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Assessment Task 3:

Visual Analytics

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Executive Summary

The report offers a comprehensive and insightful visual analysis of the Australian International Trade in the past 36 years, primarily focusing on the food and live animal main category of exports and imports. The relationships and patterns between the subcategories and the main categories are analysed and presented using a storyboard with a further focused analysis of two of the sub-categories of meat items and vegetables, presented using a dashboard for a more interactive and dynamic analysis of trends. The report concludes by offering recommendations based on insights gained during the main category analysis regarding strategies to boost export/import as well as potential vulnerabilities and strategies to overcome economic downturns such as the 2008 financial crisis.

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1.0 Introduction

The report presents a comprehensive look at the Australian Trade data from 1988 to 2023, primarily focusing on the food and live animal category by utilising visual analytics. It begins with an explanation of the data preparation procedure, followed by a brief analysis of the main categories in Australian trade regarding statistical, analytical and raw dollar value trends. The report then delves into a more detailed analysis of the subcategories of the selected main categories, utilising storyboards to highlight insights gained, as well as a more focused analysis of the meat and vegetable subcategories by using dashboards to compare and understand potential patterns between the subcategories. The analysis will conclude with a summary of the advantages and disadvantages of the dashboard and storyboard tools, and recommendations to boost export/import in the food and live animal categories, as well as potential strategies to minimise the effect of adverse market conditions.

2.0 Data Exploration and Preparation

The dataset used for this report is an Australian Trade Dataset, extracted from ABS Statistics data, containing data through 36 years, from 1988 to 2023. The dataset provides import and export information on ten main categories and 67 categories. The ten main categories are listed below:

- 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

Category 0, representing food and live animals, was selected as the main category for subcategory analysis in this report.

2.1 Excel Data Preparation

Considering this dataset's large number of categories and subcategories, the original export and import data sheets were transformed into three comprehensive sheets representing different patterns in the dataset for a much more straightforward data analysis.

The “Analytics” sheet represents the percentage change over time for all the export and import data categories relative to 1988. Each value for each category was calculated using the following formula.

Percentage change of category A in year YYYY = (Category A value in YYYY) / (Category A value in year 1988) *100

The “Statistics” sheet represents the portions of subcategories in its main category total and the portions of main categories in the total of exports or imports. It shows how subcategories add up to the main categories. The values for the subcategories and the main categories are calculated as below.

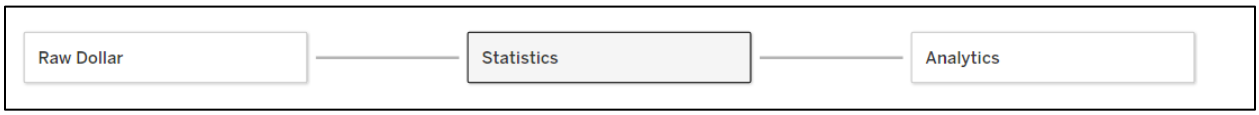
Subcategory portion (%) = (Subcategory value) / (Main Category value) * 100

Main category portion (%) = (Main category value) / Total * 100

The “Raw Dollar” sheet summarises the raw dollar values in millions for exports and imports combined into a single sheet.

2.2 Tableau Data Preparation

In order to use these three sheets in the visual analysis in Tableau, it was necessary to combine them by forming relationships as follows. The relationships were formed using the “Time” and “Trade” columns, which were common for all sheets in terms of values.



Further, the “Time” attribute was converted into a Date data type so that Tableau interprets its data as years instead of mere string values for a more accurate analysis.

3.0 Data Visualisation of All Main Categories

3.1 Analytical Trends

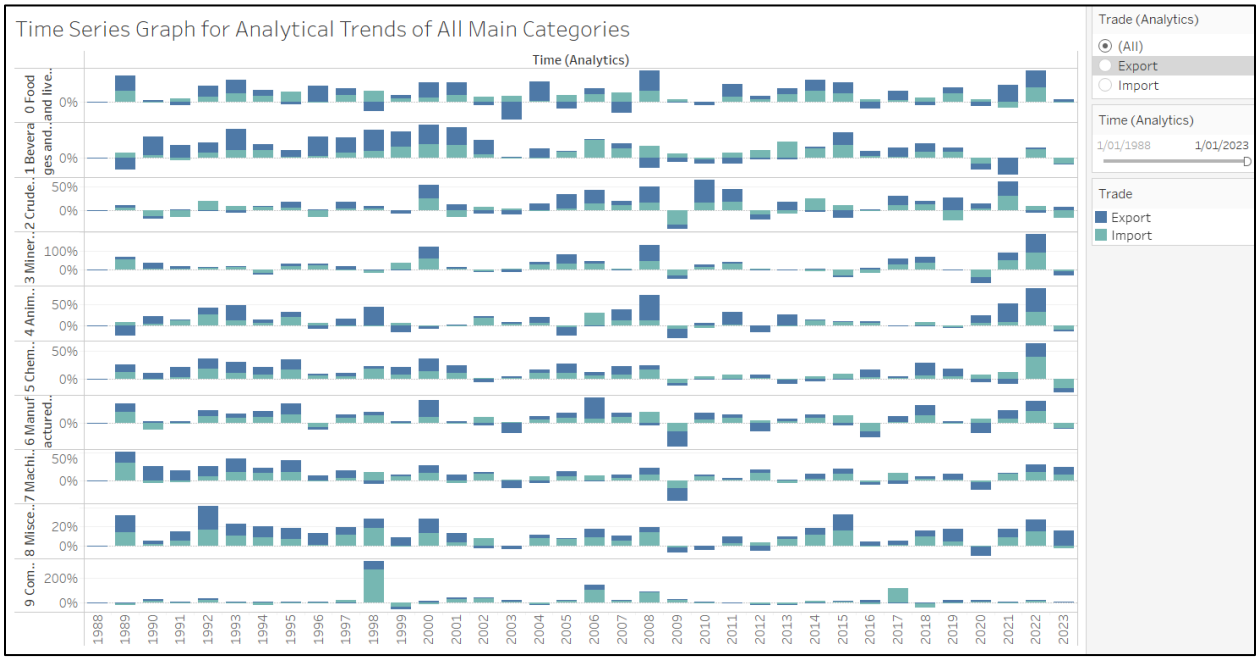


Figure 1: Time Series Graph for Analytical Trends of All Main Categories

Figure 1 illustrates the analytical trends of Australian trade data for all the main categories from 0 to 9, highlighting the percentage change in exports and imports over the years relative to the year 1988. Fluctuations in exports seem to be more significant, whereas the fluctuations in imports are relatively stable. Category 9, representing commodities and transactions not classified elsewhere in the SITC, shows the most minor fluctuations, suggesting no recognisable change in exports and imports for that category since 1988. In contrast, most fluctuations can be seen in categories 0, 1 and 8, where most changes indicate a relative increase in exports and imports since 1988.

This graph was created by assembling the “Time” attribute in columns and all the main categories with sum aggregation functions in rows. Stacked bar charts were utilised to show the relative percentage of exports and imports for a better comparison, separating the trade types by colour. A Trade filter is also used to allow the separate analysis of exports and imports as well as a combined analysis. Another filter is also in place to filter the date range from 1988. These filters allow the user to shift the focus of data based on the type of trade and time to analyse an area of data the user is interested in.

3.2 Statistical Trends

Statistical Trends represent the percentage of the total exports or imports for each main category. Figures 2 and 3 utilise stacked area charts to highlight the relative contribution of each main category to the overall exports and imports in Australia. Using colours to represent each category was also helpful in highlighting how the patterns change for exports and imports.

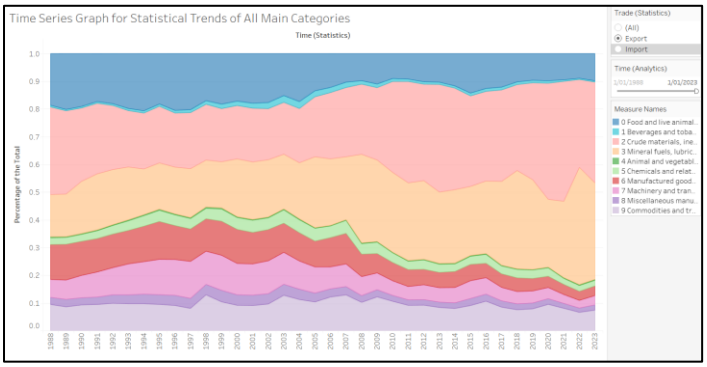


Figure 2: Time Series Graph for Statistical Trends of All Main Categories (Filtered for Exports)

In analysing the statistical trends of all main categories, Figure 2 focuses on Exports by filtering out Imports. Categories 2 and 3, representing crude materials and mineral fuels, respectively, dominate Australian exports, showing an increasing trend over the years. Categories 0, 6, and 7, however, show a decreasing trend over the years, which may indicate a decreasing surplus of these with time. Category 1, representing beverages and tobacco, makes the most minor contributions for exports in Australia, with a slight peak in the early 2000s. Most other categories show a low, stable contribution towards overall exports over the 36 years of Australian international trade, as indicated in Figure 2.

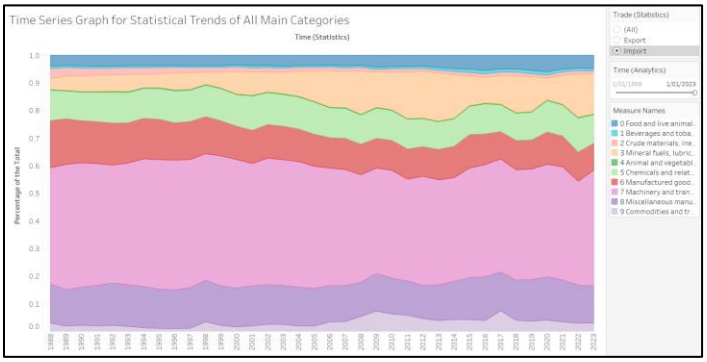


Figure 3: Time Series Graph for Statistical Trends of All Main Categories (Filtered for Imports)

Figure 3 focuses on the statistical trends of imports in Australia over the years. Like in export data in Figure 2, category 1, representing beverages and tobacco, shows the most minor contribution in overall imports, suggesting there's no surplus or shortage of these in Australia. Rather contrastingly, categories 2 and 3 that dominated exports showed relatively low contributions to imports, indicating a surplus of these products. Category 7, representing machinery and transport equipment, comprises a large portion of imports in Australia throughout the years, remaining consistent over the years.

3.3 Raw Dollar Value Trends

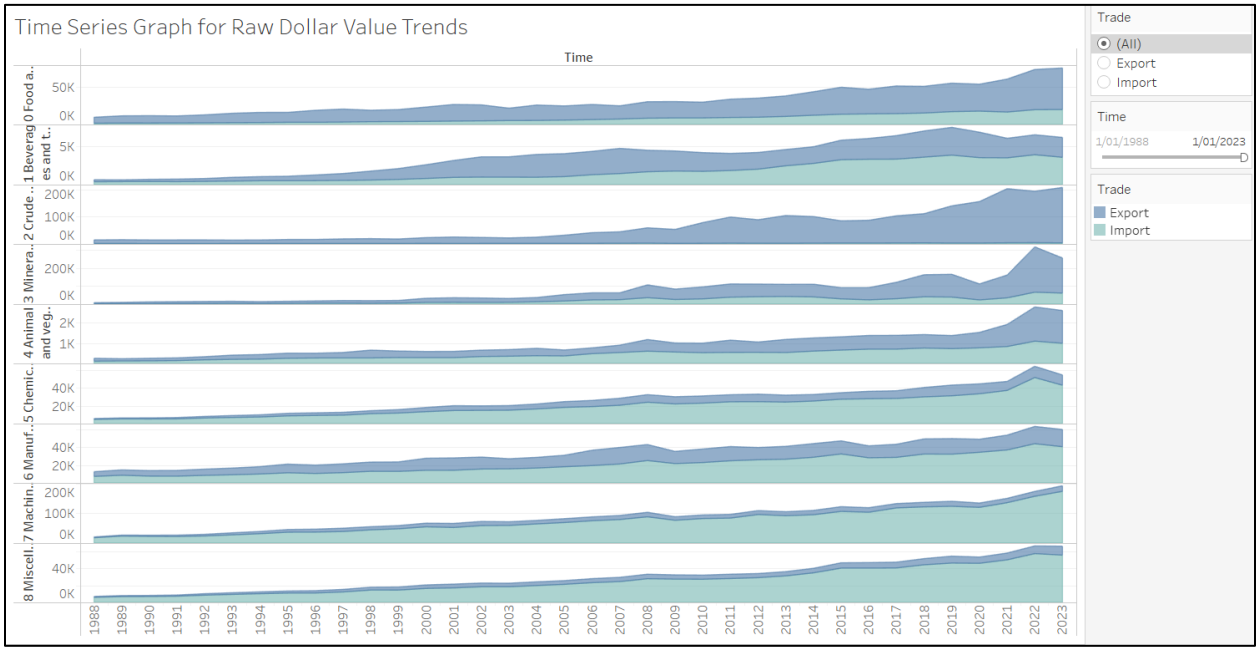


Figure 4: Time Series Graph for Raw Dollar Value Trends

Raw dollar value trends depict the income of exports and expenditure for imports in millions of dollars for each main category over the years. For all the categories, export values exceed import values in Australian trade, and there's an overall increasing trend in the raw dollar value for all the categories in both exports and imports over the years. For categories 1 and 2, representing beverages and tobacco and crude materials, respectively, the import raw dollar values remain relatively low. The highest import raw dollar values can be observed for categories 5, 6, 7 and 8, running close to the export raw dollar values.

The graph was assembled similarly to the graph in Figure 1. However, Figure 4 utilises area charts to depict the raw dollar value trends over the years. Even though area charts are primarily used to show patterns in data that contribute towards a total, in this case, area charts were preferred over line charts as it is much easier to visually interpret the magnitude difference between the export and import raw dollar values.

3.4 All Main Categories

The treemaps in Figures 5 and 6 give an overview of the main categories throughout the years to illustrate the average contribution of each category to the overall exports and imports, respectively.

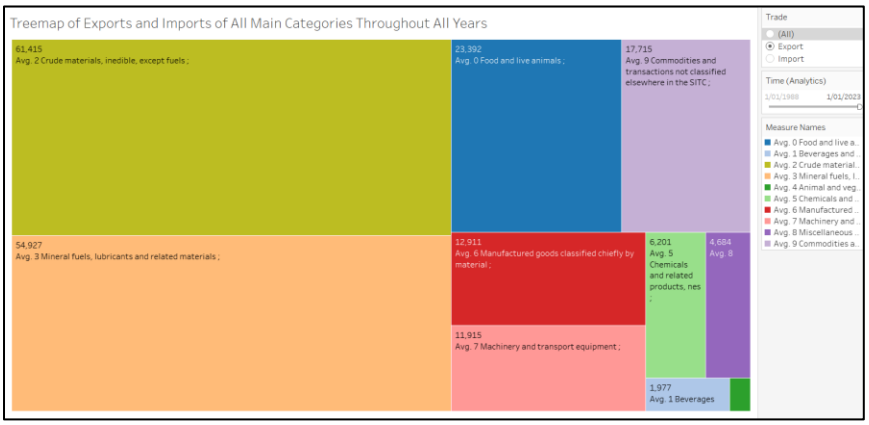


Figure 5: Treemap of Exports and Imports of All Main Categories Throughout All Years (Filtered for Exports)

Categories 2 and 3 have consistently dominated exports over the past 36 years, occupying more than half of Australian International trade in exports. The most minor contribution towards exports is by category 4, representing Animal and vegetable oils, fats and waxes, as indicated by the category occupying the least space in the Treemap. These patterns are mostly consistent with the observations in Figure 2, which gives a more detailed comparison of the contributions over the years.

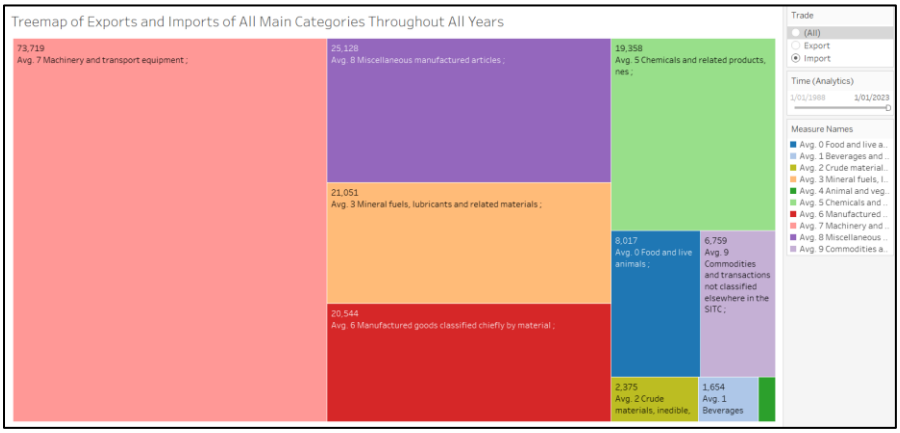


Figure 6: Treemap of Exports and Imports of All Main Categories Throughout All Years (Filtered for Imports)

The majority of Australian imports have been occupied by machinery and transport equipment. Categories 8, 3 and 6 also occupy a significant portion of imports. Although there are changes in distribution for these categories at different times, as illustrated in Figure 5, on average, they show an equal distribution throughout the years. A similar observation can be seen for category 4, for exports as well as imports, which contribute the least to Australian international trade.

4.0 Data Visualisation and Analysis of the Food and Live Animals Main Category and its Subcategories

4.1 Statistical Trends

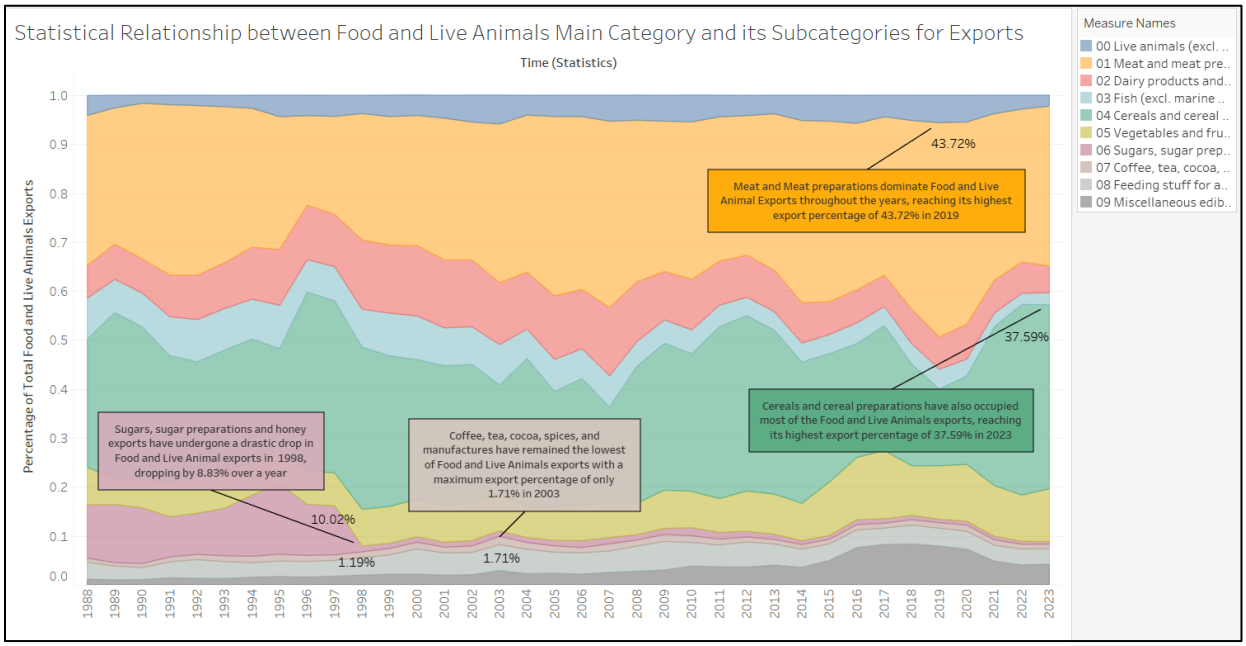


Figure 7: Statistical Relationship between Food and Live Animals Main Category and its Subcategories for Exports

Figure 7 visualises the statistical relationship between the food and live animal main category and its subcategories for exports, showing their contribution towards the total exports of the main category.

Meat and meat preparations dominate the food and live animal exports, consistently maintaining a high percentage of total exports throughout the years. It reached its highest export percentage of 43.72% in 2019 as the highest contributor among other subcategories. Although Australia is a small-scale meat producer at a global level, meat items have consistently dominated food and live animal imports. This is because of its small population and, therefore, smaller consumption rates, which means Australia can export about 60% of its meat production (PWC, 2011).

Cereals and cereal preparations have also occupied most of the main category exports through the years, peaking in recent years, with a high of 37.59%, dominating the meat and meat preparations subcategory. The rising trend in cereal exports can be explained by the record high grain harvests in the past two consecutive seasons in Australia, which has created a stronger demand for grain exports, according to ACCC (2022). The rising demand for cereal products can also be explained by the recent shifts in global dietary preferences towards increased cereal consumption due to its health benefits.

Coffee, tea, cocoa, spices, and manufacturers have consistently shown the lowest contribution towards the main category exports over the years, with a maximum export percentage of only 1.71% in 2003. This could be due to the competition of these products in the international market, possibly supported by the increased domestic demand, reducing the incentive to export coffee, tea, cocoa, and spices in Australia.

Although the subcategory of sugars, sugar preparations and honey contributed to the main category exports a relatively significant amount in the early years, a drastic drop in the export percentage can be observed in 1998, with an 8.83% drop over a year. Since then, it has remained one of the lowest contributors to the main category exports until 2023. Despite increasing the sugar cane plantations in Australia during 1988-1999, the expected sugar crop decreased by 3%, leading to this drop in Australian sugar exports. This was mainly due to poor growing conditions due to continuous rain damage, which is expected to continue for the following seasons, as Zeitner reported in 1998.

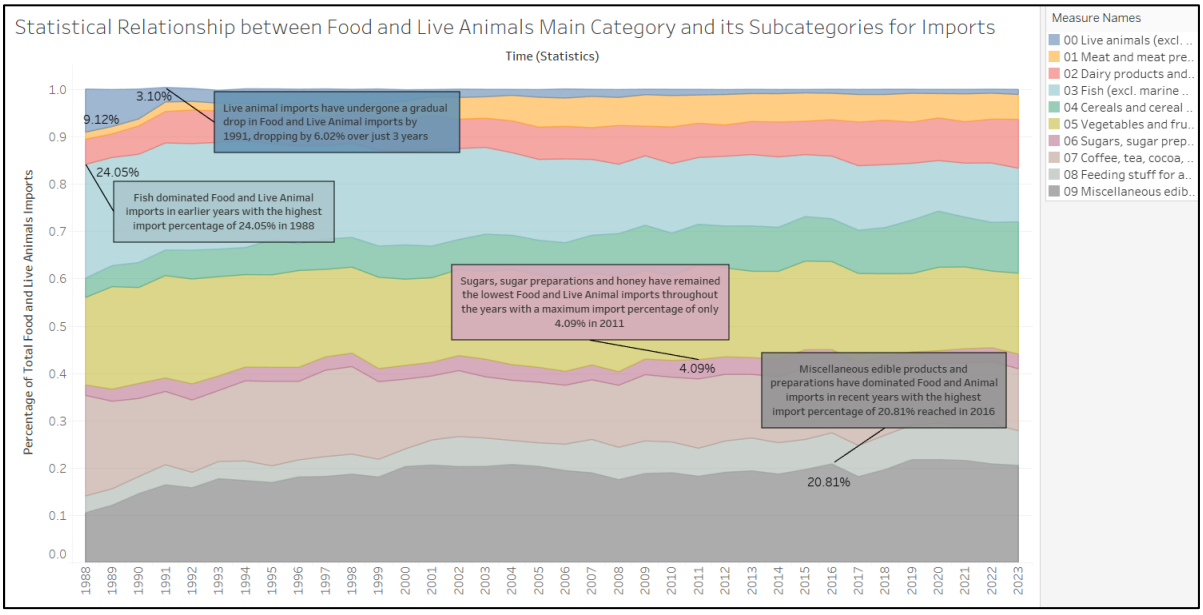


Figure 8: Statistical Relationship between Food and Live Animals Main Category and its Subcategories for Imports

Figure 8 visualises the statistical relationship between the main category of food and live animals and its subcategories for imports, showing their contribution towards the total exports of the main category. Compared to the export visualisation, most subcategory imports show a relatively equal contribution towards overall imports of the main category, where there are no prominent predominant subcategories with a considerable gap among others.

Dominating the food and live animal imports by a small gap, fish imports peaked at 24.05% in the early years, with a noticeable decline in dominance over time. Fish dominated the food and live animal imports as Australia imports 65% of its fish consumed. However, during the lockdown phase of the COVID-19 pandemic, fish imports were restricted, encouraging domestic producers to

increase their fish supplies and boost the domestic fish market (Oiger et al., 2021). This explains the gradual decline in fish imports in Australia towards recent years.

On the other hand, miscellaneous edible products and preparations have shown increasing dominance among other subcategories in recent years, reaching the highest import percentage of 20.81% in 2016. This could be because of the increasing global demand for processed, ready-to-eat food with the change in lifestyle due to urbanisation and busy work cultures.

Sugars, sugar preparations, and honey have consistently maintained low import percentages and are the lowest contributors towards the main category imports. This is because Australia primarily focuses on exporting sugars, as they have suitable harvesting conditions with a harvest that is more than enough to supply the domestic sugar demand.

Live animal imports also show a gradual decline in imports, with a significant drop of 6.02% over three years by 1991, remaining the lowest contributor since. This could be because of the preventive guidelines implemented in 1991 regarding the import and control of exotic vertebrate animals in Australia (Natural Resource Management Standing Committee, 2004).

4.2 Raw Dollar Value Trends

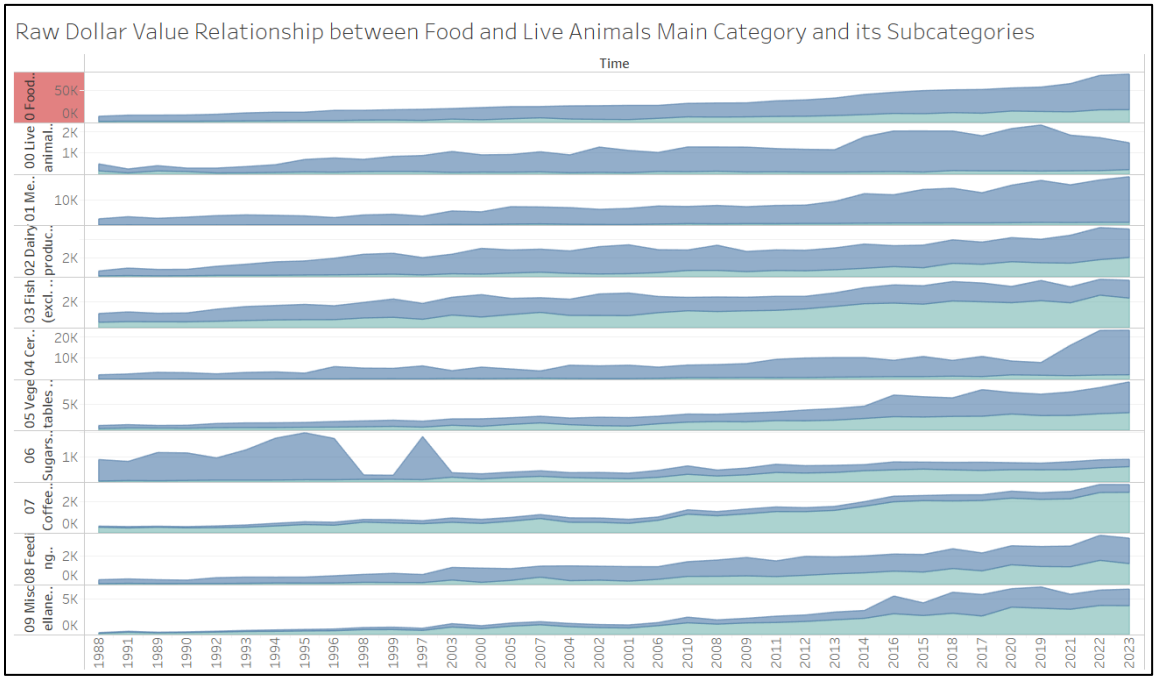


Figure 10: Raw Dollar Value Relationship between Food and Live Animals Main Category and its Subcategories

Figure 10 illustrates the raw dollar value trends of the food and live animal main category and its subcategories to analyse how changes in the main category are influenced by different subcategories.

For exports, subcategories 1 and 4 show the most similar patterns to the main category, indicating a gradual increase in the raw dollar value over time. As analysed before in Figure 7, these subcategories have the highest contribution of exports towards the main category, which explains why these categories have more influence towards the raw dollar value pattern.

However, for imports, most values are under 2000, which can also be seen in the main category import raw dollar value. This, again, can be explained using the statistical analysis for imports by referring to Figure 8, where it was identified that almost all subcategories have a relatively equal contribution of imports towards the main categories. Therefore, the main category's overall raw dollar value trend isn't strongly influenced by any of the subcategories, remaining relatively stable when there are significant changes in any of the subcategories.

4.3 Analytical Trends

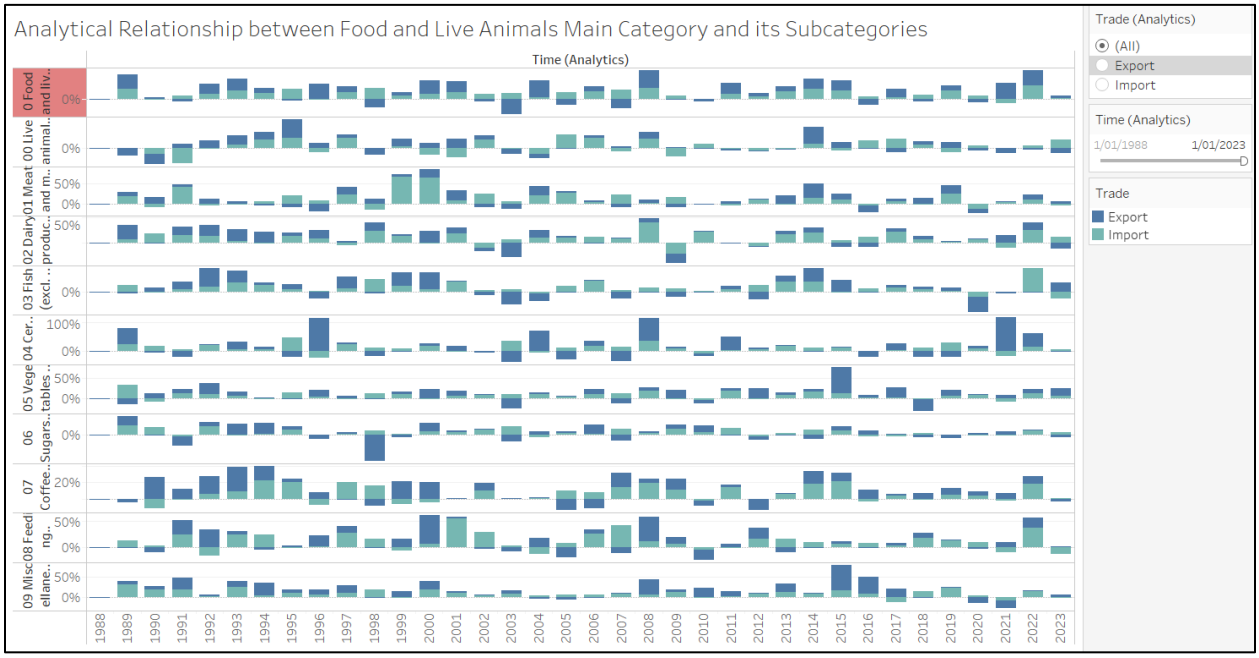


Figure 9: Analytical Relationship between Food and Live Animals Main Category and its Subcategories

Figure 9 illustrates the analytical trends of the food and live animal main category and its subcategories to analyse how the percentage changes of exports and imports of the subcategories, relative to 1988, have influenced the percentage of exports and imports of the main category.

The main category shows more export fluctuations over the years, with relatively stable and minor import fluctuations. Similar patterns can be observed in the fish and miscellaneous subcategories, where export fluctuations are more predominant, with only minor import fluctuations. While export fluctuations are significant across many categories, import fluctuations are relatively stable only for the previously mentioned categories. This indicates that fish and miscellaneous subcategories primarily influence import fluctuations in the main category. This could be because of the relative stability of the imports of these subcategories observed in the statistical analysis in Figure 8.

5.0 Dashboard

The dashboard depicted in Figure 11 attempts to analyse the relationship between the two subcategories of the selected main category: meat and meat preparations, and vegetables and fruits. The dashboard combines three visualisations of analytical, statistical, and raw dollar value trends to compare the two subcategories in detail and derive insights. The dashboard allows filtering all the charts based on the trade type and the date range to focus on particular areas of interest. It is also possible to highlight a specific data point in all charts by selecting the data point in just one chart, making it more interactive by shifting the focus of data when needed.

It is important to note that the analytical trends chart utilises quick table calculations to illustrate the percentage change in terms of a positive or negative change. As this is configured to calculate the percentage change relative to the first year, it facilitates a more dynamic look at the data by filtering the starting date to see the percentage change of exports and imports relative to a selected year. However, this restricts the analytical trends chart from being filtered when a single data point is selected in one of the other charts because, with no second data point to calculate the percentage difference, the chart doesn't provide the information it is meant to provide. To ensure the analytical trends chart doesn't malfunction due to this, it was configured to ignore any actions of the other charts.

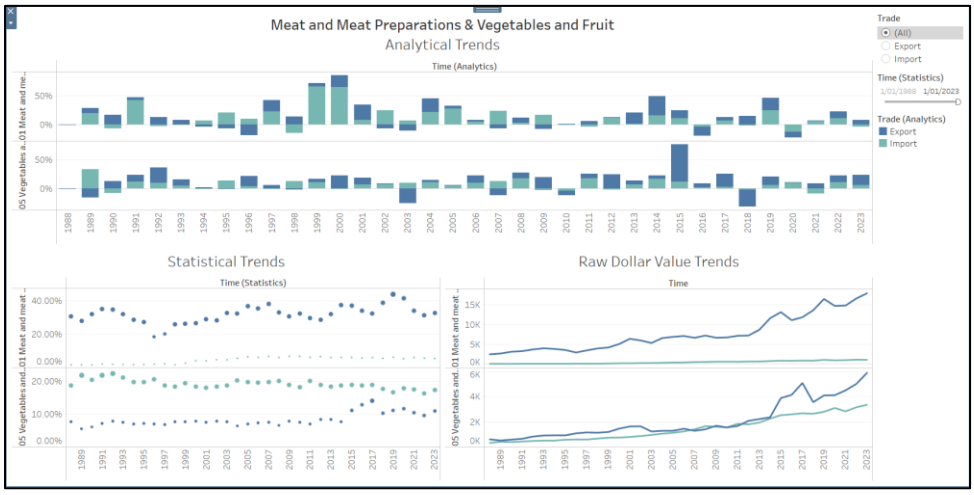


Figure 11: Dashboard for Meat and Meat Preparations & Vegetables and Fruits Subcategories

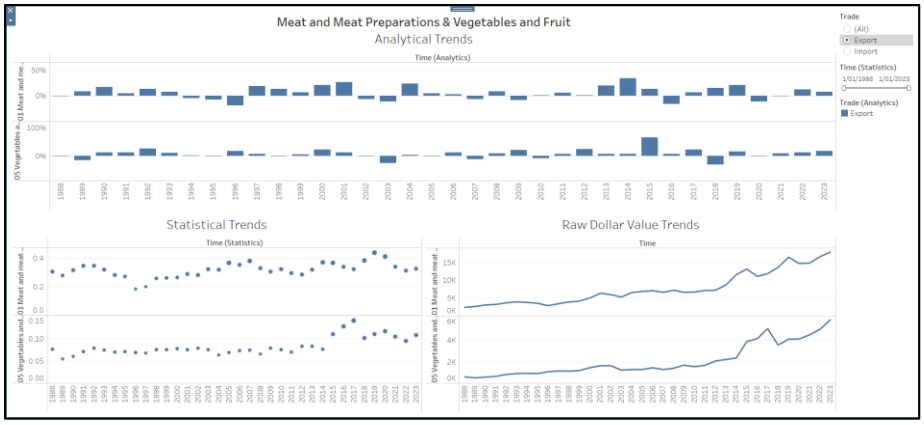


Figure 12: Dashboard Filtered for Exports

Analysing export trends for meat and vegetable subcategories in Figure 12, it seems that meat exports show more fluctuations over the years, whereas vegetable exports tend to be more stable. Looking at the statistical trends for these categories, meat items significantly contribute to overall food and live animal exports, ranging from 30%-40%. In contrast, vegetables and fruits are around 5%-15%, as a relatively low contributor.

Meat items, with a higher percentage of total food exports in Australia, have more significant economic importance than vegetables and fruits and, hence, are more sensitive to changes in market conditions and trading policies. This explains the volatility of meat exports over the years and how it depends on their significant contribution to overall food exports. The subcategories of meat items and vegetables, and fruits behave rather contrastingly in terms of economic importance and market sensitivity.

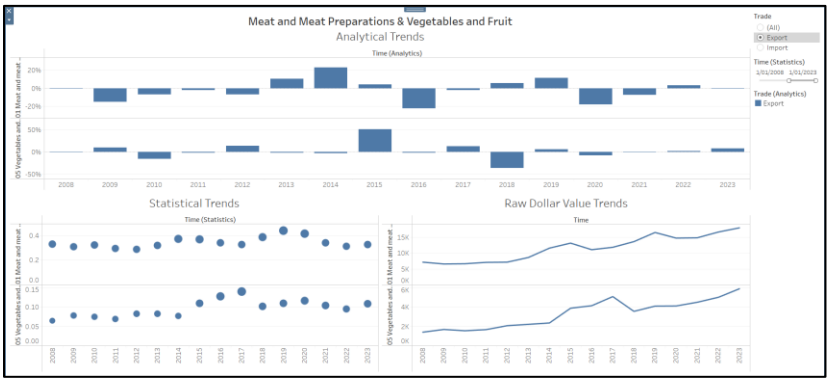


Figure 13: Dashboard Filtered for Exports and Date Range Narrowed to 2008-2023

In order to analyse how the 2008 financial crisis affected exports of these subcategories, the date range was narrowed down to a range of 2008-2023, as shown in Figure 13. Therefore, the analytical trends now show the percentage change in exports relative to 2008.

The meat items subcategory has seen continuous drops in exports relative to 2008 up until 2012. While vegetables and fruits also depict drops in exports, it has been relatively stable compared to the other subcategory. The impact of the 2008 financial crisis can also be observed in the rate of increase in the raw dollar value trends, where the raw dollar value increase has stagnated more for

meat items than for vegetables. During the post-crisis period after 2012, the recovery of vegetable exports seemed more immediate, with a sharp increase in the raw dollar value. In contrast, for meat exports, the recovery of the rate of increase of the raw dollar value was more gradual.

These observations highlight how the impact of the financial crisis was less severe for vegetable exports than meat exports, and the recovery was also more immediate for vegetable exports, while it was slower and more gradual for meat exports. This can be because vegetables and fruits are considered essential food items. Therefore, they showed a more stable demand even through the financial crisis and quickly recovered after the crisis. As meat is not considered an essential food item, unlike vegetables, there was a drop in demand due to the reduced disposable income of consumers during the financial crisis, and meat was no longer affordable. This shows how the nature of the two subcategories affects their economic resilience during a major financial crisis.

6.0 Storyboard

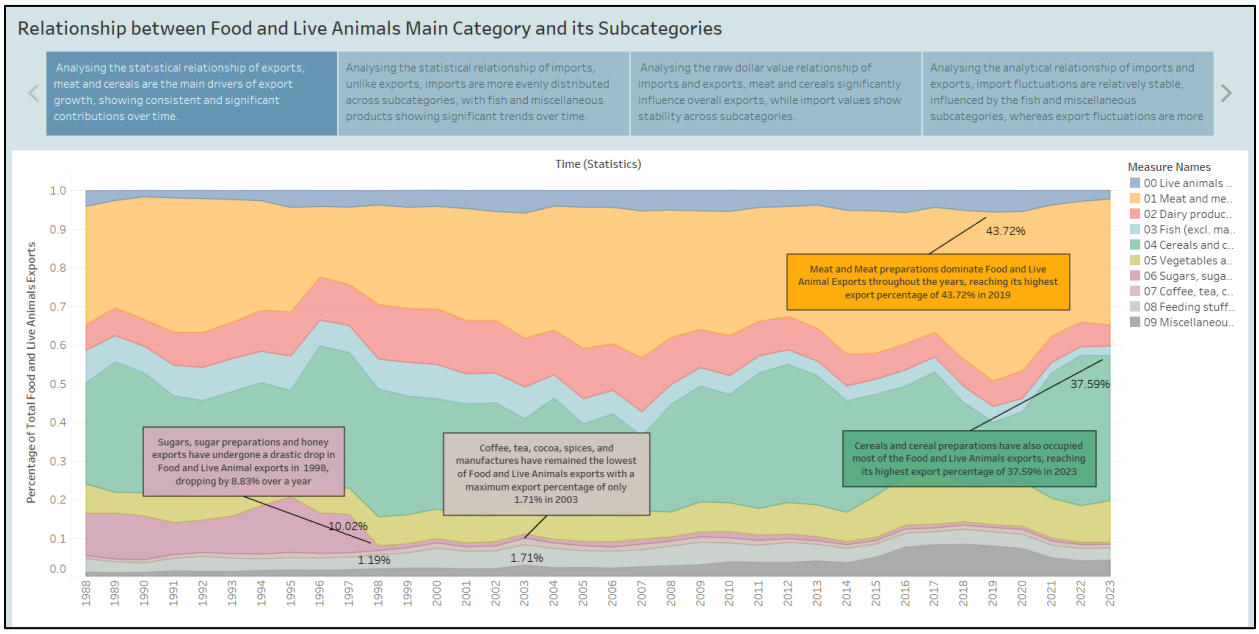


Figure 14: Storyboard about the Relationship between Food and Live Animals Main Category and its Subcategories

The storyboard illustrated in Figure 14 combines all visualisations analysed in section 4.0, attempting to tell a story about the relationship between the food and live animal main category and its subcategories across statistical, analytical and raw dollar value trends.

First, the storyboard takes the viewer through the statistical relationship of exports between the main category and its subcategories, highlighting how the meat and cereal subcategories primarily drive exports. Moving on to the statistical relationship of imports, the contrast between exports and imports is noted, where imports of the main category are evenly distributed among all subcategories, with fish and miscellaneous categories slightly dominant. In the raw dollar value trend analysis, a pattern is drawn with the statistical trends of exports, where dominant subcategories significantly influence the raw dollar value trend of the main category. It also highlights how the equal statistical distribution of imports among all subcategories has resulted in a stable raw dollar value trend across all import subcategories. Finally, the storyboard looks at the analytical relationships of exports and imports, signifying how the fish and miscellaneous categories follow a similar pattern to the main category's analytical pattern, suggesting that despite the significant import fluctuations across other categories, the stability of changes in imports over the years for the said subcategories have more influence towards the main category's import fluctuations.

Overall, the storyboard gives a comprehensive look at the relationship dynamic between the selected main category and its subcategories, drawing patterns across statistical, analytical and raw dollar value trends to help understand the main drivers and the overall import and export balance in the food and live animal main category.

7.0 Advantages and Disadvantages

7.1 Dashboard

Advantages

- Comprehensive presentation of data: the primary purpose of a dashboard is to combine multiple visualisations into a single place to give a broad look at data trends. The dashboard presented in this report looks into statistical, analytical and raw dollar value trends together to find patterns and present insights in an easy-to-digest form.
- Interactivity: the dashboard utilises filters such as trade type and date range to allow the user to focus the data on a specific area of interest, manipulating data as they want by interacting with these filters.
- Immediate insights on data points: the ability to highlight a specific data point in all charts, when highlighted in one, allows easy identification of patterns to gain immediate insights on particular data points and their behaviour across different categories.

Disadvantages

- Complexity: the combination of multiple visualisations with interactive features makes it more complex to create while ensuring all features work seamlessly, functioning together.
- Information overload and clutter: the advantage of comprehensive data presentation itself could be a disadvantage, leading to information overload, making it difficult to focus on what is relevant.
- Incompatibility of chart dynamics: as noted in section 5.0, the analytics chart couldn't be filtered to highlight a specific data point selected in another chart because the analytics chart utilises quick table calculations, which depend on having multiple data points. Therefore, the analytics chart couldn't be filtered with the other charts.

7.2 Storyboard

Advantages

- Narrative structure: the purpose of a storyboard is to present data in a story-like format, guiding the viewer through the relationships and trends presented, making complex data more understandable and engaging.
- Comprehensive look at insights: combining analytical, statistical, and raw dollar value trends into one storyboard provides a complete look at the patterns identified by all visualisations, highlighting relevance between visualisations as well.
- Targeted analysis: when presenting various visualisations in a comprehensive story, one can guide the viewer by focusing on the most significant relationships in each visualisation to identify critical patterns easily.

Disadvantages

- Less interactivity: unlike dashboards, storyboards are not interactive. With the limited ability to focus and explore specific areas of interest, the storyboard only allows one to see the presented patterns.
- Introduces narrative bias: the storyboard only allows the viewer to see the patterns highlighted and narrated by the creator; therefore, any bias in the storyboard may skew a viewer's understanding of the data.

8.0 Recommendations

Analysing the relationship between the main category and its subcategories, it was identified that meat and meat preparations and cereals and cereal preparations subcategories dominated export contributions towards the main category. It was also identified how these subcategories strongly influence the overall raw dollar value in the main category. Therefore, it is recommended that in order to see export growth in the food and live animal main category, targeted strategies to boost exports should be implemented in these dominant subcategories.

The focused analysis on the two subcategories of meat and meat preparations and vegetables and fruits highlighted that meat exports, which have the more significant contribution towards overall exports of the main category, are more vulnerable to market changes, as indicated by the continuous fluctuations of exports over the years. This suggests the need to develop strategies to stabilise meat exports with improved market access and better trading terms to minimise the meat market being severely affected by economic downturns.

The two subcategory analyses also identified how the vegetables and fruits subcategory quickly recovered after the 2008 financial crisis, with a sudden boom in the export raw dollar value for the said subcategory. This suggests that essential food items like vegetables and fruits can be promoted during a financial crisis to maintain trade balance due to the stable demand for such items even amidst a crisis.

Interactive dashboards, such as those in the report, can be utilised to monitor and respond to real-time trade data changes. Implementing such dynamic and interactive visualisation tools will better facilitate decision-making at governmental and organisational levels.

9.0 Conclusion

The report commenced with a quick look at the data preparation procedures of the Australian International Trade dataset, followed by a brief visual analysis of the main categories of import and export relating to analytical, statistical and raw dollar value trends. Then, a more in-depth analysis was conducted for the subcategories of the food and live animal main category to identify relationships and patterns, further narrowing the analysis to two of the subcategories to compare performance across different aspects of trade data. Storyboards and dashboards were also utilised to present the analysis conducted throughout this report, offering insights into main drivers and contributors towards the main categories and behaviour of subcategories towards market changes. The report concludes by providing recommendations on export growth strategies, potential vulnerabilities, and potential recovery strategies with changing market conditions, as well as recommendations of Tableau interactive tools for continuous analysis of international trade patterns for enhanced decision-making.

10.0 References

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