320146 Assessment Task 3

APPLIED DATA VISUALISATION

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Executive Summary

This report focus on multiple analysis relate to the Australia International Trade dataset (from ABS). The Dataset contains over 33 years of data between 1988 and 2021, divided into two worksheets, one for import and another with export information. Each worksheet has 10 main categories and 67 sub-categories, which gives a total of 2652 inputs on Australian Trade for each worksheet, and a total of 5304 for both.

A detailed list of all attributes, include main category and subcategory follows:

0 Food and live animals ;
−   00 Live animals (excl. fish (not marine mammals) crustaceans, mollusks and aquatic invertebrates of SITC Division 03) ;
−   01 Meat and meat preparations ;
−   02 Dairy products and birds' eggs ;
−   03 Fish (excl. marine mammals) crustaceans, molluscs and aquatic invertebrates, and preparations thereof (excl. extracts and juices of fish, crustaceans, molluscs or other aquatic invertebrates, prepared or preserved of SITC 01710) ;
−   04 Cereals and cereal preparations ;
−   05 Vegetables and fruit ;
−   06 Sugars, sugar preparations and honey ;
−   07 Coffee, tea, cocoa, spices, and manufactures thereof ;
−   08 Feeding stuff for animals (excl. unmilled cereals) ;
−   09 Miscellaneous edible products and preparations ;
1 Beverages and tobacco ;
−   11 Beverages ;
−   12 Tobacco and tobacco manufactures ;
2 Crude materials, inedible, except fuels ;
−   21 Hides, skins and furskins, raw ;
−   22 Oil-seeds and oleaginous fruits ;
−   23 Crude rubber (incl. synthetic and reclaimed) ;
−   24 Cork and wood ;
−   25 Pulp and waste paper ;
−   26 Textile fibres (excl. wool tops and other combed wool) and their wastes, not manufactured into yarn or fabric ;
−   27 Crude fertilizers (excl. those of Division 56) and crude minerals (excl. coal, petroleum and precious stones) ;
−   28 Metalliferous ores and metal scrap ;
−   29 Crude animal and vegetable materials ;
3 Mineral fuels, lubricants and related materials ;
−   32 Coal, coke and briquettes ;
−   33 Petroleum, petroleum products and related materials ;
−   34 Gas, natural and manufactured ;
4 Animal and vegetable oils, fats and waxes ;
−   41 Animal oils and fats ;
−   42 Fixed vegetable fats and oils, crude, refined or fractionated ;
−   43 Animal or vegetable fats and oils, processed; waxes of animal or vegetable origin; inedible mixtures or preparations of animal or vegetable fats or oils;
5 Chemicals and related products, nes ;
−   51 Organic chemicals ;
−   52 Inorganic chemicals ;
−   53 Dyeing, tanning and colouring materials ;
−   54 Medicinal and pharmaceutical products ;
−   55 Essential oils and resinoids and perfume materials; toilet, polishing and cleansing preparations ;
−   56 Fertilisers (excl. those of group 272) ;
−   57 Plastics in primary forms ;
−   58 Plastics in non-primary forms ;
−   59 Chemical materials and products ;
6 Manufactured goods classified chiefly by material ;
−   61 Leather, leather manufactures, nes, and dressed furskins ;

- 62 Rubber manufactures ;
- 63 Cork and wood manufactures (excl. furniture) ;
- 64 Paper, paperboard and articles of paper pulp, of paper or of paperboard ;
- 65 Textile yarn, fabrics, made-up articles, and related products ;
- 66 Non-metallic mineral manufactures ;
- 67 Iron and steel ;
- 68 Non-ferrous metals ;
- 69 Manufactures of metals ;

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, and machine parts ;
- 75 Office machines and automatic data processing machines ;
- 76 Telecommunications and sound recording and reproducing apparatus and equipment ;
- 77 Electrical machinery, apparatus and appliances, and electrical parts thereof (incl. non electrical counterparts, of electrical household type equipment) ;
- 78 Road vehicles (incl. air-cushion vehicles) ;
- 79 Transport equipment (excl. road vehicles) ;

8 Miscellaneous manufactured articles ;
- 81 Prefabricated buildings and sanitary, plumbing, heating and lighting fixtures and fittings ;
- 82 Furniture and parts thereof; bedding, mattresses, mattress supports, cushions and similar stuffed furnishings ;
- 83 Travel goods, handbags and similar containers ;
- 84 Articles of apparel and clothing accessories ;
- 85 Footwear ;
- 87 Professional, scientific and controlling instruments and apparatus ;
- 88 Photographic apparatus, equipment and supplies and optical goods; watches and clocks ;
- 89 Miscellaneous manufactured articles ;

9 Commodities and transactions not classified elsewhere in the SITC ;
- 93 Special transactions and commodities not classified according to kind ;
- 95 Gold coin whether or not legal tender, and other coin being legal tender ;
- 96 Coin (excl. gold coin) not being legal tender ;
- 97 Gold, non-monetary (excl. gold ores and concentrates) ;
- 98 Combined confidential items excluding some of SITC 28099 (exports only) and some of SITC 51099 (imports only) ;

-1 TOTAL ;

Data Preparation

Task 1. Understand the sample trade dataset and its characters, styles, patterns. Merge import and export dataset together and rescale, reform, clean up the data.

Task 2. Create two new patterns for measuring statistical results and analytical results within the import and export category and sub-category, in yearly time series. Reformat data for comparison between import and export both category and sub-category

In order to proceed with a detailed analysis it was necessary to calculate statistical and analytical patterns for each worksheet. Statistical calculations represent the percentage of each category or sub-category compared to the total amount in each year – or proportion per year. Analytical patterns include the growth Year-over-Year (Y-o-Y) for each category and sub-category – or variations over time.

Further transformations in the dataset include two worksheets with the main categories only for all calculated statistical and analytical patterns. Another table was created with the values for the main categories without any transformation. These three tables aim to provide a simpler structure to work with in Tableau, with less attributes to choose.
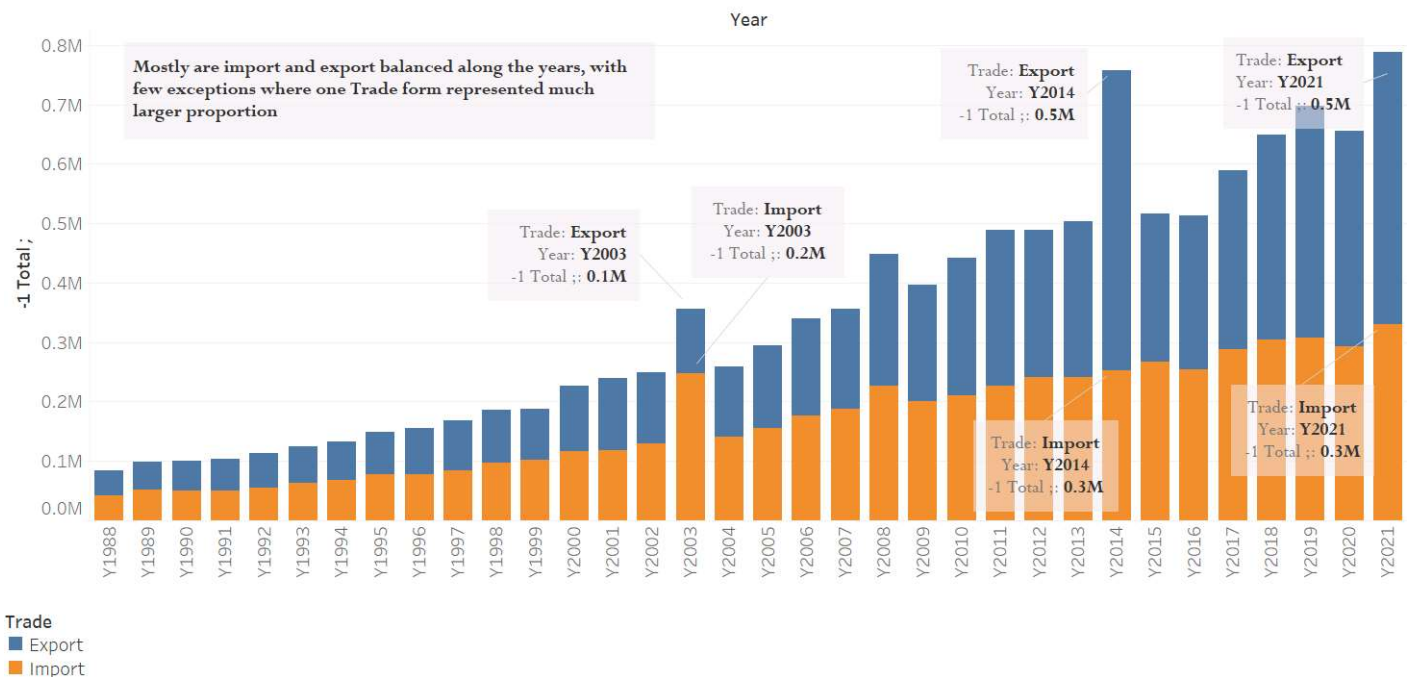
Visualisation Technique 1. Time Series Charts

Task 3. Import patterns into visualization software such as Tableau or PowerBI. Then create time series charts for comparing between import and export for the TEN main categories from the dataset.

Below is a graph that shows a time series with Import and Export values in AUD Millions. An increase in the values/amounts over time is visually clear and understandable. It is possible to see that most of the Trade Balance is characterized by similar proportions (import = export), with few exceptions that show strong deficit or surplus in Trade.

Despite the increase in monetary value over time, the data shows only the nominal values of trade in AUD, which does not allow users to verify the real increase in the Trade participation in economy. The real values of Trade would consider values discounted by inflation, because prices and goods may be highly influenced by inflationary factors, which will distort the economic value. Furthermore, the monetary values do not consider economic growth (GDP) on local or global level, which would also influence the growth over time considering that the Australian economy had a positive growth from 1998 to 20120, the exports and imports will surely increase as the economy increases.

Import and Export over time
in Milllions

Visualisation Technique 2. Interactive Chart

Task 4. Create interactive charts exploring details of trade for the TEN main categories. Find any trend and breakthrough point in interactive charts, then explain what you have found and how that has happened.

In order to check the proportion of each category on the total export for the year, the Bar charts below represent the TEN main categories over the years. These time series are not continuous because the dataset has over 30 years of inputs and it would be visually too small to have a clear view of all the values, therefore I chose an interval of five years between each time series. This way the graphs allow an objective comparison of proportions over time and since all percentages are detailed in the same axis (Y) it shows an equal proportion from total.

Because the graph is represented by bars close to each other in different years, it clearly shows that the category with stronger representation along the years is "7 Machinery and transport equipment". Over the years it has represented around 40% of the import goods in Australia, which is more than double of any other category. Another category that has a steady

participation on import is "8 Miscellaneous manufactured articles", this can be probably correlated with the high level of imports for Category 7, since both categories are related to goods which require a higher level of manufacturing and engineering (further details below).

Import per main category in percentage

The same graph for export shows some shifts over time with category "0 Food and live animals" loosing representation on exports, while "2 Crude materials, inedible, except fuels" and "3 Mineral fuels, lubricants and related materials" have a considerable increase on export participation.

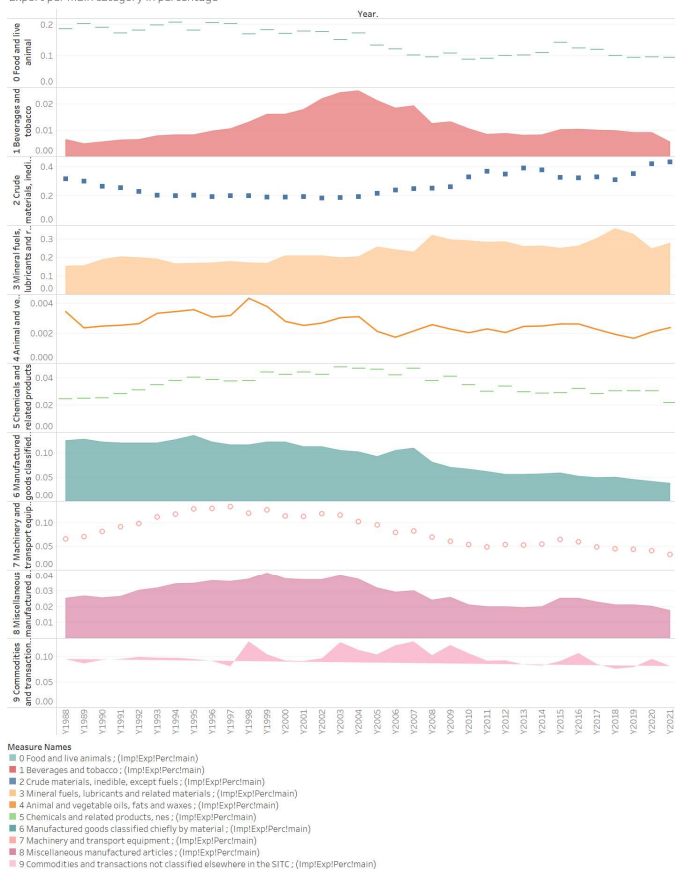Export per main category in percentage
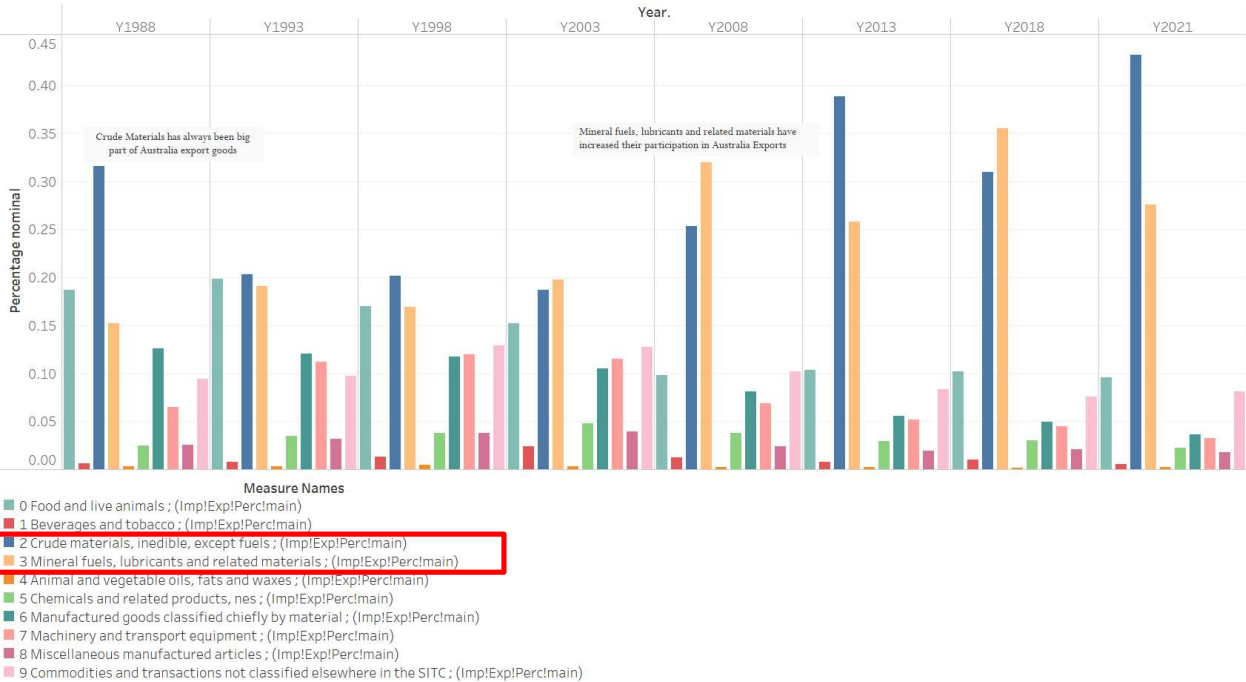
One variation of the same output is below, where categories are displayed in Y-Axis, while the years are displayed vertically X-Axis. It is visually smaller, though the scales available for the different categories differ drastically and does not allow a

clear insight on which category is proportionally stronger. The graph is more helpful to see insights on the development of a single category over the years, instead of comparison among them.

We can confirm by the graph that category "2 Crude materials, inedible, except fuels" has increased their participation in Exports over the years, as the exports represented around 30% in 1988 and 40% in 2022, though between 1993 and 2004 this category had only 20% of the exports Trade. The graph also confirms that "3 Mineral fuels, lubricants and related materials" has a steady growth in export participation over the years, as it grew from 15% in 1988 to 27% in 2021. Oppositely the category "0 Food and live animals" and "6 Manufactured goods classified chiefly by material" have consistently lost more than half of its share on export trade.

The import graph shows more stability over time, with lighter variations for each single category. Even though some categories like "2 Crude materials, inedible, except fuels" and "3 Mineral fuels, lubricants and related materials" seem to have lost participation on the overall import trade due to decline over time, their representativeness is very low compared to other categories and these changes are simply monetary low.
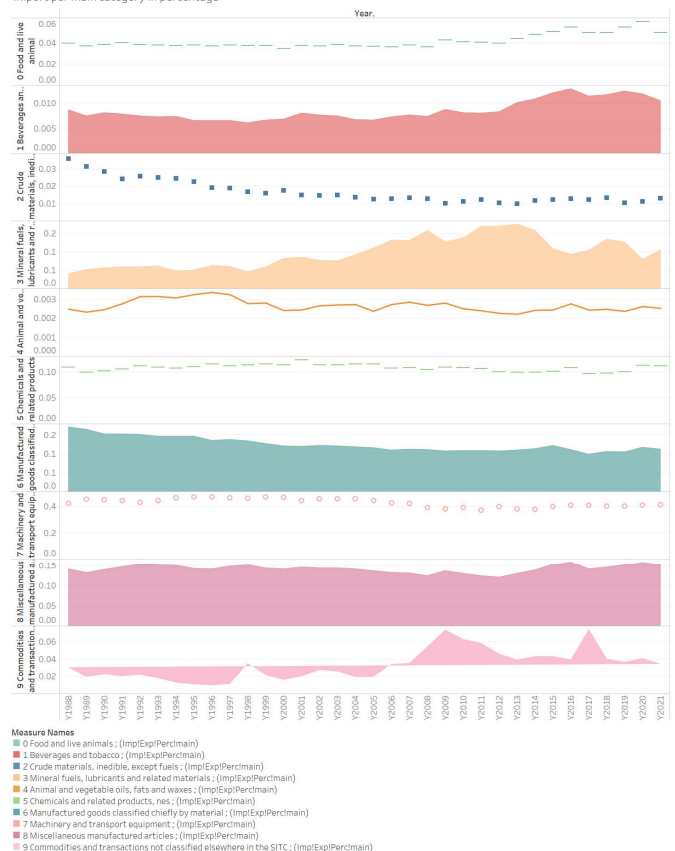

Task 5. Create analytic charts to focus the details of ONE main categories and its sub-category. Using trend analysis to find out what you have found and how that has happened.

In order to check the main categories and sub-categories, lets consider an overview of the most relevant category for each trade : import and export. As seen above the exports accounts are highly influenced by the "2 Crude materials, inedible, except fuels" and "3 Mineral fuels, lubricants and related materials".

On the import side the most relevant category is "7 Machinery and transport equipment".

Export percentage Sub-category Crude materials, inedible, except fuels
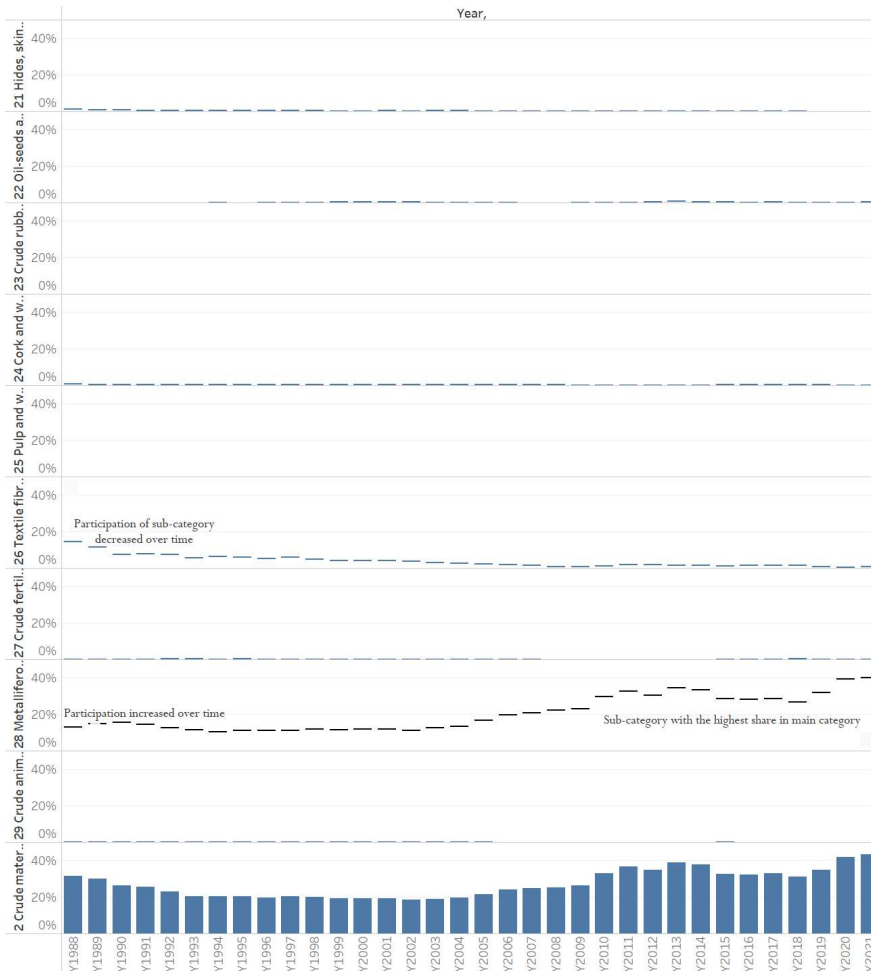
The overview of Main category and Subcategory for "2 Crude materials, inedible, except fuels" on the left shows the participation over time for each Subgroup considering a similar scale for all graphs (0% to 40%). The bottom bar chart is the main category which amounts to 40% in 2021 and had ups and downs over time. The subcategory with the highest proportion on 2021 is "28 Metalliferous ores and metal scrap", which reached also 40%, therefore being responsible for almost 100% of the proportion in this category. Looking at the graphs for this sub-category it is possible to see that this sub-category gained importance over time in comparison to other sub-categories that lost importance.

Meanwhile, the graph on the bottom shows the category "3 Mineral fuels, lubricants and related materials" and its sub-categories. This category has increased its participation over time on exports and the most relevant sub-categories are "32 Coal, coke and briquettes" and "34 Gas, natural and manufactured", the latter with increasing participation, while Coal has always been a steady contributor to exports.

Export percentage Sub-category Mineral fuels
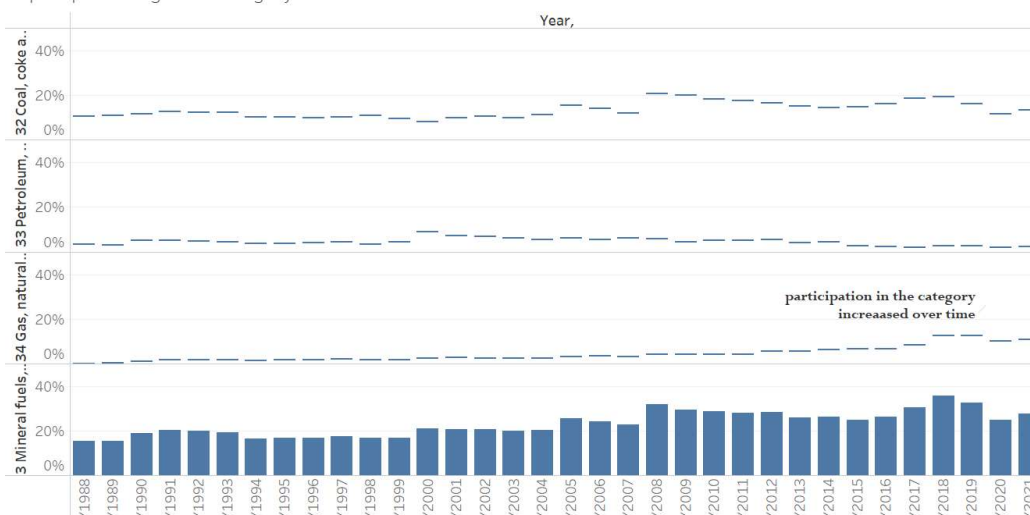
The next graph is a Trend graph for imports in all sub-categories for "7 Machinery and transport equipment", which are all homogenously distributed and has no dominance of one sub-category. As we have seen already this category amounts for 40% of imports in Australia and it seems like there is proportional need for all machinery products in the economy.

Import_Percentage Machinery and transport equipment per sub-segment
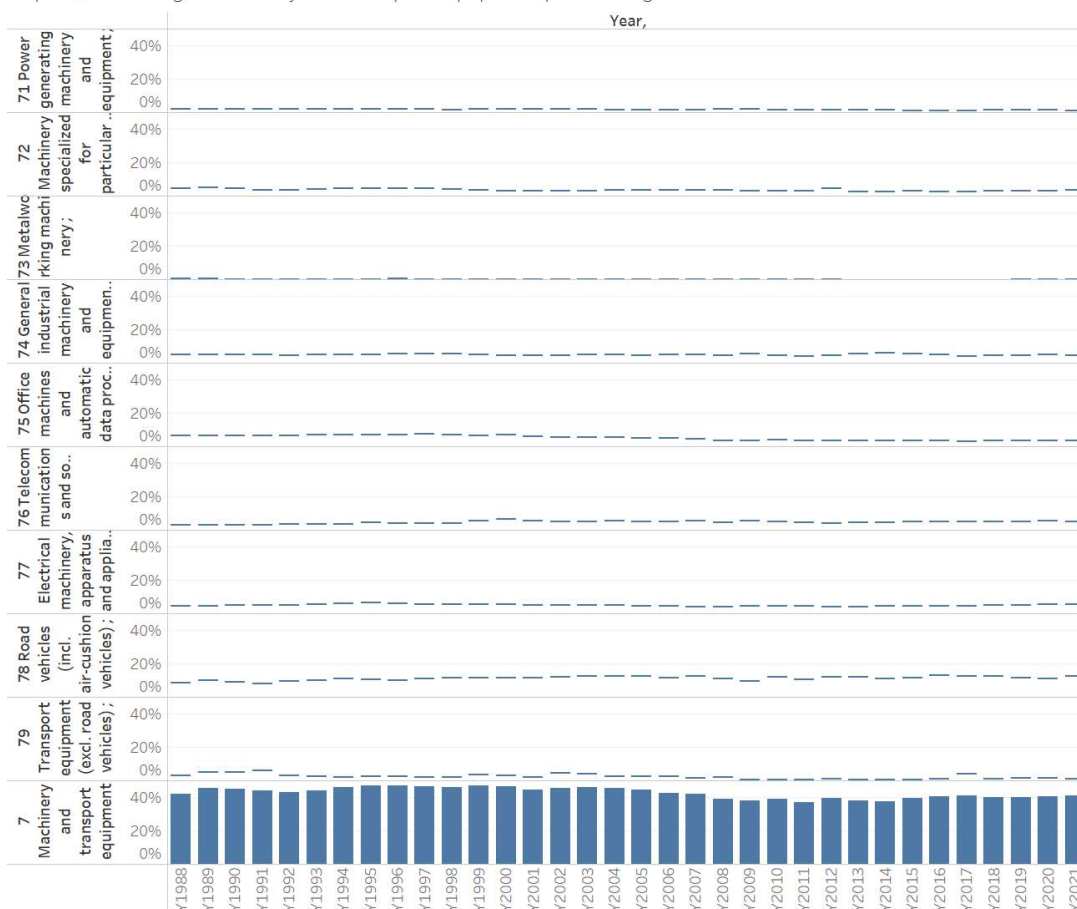
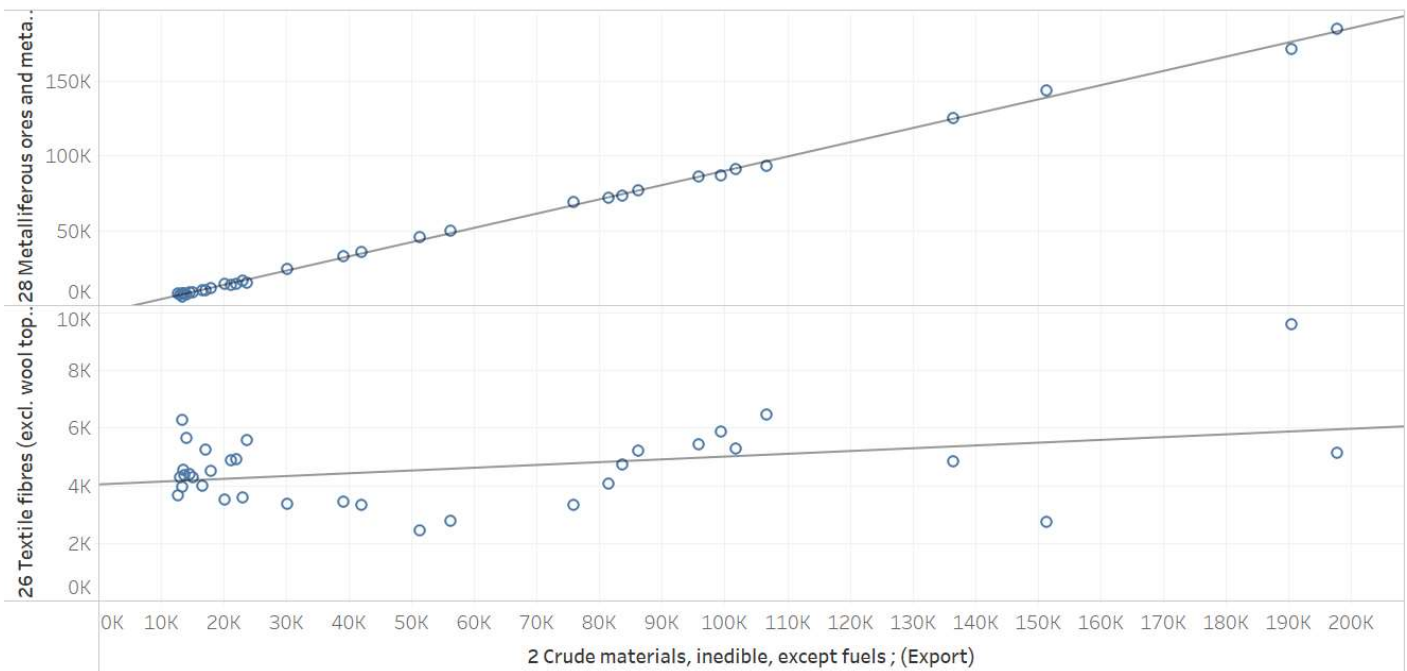Import most representative Categories

Trade Y-o-Y
■ Import

Also highlighted before the correlation of Machinery and transport equipment with Manufactured goods is strong, we can see this by the graph on the left, where both accounts behave in a similar pattern over time.

Another overview for category and sub-category can be done as below, which includes a scatter plot with the main category in horizontal axis (X) and the sub-categories in the vertical axis (Y). By the graphs we can see if the main category and the sub-category have a high correlation or not. The Export category "2 Crude materials, inedible, except fuels" which is leaded by the sub-category "28 Metalliferous ores and metal scrap" shows clearly that both accounts have a perfect correlation, as the dots distribution over the trend line is perfect and there are almost no variations outside the trend line. Differently from sub-group "26 Textile fibres", which has an "erratic" behavior among Trend line and show no correlation with main category.

Trend Analysis for Category 2 and Subscategory 26 and 28
Subcategories with the biggest variations over time in the crude material category

(Y-axis top: 26 Textile fibres (excl. wool top.. 28 Metalliferous ores and meta.., scale 0K–150K; Y-axis bottom: 2K–10K; X-axis: 2 Crude materials, inedible, except fuels ; (Export), scale 0K–200K)

Visualisation Technique 3. Visual Dashboard

Task 6. Create a visual dashboard that combines time series chart and interactive chart together for ONE main category and its sub-category.

The Export Dashboard includes two new graphs related to the topic:

1. Stacked bar chart with the amounts of each category displayed over time
2. Trend line for the variations year-over-year in all main categories.

The stacked bar chart shows the biggest jump in Australian exports happened in the year 2014, from an amount of 300 Million to almost 500Million. A year later the exports returned to the previous levels, showing that this stellar achievement was a one time economic momentum, not a lasting one.

The graph on the right shows annual variations for categories in time, the peaks and bottoms for each category show the increase and decrease in percentage and confirm if this category expanded its representation compared to previous year. We can see in the year 2014 that the peaks happened in all categories, followed by bottoms in the following years. Further expressive peaks and bottoms also happened in other period of times but not in a generalized context, rather in a specific category movement. Some examples of the categories peaks and bottoms are highlighted in red circle.

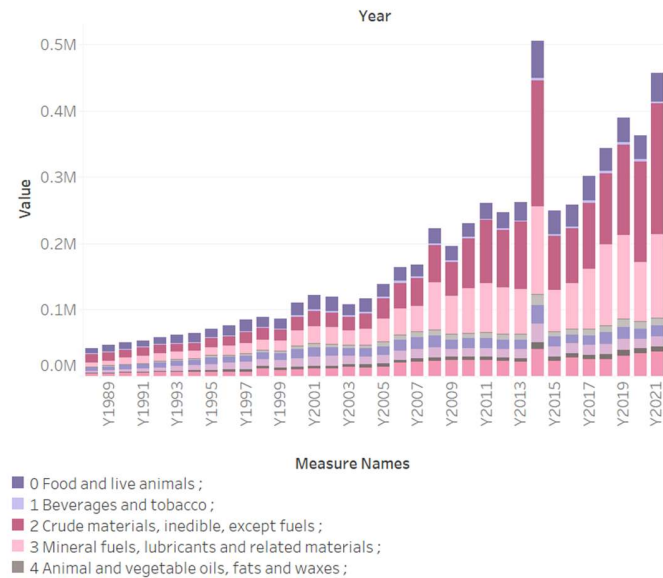The Import Dashboard includes the same graphs with the figures related to import:

The stacked bar chart shows the biggest jump in import happened in 2003 from 129 Millions to 250 Millions, with almost all categories having a similar participation in this increase, except "9 Commodities and transactions not classified elsewhere in the SITC" which had a shy improvement in this year. Nevertheless, this was also an economic momentum and not a lasting event.

The Y-o-Y graph on the right shows other additional increases and decreases in categories over time, with the most expressive being marked in red. Within the Y-o-Y trend line it is possible to notice that categories with more peaks actually
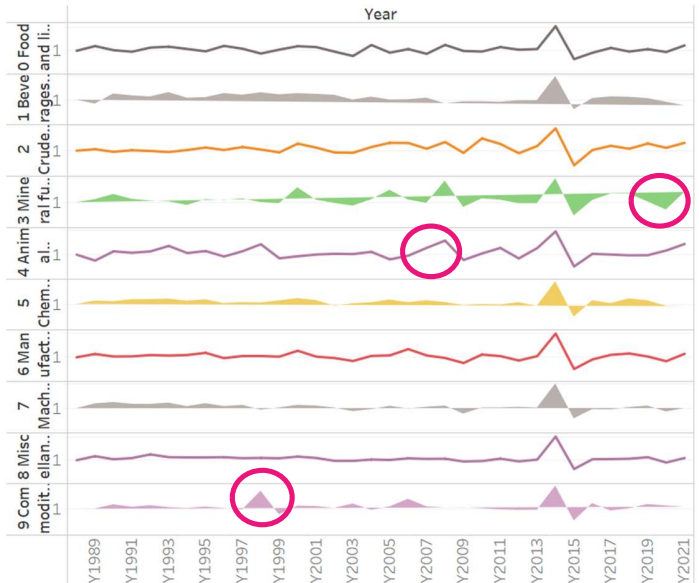
increased their participation in the overall trade, while categories with more bottoms decreased their participation in the specific trade account, though the increase and decrease may not be representative for the overall trade account as it is only a comparison to the category previous share.

Australia Export Analysis

Export per Category in Mio AUD

Measure Names
- 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 ;

Export growth per main category year over year (Y-o-Y)

Australia Import Analysis

Import per Category in Mio AUD

Measure Names
- 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 ;
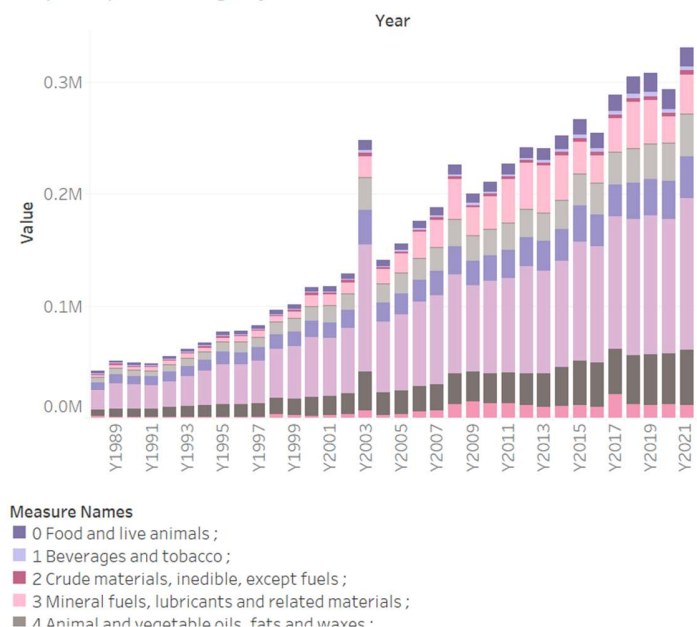
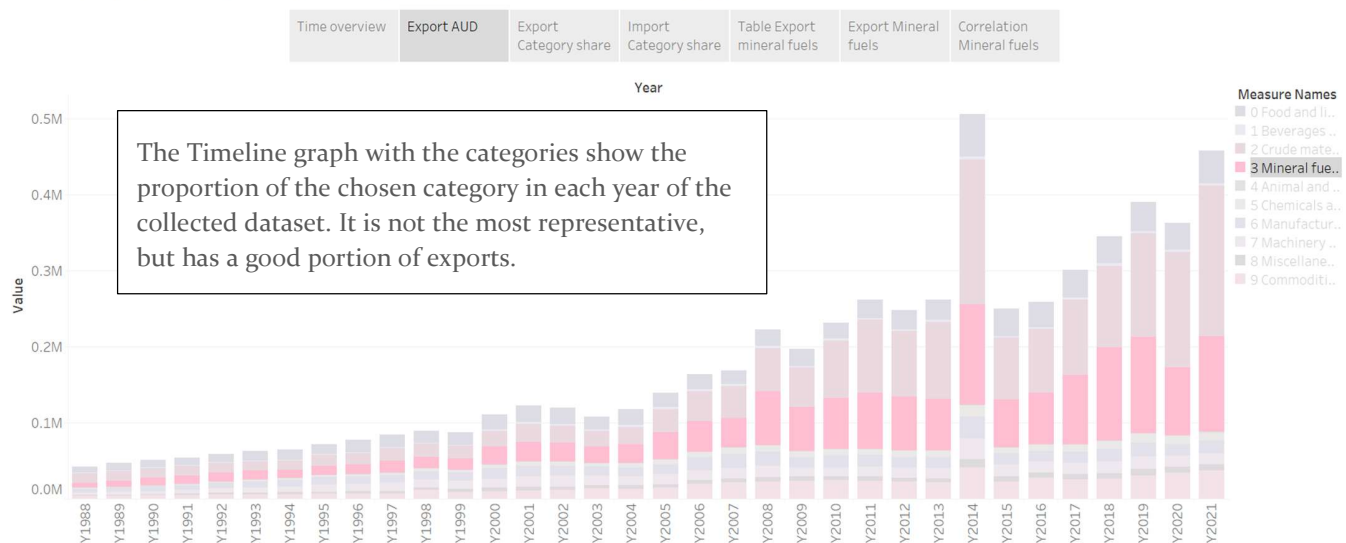Import growth per main category year over year (Y-o-Y)
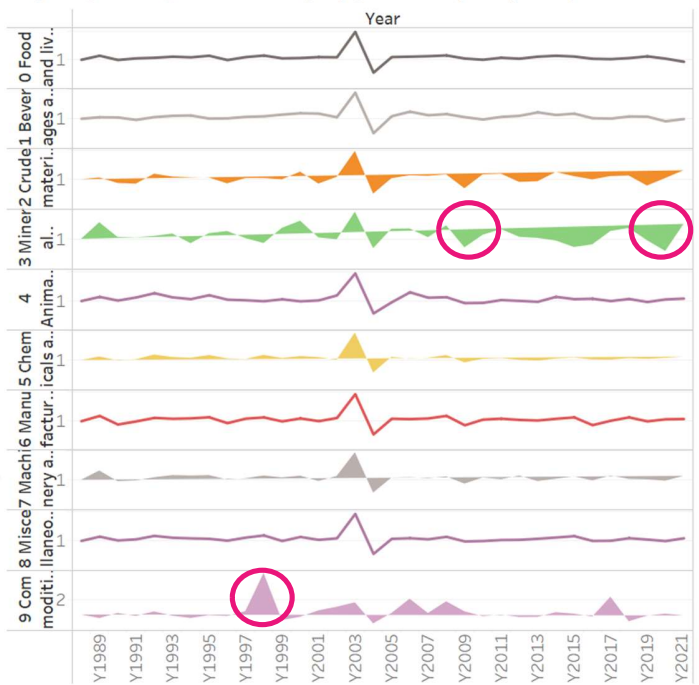
Data Storytelling: Visual Storyboard

Task 7. Create a visual storyboard for ONE main category to illustrate relationship between those trends and breakthrough points.

The Story board chosen includes the Category "3 Mineral fuels, lubricants and related materials", which is analyzed in detail below including import and export values, as well as sub-categories correlations. The objective is to show the general Import and Export situation for Australia and later break down into the categories and its importance to each trade, lastly show the importance of the chosen category and sub-categories for the Australian export.

Australia import and export of Mineral fuels, lubricants and related materials

The Timeline graph with the categories show the proportion of the chosen category in each year of the collected dataset. It is not the most representative, but has a good portion of exports.

Australia import and export of Mineral fuels, lubricants and related materials

Side Bars above and below compare the categories horizontally for proportions of the Trade, giving a clear overview of importance level to the specific Trade account (in the case above exports, while below is import)

Australia import and export of Mineral fuels, lubricants and related materials

| Time overview | Export AUD | Export Category share | Import Category share | Table Export mineral fuels | Export Mineral fuels | Correlation Mineral fuels |

Australia import and export of Mineral fuels, lubricants and related materials

| Time overview | Export AUD | Export Category share | Import Category share | Table Export mineral fuels |

Year	3 Mineral fuels, lub..	32 Coal, coke and b..	33 Petroleum, petr..	34 Gas, natural and..
Y1988	6,461	4,636	1,615	210
Y1989	7,234	5,314	1,660	260
Y1990	9,596	6,024	2,882	690
Y1991	10,877	6,857	2,915	1,105
Y1992	11,612	7,345	3,123	1,144
Y1993	11,983	7,798	2,964	1,221
Y1994	10,671	6,750	2,705	1,216
Y1995	11,980	7,433	3,029	1,518
Y1996	13,002	7,818	3,508	1,676
Y1997	14,966	8,821	4,102	2,043
Y1998	15,078	9,849	3,374	1,855
Y1999	14,460	8,406	4,174	1,880
Y2000	23,041	9,349	10,465	3,227
Y2001	25,430	12,514	9,212	3,704
Y2002	24,700	12,877	8,622	3,201
Y2003	21,345	10,900	7,244	3,201
Y2004	23,836	13,475	7,088	3,273
Y2005	35,571	21,895	9,054	4,622
Y2006	39,335	23,357	9,812	6,166
Y2007	38,264	20,875	11,211	6,178
Y2008	71,108	46,868	13,808	10,432
Y2009	57,833	39,602	9,600	8,631
Y2010	66,590	43,125	12,957	10,508
Y2011	73,391	46,948	14,396	12,047
Y2012	70,344	41,566	14,286	14,492
Y2013	67,513	40,009	11,783	15,721
Y2014	131,867	74,730	24,111	33,026
Y2015	62,249	37,110	8,085	17,054
Y2016	67,699	42,273	6,946	18,480
Y2017	91,150	57,133	7,662	26,355
Y2018	122,278	66,855	11,192	44,231
Y2019	126,242	63,941	12,177	50,124
Y2020	89,566	43,365	8,502	37,699
Y2021	126,152	62,034	13,232	50,886

Once has been clarified the main points to the general overview, it is possible to convey further details about the account with a Table and inputs to each sub-category.

The table on the left shows export amounts for the category and sub-category chosen. We can see that Coal and Coke are the biggest contributors to the exports of the Category Minerals fuels. After 2013 Gas, natural and manufacture set itself apart as the second largest contributor to this category with strong participations on Y-o-Y share.

The next graph is a scatter plot chart which shows correlation between variables. Since sub-category "32 Coal, coke and briquettes" is the strongest among all three, the correlation between this sub-category and the main category is stronger than any other correlation, this is represent by the dots (points) closeness to the trend line.

The other sub-categories have their dots more distant to the trend line and the distance increases as the monetary values also increase. Below you can see that many dots (points) are located no only outside of the trend line, but also outside the auxiliary trend line in red, which convey a higher standard deviation of these points (dots) from the normal trend.

The sub-category "34 Gas, natural and manufactured" has gained importance over time in the category and it does represent a greater participation in the total value in 2021 compared to 1988, this is reflect in the chart below, with fewer points outside the limits of the auxiliary trend line as the monetary value gets higher. Most of the points outside the trend line for this sub-category is located between 60K and 80K of the Y-Axis. Meanwhile the sub-category "34 Gas, natural and manufactured" has most points away from the trend line in the intervals 20K – 40K as well as 80K – 130K.

The second scatter plot convey the same message, but in one visual graph, which is summarized in four different dimensions (X-Axis, Y-Axis, color and size.

Australia import and export of Mineral fuels, lubricants and related materials
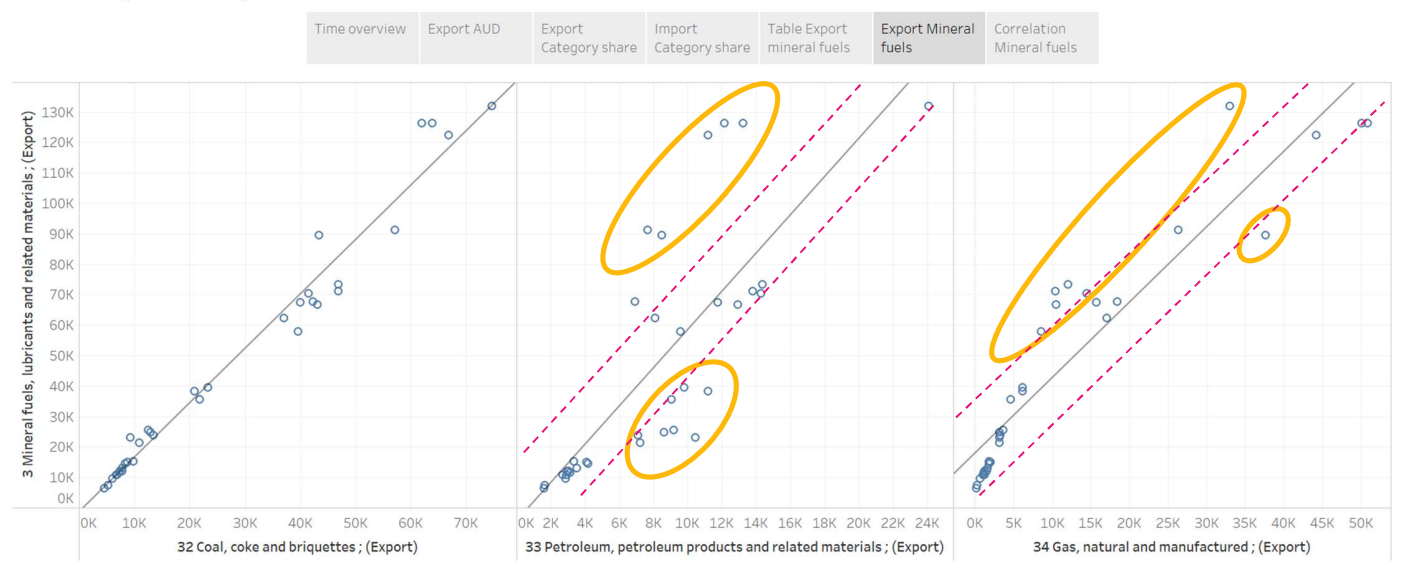
Australia import and export of Mineral fuels, lubricants and related materials
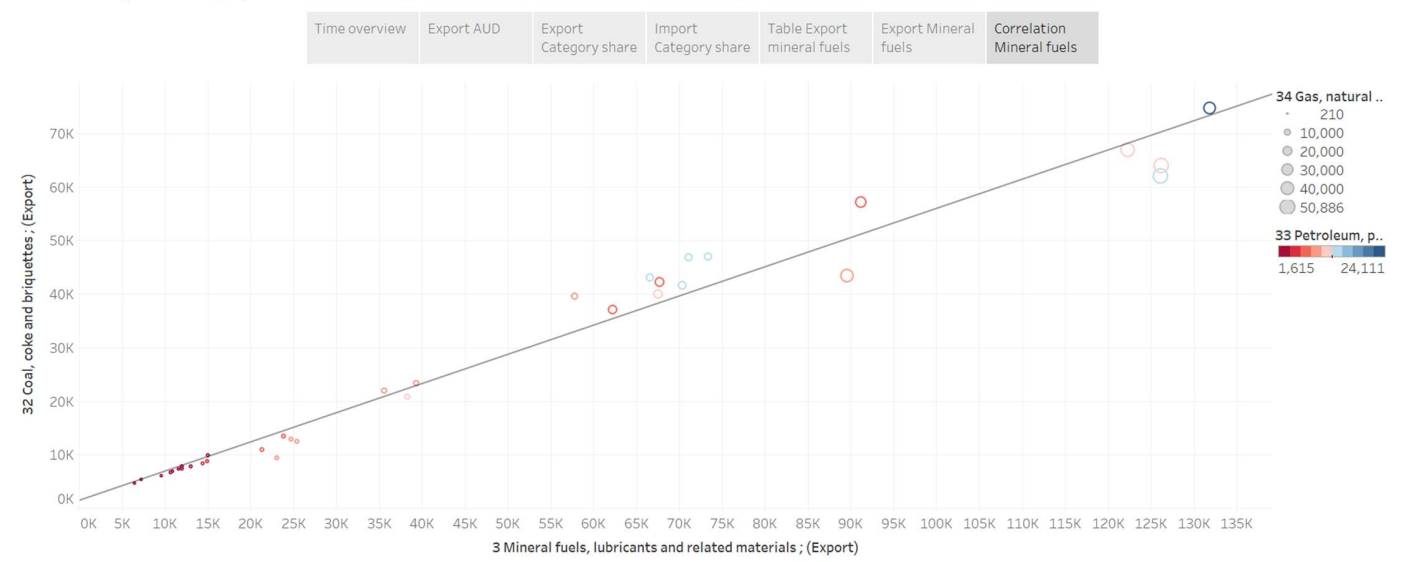
Summary: Visual Dashboard & Visual Storyboard

Task 8. Write a summary for the visual dashboard and story board highlights and advantages.

Visual Dashboard comprises all the information related to a topic in one screen, which can be very challenging if the graphs are to big or full with information. To make better use of Visual Dashboards it is better to include very specific topics and highlights in the graphs in order to convey a clear message.

During the preparation of the Visual Dashboard, I included only two graphs in each Dashboard in order to allow stakeholders to focus on a very specific topic : Australian export and import figures over time per main category. The graphs gave a clear picture of the data statistical and analytical patterns calculated during class.

With the available information it is possible to see that Australia has a good balance between import and export over the years, which has a positive effect on economic growth. Even though its exports are mostly characterized by products with low aggregated value (minerals and crude materials), while the imports are heavily weighted on products with high aggregated value (machines and manufacture goods), this does not create an economic disadvantage for the country as the GDP growth shows a robust development. As we can see from the Graph[1] below, since 1961 the Australian economy experienced recession only three times and covid recession was more of a growth stagnation rather than a negative contraction.

Findings and Recommendation

Task 9. Write a report to summarise the results of visual analytics for selected categories. Any recommendation should consider the Australian local industry's impacted.

International trade and trade balance can be complex topics. Many theories about international trade and the advantages of surplus in the trade accounts have been acknowledge over the years (mercantilism, bullionism), though United States has been running continuous trade deficits over the years and still has one of the strongest GDP growth globally. On the other hand Japan and Germany are well know for their strong export and positive trade accounts, though their GDP growth over years is not as strong as USA and China.

It is reasonable to say that if you have to import goods that you are not able to produce, you might get dependent on the situation and not try to develop your own solutions. In the case of Australia this might be a reasoning why the country does not have a strong manufacturing sector, despite the high level of education and resources available in the country. While doing this analysis I asked myself, why Australia needs to import so much on machines and manufactured goods if they have the natural resources, good educational levels, skilled workers and a culture that allows qualified people to start up business in the country? Germany, UK, Switzerland and Japan are well known for their strong manufacturing skills and exports, as

well as their high wages and social costs, therefore Australia also has all possible tools to build up a strong manufacturing economy.

The risks of creating a dependency situation in imports can be dangerous at some point, Europe for instance has created a co-dependent situation with Russia for oil and natural gas, which turned out to be unsustainable this year due to political conflicts. Despite having qualified engineers and resources to develop alternative energy resources, Europe and the world have relied on one supplier that can dictate conditions and limitations according to its free will. As in 1970´s oil crisis, this has shown a non-constructive approach to a strong global economy.

As a conclusion, I would highly recommend the investments in manufacturing industry with focus on products that have high aggregated value. This helps bring technical knowledge, high income individuals and also develop key industries and products that would rather be done locally.

Reference

1. https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?end=2021&locations=AU&start=1961&view=chart