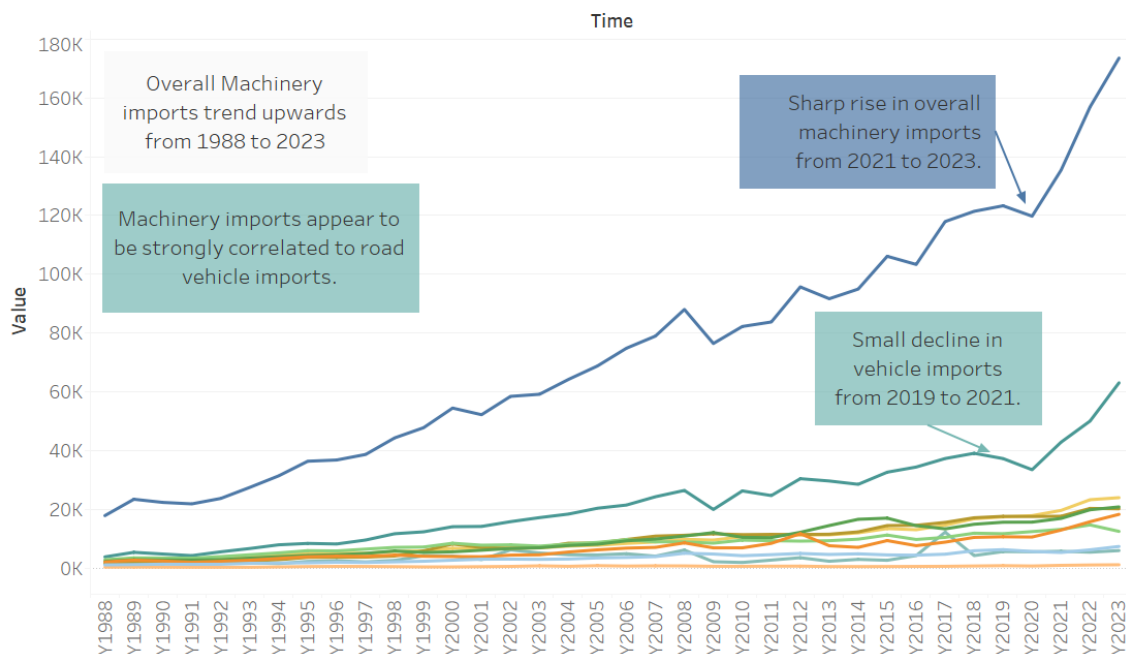
100% Stacked Column Chart	Shows changes in export distribution across each year.
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### Findings/Trends

The combined valuation of total export distribution is majority occupied by crude materials and mineral fuels. Notably, Australia appears to have a significantly lower export distribution between 1990 and 2000. In the 1980s, Australia was already the world's leading coal exporter and had potential for uranium exports, but its crude oil production was insufficient to meet domestic demand (Owen, 1988). By the early 2000s, the mining sector's contribution to the economy had grown substantially, with minerals accounting for 62.8% of total exports in 2006-07 (Robertson, 2008).

## MACHINERY IMPORT

### Machinery Import



#### Measure Names

- 7 Machinery and transport equipment ;
- 71 Power generating machinery and equipment ;
- 72 Machinery specialized for particular industries ;
- 73 Metalworking machinery ;
- 74 General industrial machinery and equipment, nes, and machine parts, nes ;
- 75 Office machines and automatic data processing machines ;
- 76 Telecommunications and sound recording and reproducing apparatus and equipment ;
- 77 Electrical machinery, apparatus and appliances, nes, and electrical parts thereof (incl. non electrical counterparts, nes, o
- 78 Road vehicles (incl. air-cushion vehicles) ;
- 79 Transport equipment (excl. road vehicles) ;

### Description

Comparison of all machinery sub-commodities relative to the raw dollar valuation imports from 1988 to 2023.

### Analysis

Data Points Used	Justification
Time	Used to plot time-series trends of data points.
Trade	Filtered for only import data to evaluate spending.
Commodity	Machinery and transport equipment as main set commodity.

Sub-commodity	All subsets of machinery and transport equipment for relative analysis.
Raw Dollar Value	Show relative values across entire time series.

### Visualization Techniques

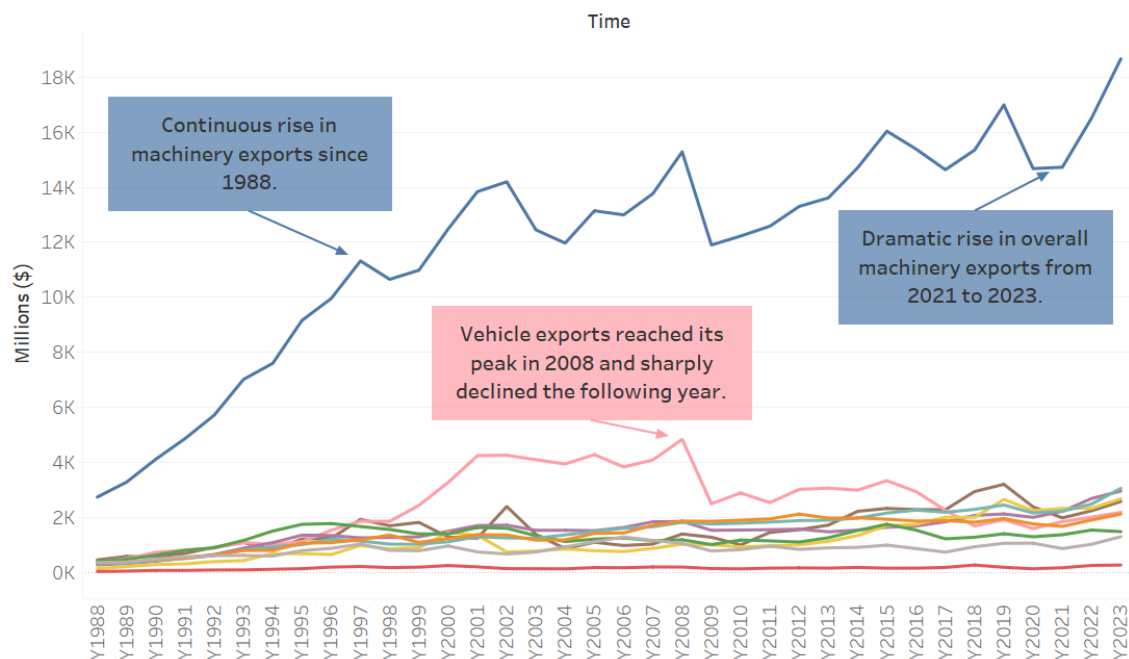
Line Chart	Compares the trends of each sub-commodity and shows the trends across the time series.
Annotations	Summarizes trends that may not be immediately obvious.
Data Labels	Highlights notable information at specific data point.

### Findings/Trends

The trend lines of machinery imports and vehicle imports appear to be almost mirrored at different scales. There was a small decline in vehicle imports from 2019 to 2021 likely due to the reduced necessity of road vehicles during the COVID-19 pandemic that significantly impacted Australia's transportation sector, leading to reduced travel activity and economic consequences. Lockdowns and social distancing measures resulted in an 80% decrease in public transport use and a 36% reduction in traffic volume (Munawar et al., 2021). Subsequently, road vehicle imports significantly increased from 2021 to 2023.

## MACHINERY EXPORT

### Machinery Exports



#### Measure Names

- 7 Machinery and transport equipment ;
- 71 Power generating machinery and equipment ;
- 72 Machinery specialized for particular industries ;
- 73 Metalworking machinery ;
- 74 General industrial machinery and equipment, nes, and machine parts, nes ;
- 75 Office machines and automatic data processing machines ;
- 76 Telecommunications and sound recording and reproducing apparatus and equipment ;
- 77 Electrical machinery, apparatus and appliances, nes, and electrical parts thereof (incl. non electrical counterparts, nes, o
- 78 Road vehicles (incl. air-cushion vehicles) ;
- 79 Transport equipment (excl. road vehicles) ;

### Description

Comparison of all machinery sub-commodities relative to the raw dollar valuation exports from 1988 to 2023.

### Analysis

Data Points Used	Justification
Time	Used to plot time-series trends of data points.
Trade	Filtered for only export data to evaluate profit.
Commodity	Machinery and transport equipment as main set commodity.
Sub-commodity	All subsets of machinery and transport equipment for relative analysis.
Raw Dollar Value	Show relative values across entire time series.

### Visualization Techniques

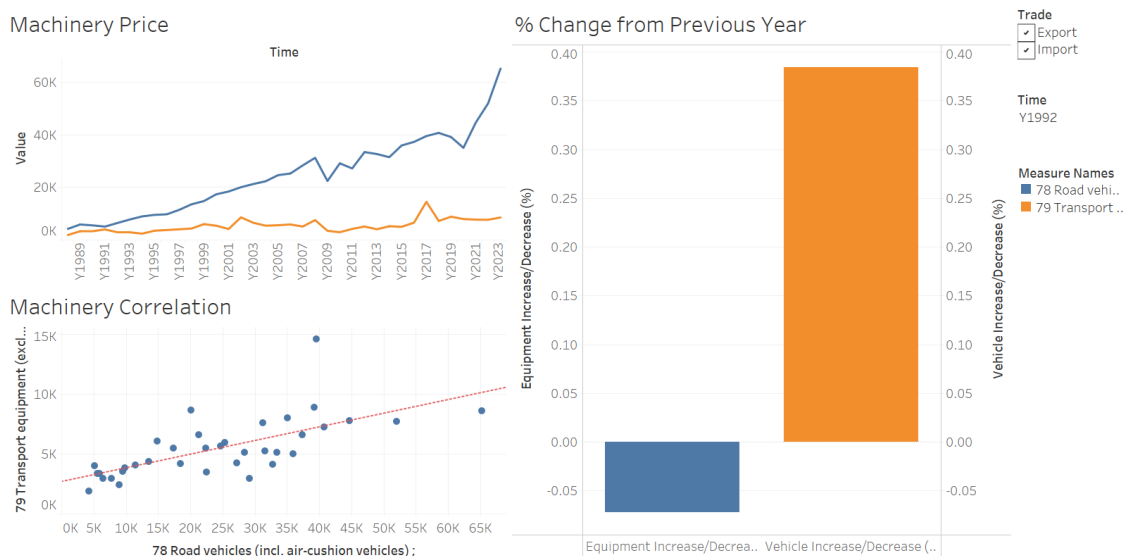
Line Chart	Compares the trends of each sub-commodity and shows the trends across the time series.
Annotations	Summarizes trends that may not be immediately obvious.
Data Labels	Highlights notable information at specific data point.

### Findings/Trends

Australia saw continuous growth in machinery exports from 1988 to 1997. This growth was driven by trade reforms and microeconomic policies in the late 1980s and 1990s leading to improved manufacturing performance, including increased labour productivity, and price-cost margins (Jayanthakumaran, 1999).

Later in 2009, vehicle exports sharply declined due to a combination of factors influencing the automotive industry including: reduced government assistance, exchange rate volatility, global strategic decisions by parent companies (Clibborn et al., 2020).

## VEHICLE/EQUIPMENT DASHBOARD



### Description

Comparison between road vehicle and transport equipment trade by analysing raw dollar valuation, correlation, and volatility.

### Analysis

Data Points Used	Justification
Time	Used to plot time-series trends of data points.
Trade	Filter to isolate import and export data for comparison.
Sub-commodity	Comparison of vehicle and transport equipment subcategories.
Raw Dollar Value	Show relative values across entire time series.
Increase/Decrease	Evaluates the volatility of a commodity.

### Visualization Techniques

Dashboard	Combines multiple charts with relative information.
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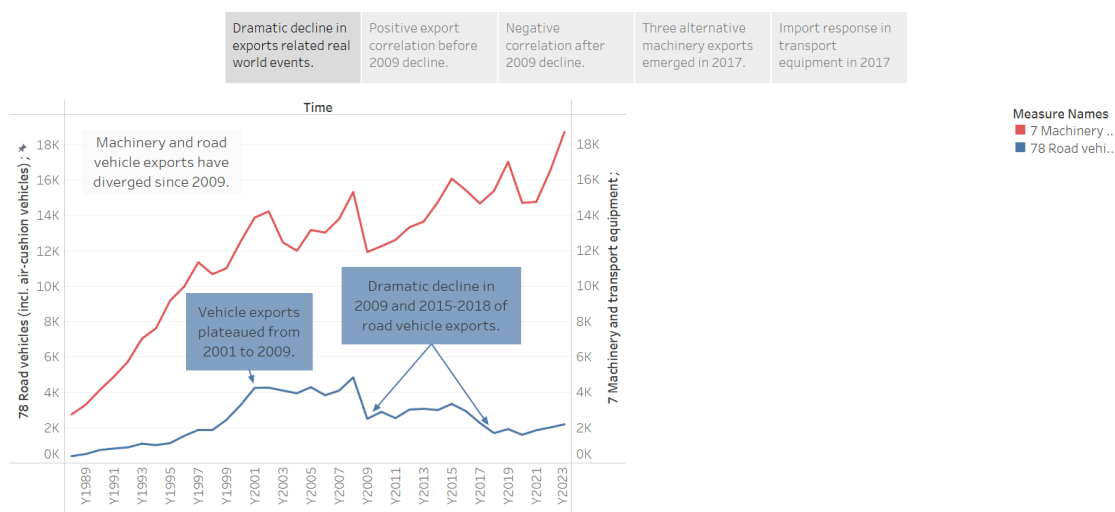
Filters	User interactivity to filter trade and specific time features for granular analysis.
Line Chart	Visual comparison of raw dollar valuation between road vehicles and transport equipment.
Scatter Plot	Attempts to identify linear correlation between vehicle and transport equipment sub-commodities.
Trend Line	Shows explicit correlation between vehicle and transport equipment sub-commodities.
Column Chart	Sub-commodity volatility comparing increase/decrease to itself as opposed to raw dollar volatility.

### Findings/Trends

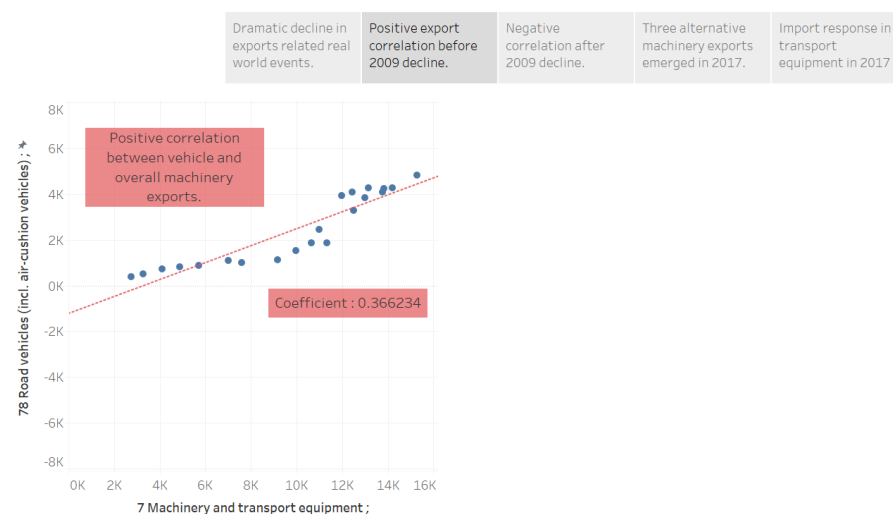
Despite road vehicles and transport equipment being related commodities, it was found that neither shares any significant correlation with one another. Both vehicle to equipment imports and exports hold a 0.08 correlation coefficient. Likewise, the line plot of each data series shows mutually distinct curves, and the volatility column chart are sparsely on opposing ends of 0. As such, it is unlikely that either road vehicles or transport equipment share any significant dependency.

## VEHICLE EXPORT STORY

### Vehicle Export Trends



### Vehicle Export Trends

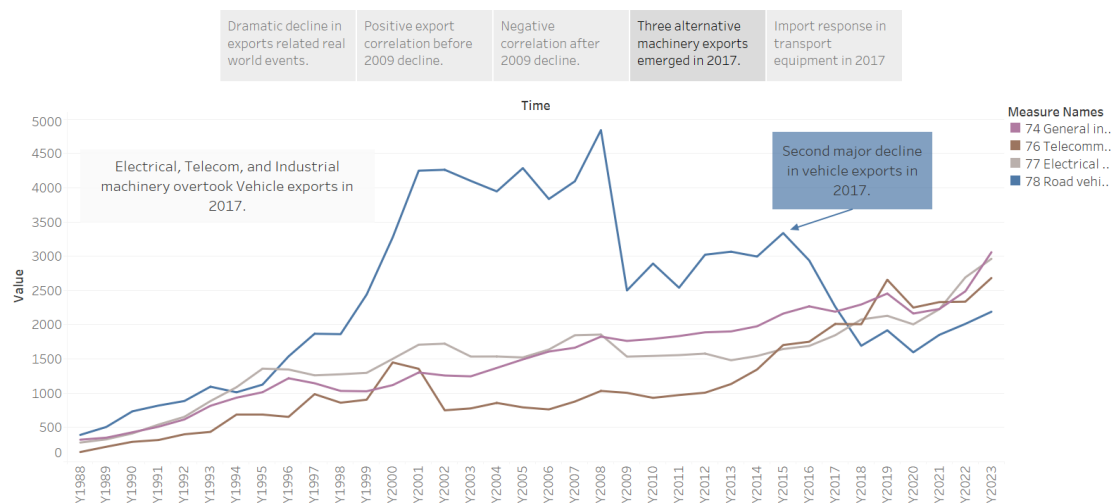




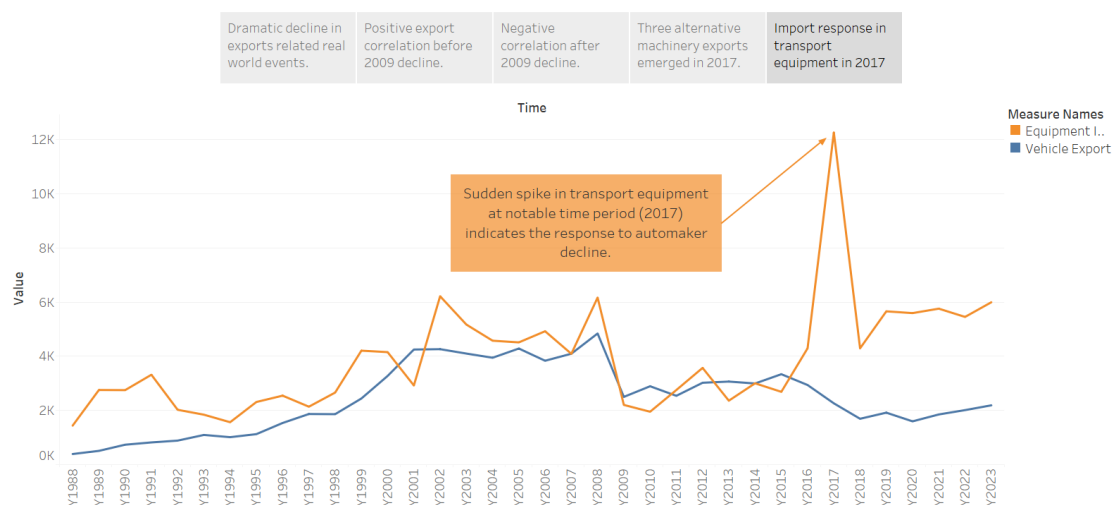
## Vehicle Export Trends



## Vehicle Export Trends



## Vehicle Export Trends



## Description

Storyboard narrative describes the changing trends of vehicle exports after notable time periods and its effect on the correlation on overall machinery exports.

### **Analysis**

<b>Data Points Used</b>	<b>Justification</b>
Time	Used to plot time-series trends of data points.
Trade	Filtered for only export data to evaluate profit.
Commodity	Machinery and transport equipment as main set commodity.
Sub-commodity	Analysis of road vehicles as a subset of machinery.
Raw Dollar Value	Show relative values across entire time series.

### **Visualization Techniques**

Storyboard	Sequence of charts used to consecutively extrapolate insights into increasingly detailed information.
Story Points	Summarizes key information and links each insight to construct a coherent narrative.
Line Chart	Shows the trends and notable data points in machinery and road vehicle exports.
Series Selection	Removed sub-commodities that are unrelated to the narrative.
Annotations	Provides insight into information that is not immediately obvious.
Data Labels	Highlights key data points that represented a changing trend in road vehicle exports.
Scatter Plot	Identifies correlation between vehicle and machinery exports where overall machinery exports indicate the performance of vehicles.
Trend Line	Shows explicit correlation between vehicle and machinery exports using data series.
Axis Slicing	Separates data set by time to identify the change in correlation before and after key points in time.

### **Findings/Trends**

Overall machinery exports have continued to grow despite the decline of road vehicle exports in 2009 onward. This implies that road vehicle exports have been overtaken by some other machine commodity.

Both 2009 and 2017 were turning points for vehicle exports in which the final Australian automakers closed their plants in 2017 (Stanford, 2017). Steady growth in telecommunications, appliance, and industry machinery exports had overtaken vehicle exports following this period.

It can be observed that there was a dramatic spike in transport equipment imports in 2017 of which could have been a response to the closure of Australian automakers.

## **DASHBOARD & STORYBOARD REFLECTION**

### **DASHBOARD**

#### **Advantage**

- User interactivity enables granular insights and exploration of data source of which would otherwise require an entirely separate chart
- Consolidated report of data in a single location is more easily interpretable for general use when there is no specific narrative point being addressed

#### **Disadvantage**

- Lack of narrative structure makes dashboards useful for data exploration however they don't inherently guide a viewer through an argument or sequential narrative
- The density of information in a dashboard can be overwhelming for some viewers and make it more difficult to focus on key insights
- Interactivity can sometimes make it difficult to include annotations or data labels as modifying a filter could destroy the target data point in the initial chart

## STORYBOARD

### **Advantage**

- Linear structure of insights allows storyboards to be used as a presentation to explain/convey a specific narrative through highlighting key points in a particular order
- Story points maintain continuity between visualizations. This simplifies the narrative structure and makes storyboards comparatively more digestible than dashboards.

### **Disadvantage**

- Due to the single focus structure of storyboards, it can be challenging to present multiple data dimensions or views simultaneously
- The absence of interactivity reduces the avenues of data exploration such that complex information may require multiple visualizations to explain the desired narrative

## CONCLUSION

Despite the country being one of the leading exporters of mineral fuels and crude materials namely coal, gas, and uranium, Australia has spent a significant amount on importing oil due to insufficient domestic production. These commodities are found to be highly volatile such that over-reliance on the exportation of crude materials could jeopardize the financial stability of the country.

Since 1988, the overwhelming majority spent on Australian trade imports has been in the machinery, and manufactured goods indicating that the country has a declining manufacturing industry. In contrast, the export market of some sub-commodities in machinery such as road vehicles have been suffering with notable periods of decline being in 2009 and 2017. This was primarily brought about by the closure of automakers in Australia that further influenced the reliance on importing road vehicles.

## RECOMMENDATION

Currently Australia spends a disproportionate amount on road vehicle imports while possessing no automotive export stream of its own. This over-reliance on international produce results in a higher consumer cost without providing any utility to that manufacturing stream.

It would be beneficial to reintroduce car manufacturing into Australia. The supporting infrastructure of other machinery sub-commodities such as electronic appliances, telecommunications, and industry machinery has developed such that their current combined export valuation is greater than that of vehicle exports in 2017.

Although the immediate reintroduction of automakers into Australia may not be immediately profitable, the concept is an efficient solution to reducing the gap between import cost and export revenue.

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