2023

Assessment Task 3

Visual Analytics

32146 Data Visualisation and Visual Analytics - Autumn 2023

13592629

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Table of Contents

Data Preparation

1. Data preparation and comprehension 2
2. Statistical and Analytical results and Data Formatting 2

Visualisation Technique 1. Time Series Charts

3. Time Series Charts for the ten main categories 3

Visualisation Technique 2. Interactive Chart

4. Interactive charts exploring details of trade for the ten main categories 4
5. Analytic charts of one main category and its sub-category 6

Visualisation Technique 3. Visual Dashboard

6. Visual dashboard: Time series chart and interactive chart of one main category and its sub-category 14

Data Storytelling: Visual Storyboard

7. Visual storyboard 16

Summary: Visual Dashboard & Visual Storyboard

8. Summary for visual dashboard and visual storyboard 18

Findings and Recommendation

9. Visual analytics summary & recommendation on Australian local industry 19

Data Preparation

1. Data comprehension

The sample trade data contains data about the history of Australia International Trade for both import and export from 1988 to 2022. All the units reported are in million-dollar.

1.1 Main categories: Particularly, the dataset contains ten main categories (for both import and export) representing all the industries in Australia:

0 Food and live animals
1 Beverage and tobacco
…
9 Commodities and transactions not classified elsewhere in the SITC

-1 TOTAL ;
A1828721W
$ Millions
42419

The -1 Total Column at the end is the sum of these ten export/import categories.

1.2 Sub-category: The export/import sector is further categorised into one level deeper. For instance, the second import sector *1 Beverage and tobacco* are split into two sub-categories:

11 Beverages;
12 Tobacco and tobacco manufacturers;

1 Beverage	11 Beverag	12 Tobaccc
A1828655I	A1828656I	A1828657I
$ Millions	$ Millions	$ Millions
367	264	103

The value of the main category is the sum of all sub-categories.

1.3 Merging

- Create a new datasheet in Excel called *Export-Import*. Input a new column after *Time* named *Trade* with two main types: Export and Import

Time	Trade
Y2021	Export
Y2022	Export
Y1988	Import
Y1989	Import
Y1990	Import

2. Statistical and Analytical results and Data Formatting

The values of the categories and subcategories are substantially different in scale. For instance, the category '1 Beverages and tobacco' started from a few hundred while the category '2 Crude materials, inedible, except fuels' ranged from 10,000 to nearly 200,000. Hence, converting these numbers into percentages and ratio changes would be more meaningful. Secondly, we can observe in the new sheet "Export-Import-Dataset" that there are more than 5000 numerical values to be processed. Hence, applying visual patterns allow the audience to fully comprehend the data and extract meaningful information. Also, the data visualisation patterns lead to the discovery of interesting insights and trends.

There are two famous data visualisation patterns: Statistical pattern and Analytical pattern

2.1 Statistical Pattern (Ratios)

The statistical pattern simply analyses the contribution of

- each of the ten main categories toward the total export/import
- each of the sub-categories toward the main categories

Time	9 Commodi	93 Special t	95 Gold coi	96 Coin (ex	97 Gold, no	98 Combine	-1 TOTAL ;
Series ID	A1827875V	A1827876V	A1827877X	A1827878A	A1827879C	A1827880L	A1827881R
Unit	$ Millions	$ Millions	$ Millions	$ Millions	$ Millions	$ Millions	$ Millions
Y1988	9.46%	3.89%	4.89%	0.02%	66.75%	24.44%	42365
Y1989	8.59%	3.79%	5.08%	0.00%	64.19%	26.94%	46999
Y1990	9.28%	3.94%	5.29%	0.04%	72.84%	17.89%	50892

For instance, the category '9 Commodities and transactions not classified elsewhere in the SITC ' contributed 9.46% toward the total export in 1988. On the other hand, we can observe the composition of category number 9, where the largest contributor was "97 Gold, non-monetary (excl. gold ores and concentrates) ".

2.2. Analytical Pattern (Changes)

The analytical pattern measures the value changes over the years for each main category and subcategory by simply dividing the value of each year by its previous year's value. The 1988- or first-year's value will be 100%.

For example, the change in 1989 will be the value of 1989 divided by the value in 1988:

- 9487/7903 * 100% = 120.04%

Note: For the changes where the previous year's value equal 0, the changes are set to 0 as well.

Time	0 Food and
Series ID	A1827804K
Unit	$ Millions
Y1988	7903
Y1989	9487
Y1990	9726

Time	0 Food and
Series ID	A1827804K
Unit	$ Millions
Y1988	100%
Y1989	120.04%
Y1990	102.52%

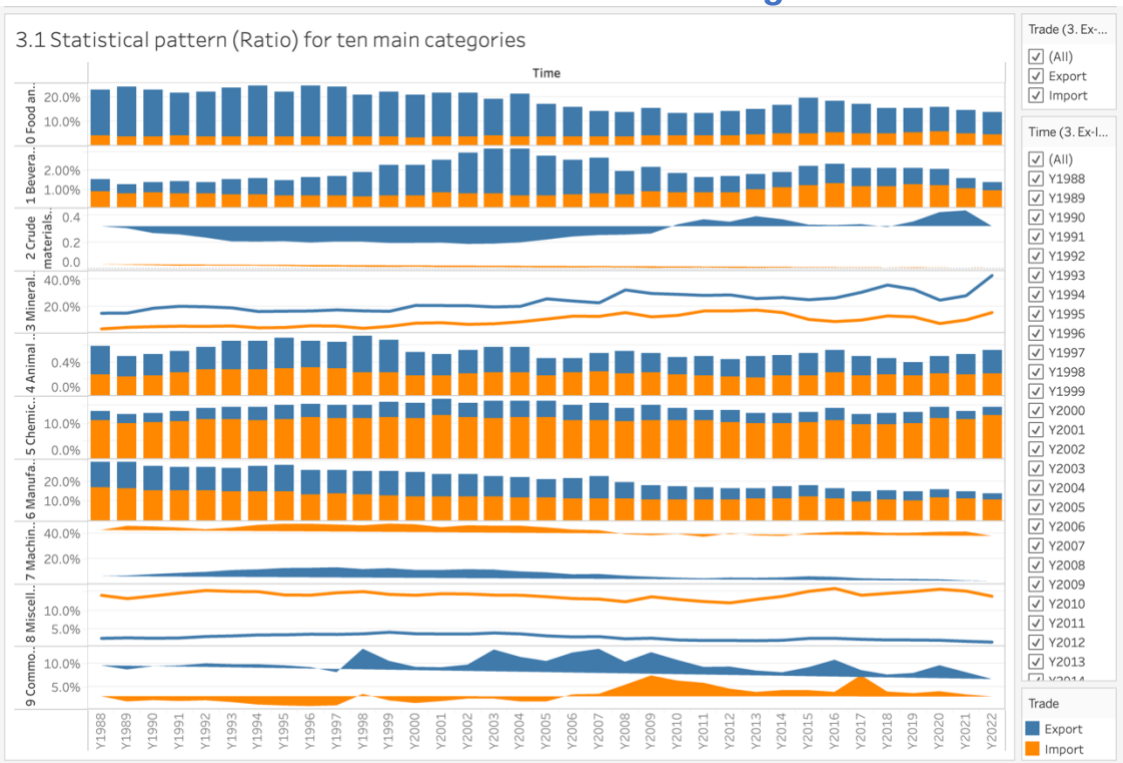
2.3 Merging Export and Import

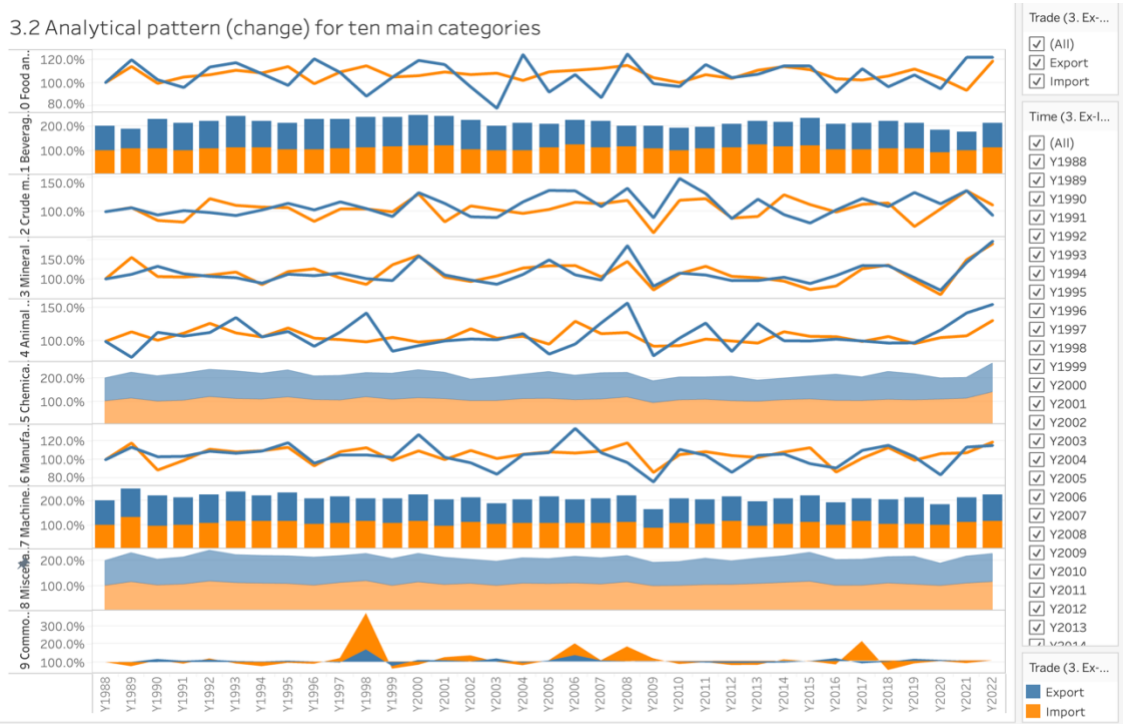
Similarly to task 1,3, the import and export data statistical patterns are integrated into a new sheet called ‘2. Ex-Import Statistical Pat’ with a new column ‘Trade’ to distinguish between export and import. Similarly, the analytical patterns follow this process with a new sheet called ‘3. Ex-Import Analytical Pat’

2. Ex-Import Statistical Pat	3. Ex-Import Analytical Pat

Visualisation Technique 1. Time Series Charts

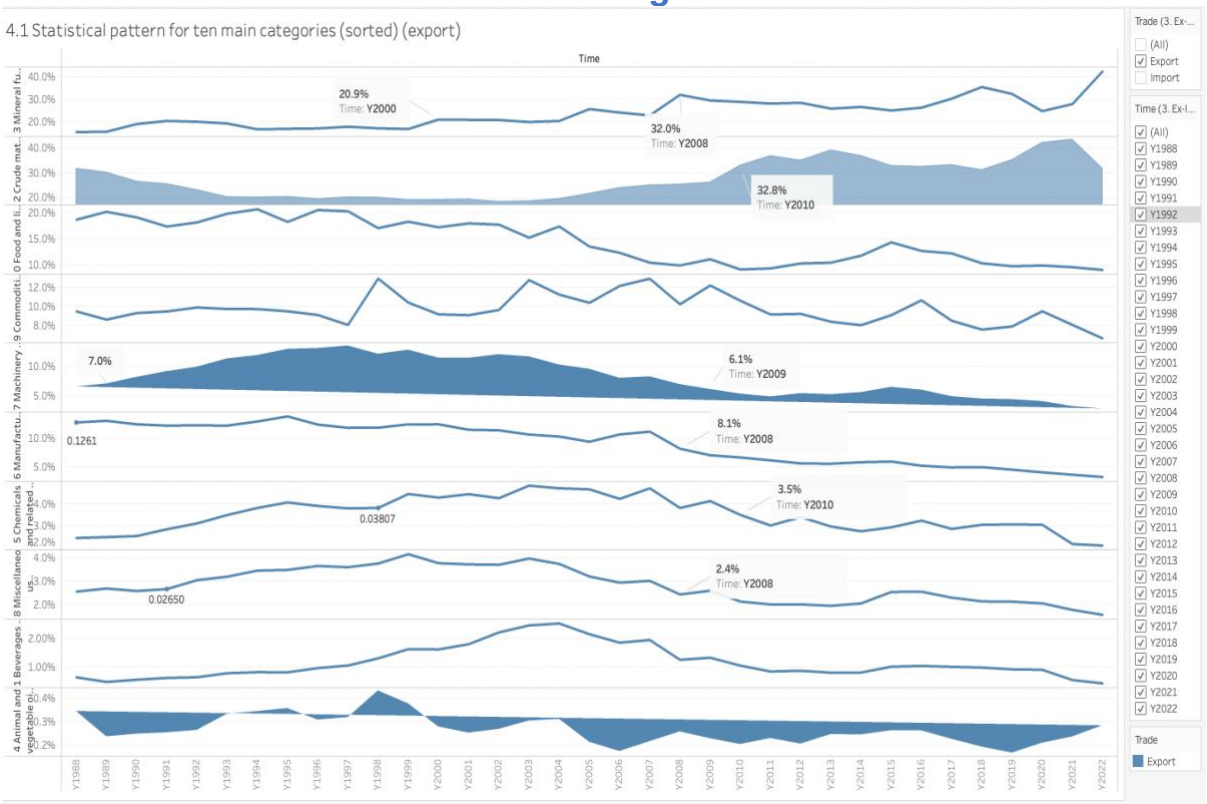
3. Time Series Charts for the ten main categories





Visualisation Technique 2. Interactive Chart

4. Interactive chart for ten main categories



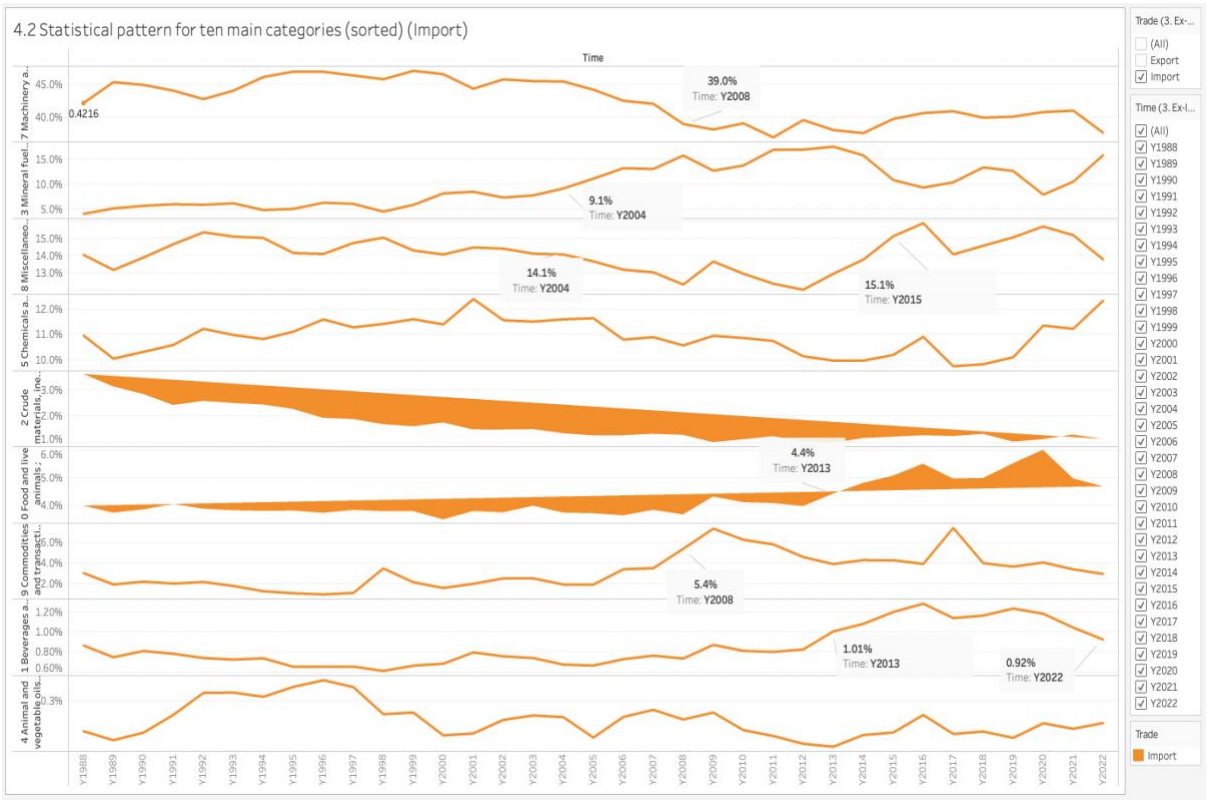
To see the contributor of export, the import sector was filtered out, and the rotation of the categories was sorted from high to lowest. Among the ten categories, the most substantial contributors toward export are:

1. Category 3 Mineral fuels, lubricants and related materials: Initially contributed 20% but gradually increased to 40% in 2022. Two major trend breakthroughs were in 2000 and 2008.
2. Category 2 Crude materials, inedible, except fuels. The second highest contribution of roughly 20 -30%. A trend breakthrough in 2010 when the contribution of the sub-category finally passed the 30% threshold in 1988 again after 22 years of decreasing and continued to grow
3. Category 0 Food and live animals: Gradually declined from 20% to around 9% in recent years. There are two breakthroughs:

- One in 2005 as the end of an increasing trend from 18.1% in 1992
- And one in 2015 as an end of a decreasing trend from 13.5% since 2005

1. Category 9 Commodities and transactions not classified elsewhere in the SITC. Constantly reduce from 10% to 7.5%, despite some heavy contribution period.
2. Category 7 Machinery and transport equipment: No major trend breakthrough, but the contribution slowly decreased after it peaked in 1997
3. Category 6 Manufactured goods classified chiefly by material experienced the most significant reduction among all ten categories, dropping from 12.6% to 3.6% in 2022. That is nearly a 75% reduction.

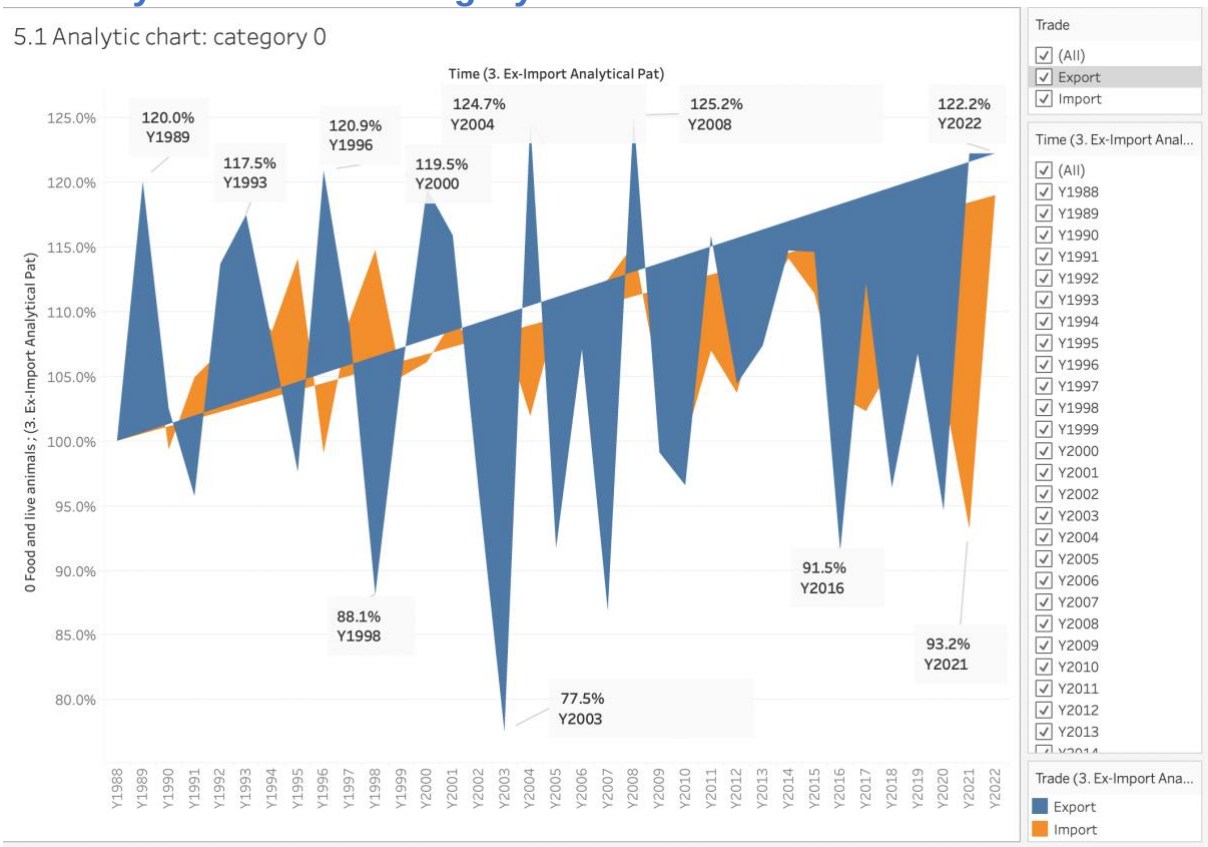
The other has some other trend breakthroughs, as indicated in Figure 4.1. However, their contribution toward the export is minor.



For imports, the export was filtered out, and the rotation of the categories was sorted from high to lowest. Among the ten categories, the most substantial contributors toward imports are:

1. Category 7 Machinery and transport equipment: Even though the contribution of this category has decreased, it is still the most substantial contributor toward the Australia Import
    - A noticeable trend breakthrough was in 2008, when the ratio dropped below 40% for the first time in 20 years, followed by a few years of decreasing after breaking again in 2015.
2. Category 3 Mineral fuels, lubricants and related materials: This category has the highest increase over the year, from just 5% in 1988 to 15.8% in 2022. There are a few trend breakthroughs, such as
    - 2000, ending no growth trend since 1988
    - 2004, breakthrough four years with no growth.
3. Category 8 Miscellaneous manufactured articles: Fluctuate quite a lot but still remind around 12 -15% over 35 years. There are two majors trend breakthrough
    - 2004, ending an increasing period from 13.9% since 1990
    - 2014, ending a decreasing period from 13.7% since 2004
4. Category 5 Chemicals and related products, nes: Consistently contribute 10 - 11 over the years. A significant trend breakthrough was in 2005 when this category experienced a continuously decreasing trend in contribution toward the total import.
5. Category 0 Food and live animals: Gradually inclined from 4% to 5% in 2022. A significant trend break trough was in 2013.

5. Analytical charts: Category 0 Food and live animals



5.1 Food and live animal export

Overall, the Food and live animals(00) for export and import have increased steadily over 35 years. The increase in export until 2022 is slightly higher, and the trend is slightly steeper than imports. Regardless, the standard deviation of the export could be more problematic, as seen in Figure 5.1. The changes from year to year ranged from 77.5% to 124.60%. Overall, the increase and decrease in food export are distributed relatively evenly after 1998. Before that, the global's demand for Australian food and live animal is relatively high, with only 2 out of 10 years experiencing a decreasing demand. 2002 - 2008 was the most volatile period where it had:

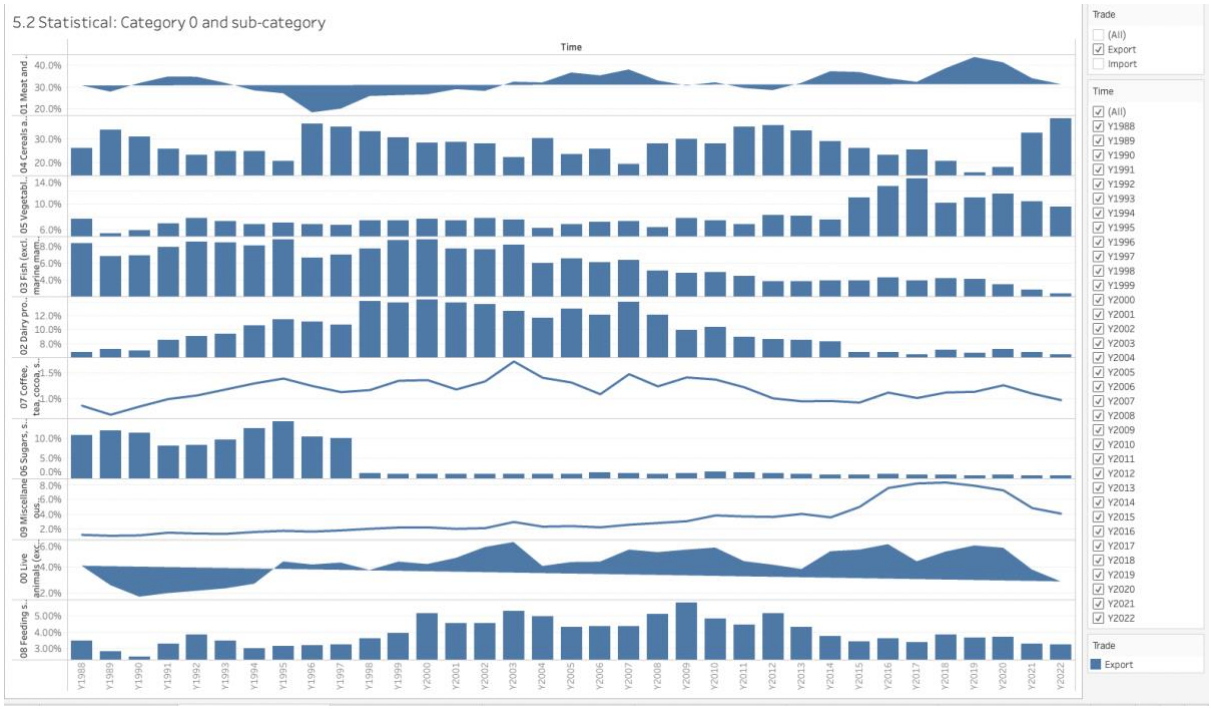
- 2003 with a 22.5% decrease, the worst drop over 35 years. After that, this sector experienced the second-highest rise of 24.69% in 2004. -> Over 45% difference
- 2007 had the second highest reduction of 13% also, followed by the highest growth in 2008 of 25.18% -> Over 38% difference

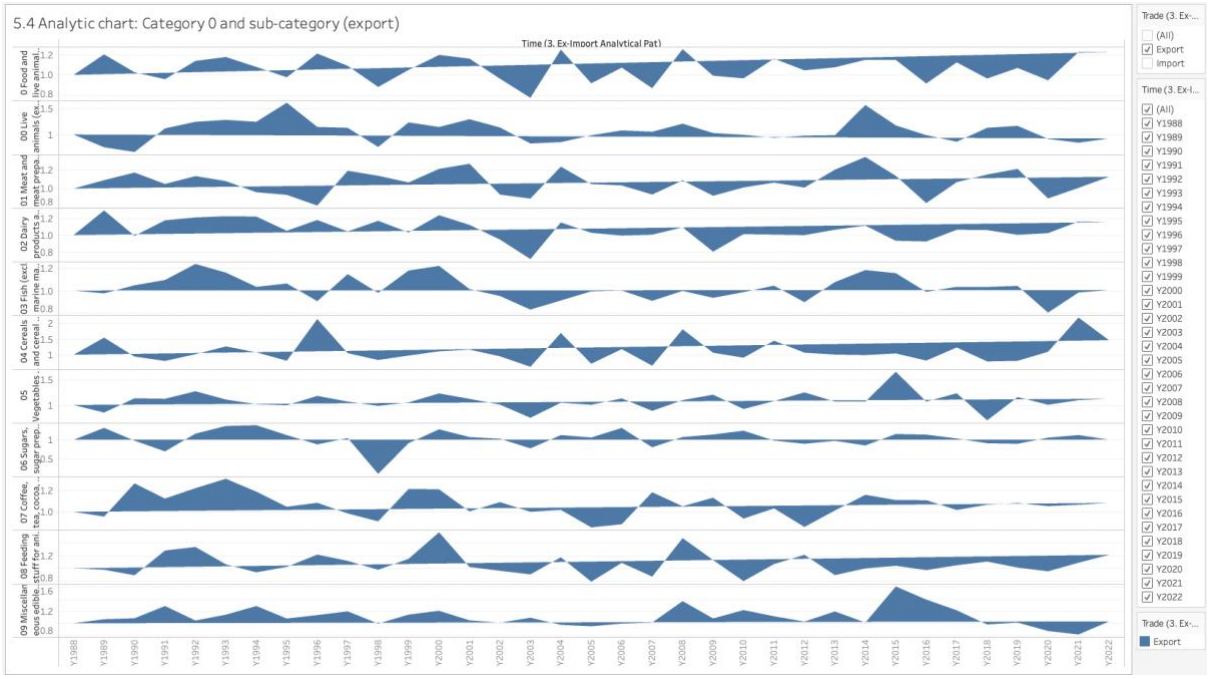
After this period of Global Financial Crisis, the demand for the export of Australia's food and live animal seemed to stabilise and slightly decreased in 2009 and 2010. This could be the side effect of the crisis, discouraging countries around the world from trading goods and products. After the recession, the export sector recovered strongly with a continuous five years of increasing demand, which is also the most prolonged period of expansion in 35 years. 2015-2021 is the second-highest volatility period, where one year of high growth is followed by a moderate-high drop with a gap of 10-25%. In the most recent years, Australia Foods and Lives Animal regained the interest of global consumers with two consecutive years of increasing demand at 22.22%

5.2 Export and its subcategory

Figure 5.4 demonstrate that most of the export sub-categories from category 0 experienced a slowly increasing trend over 35 years. Noticeably, the export sub-categories have many

expanding years before 2000. The two volatile periods from 2003 - 2008 and from 2015 - 2021 also influenced the sub-categories of Food and live animals (00).
Figure 5.3 here illustrates the weight of each sub-category in the main category 00 Food and live animals. The largest contribution is 01 (30% - 40%), 04(10 -30%), followed by 02, 06 and 09.

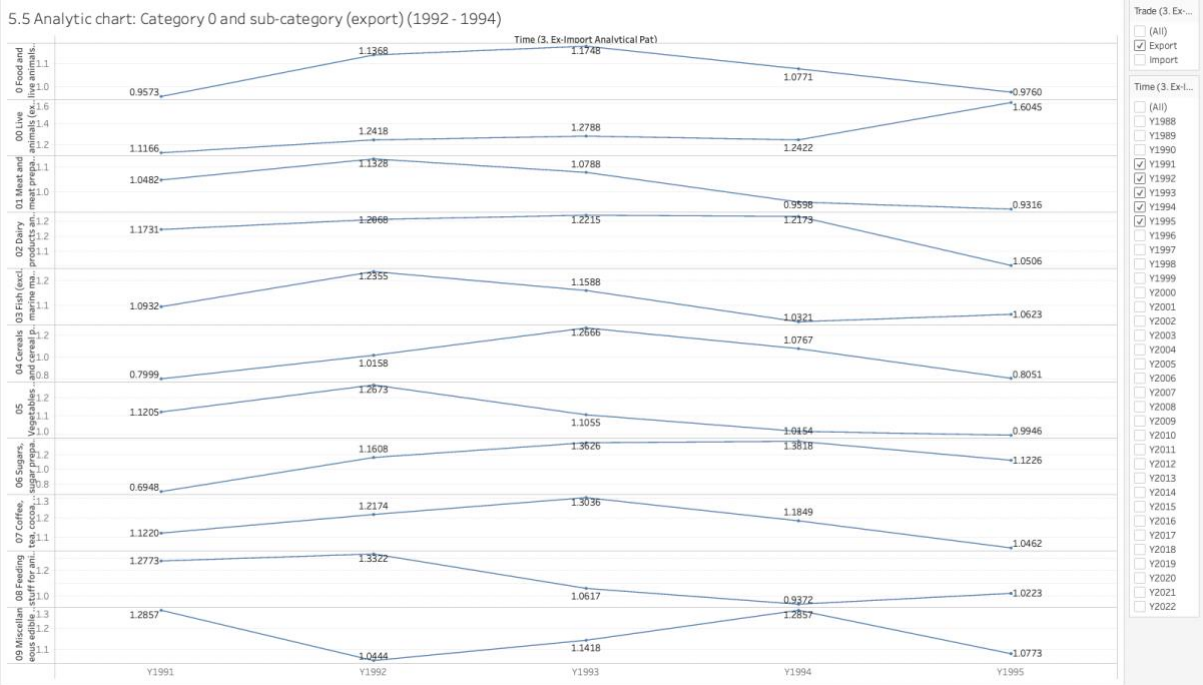




Regarding analytical summary, most of the export sub-categories had increased steadily over the years. The most stable sub-categories are 01, 03 and 07, fluctuating around -20% and +20%. On the other hand, sub-categories 00, 04, 05, and 09 had a much wider range along with higher volatility. Moreover, there are many durations in which the sub-categories had similar impacts, as well as the sub-categories. For instance, all sub-categories of 0 Food and live animals declined seriously in 2003 except for category 09. In the next year or 2004,

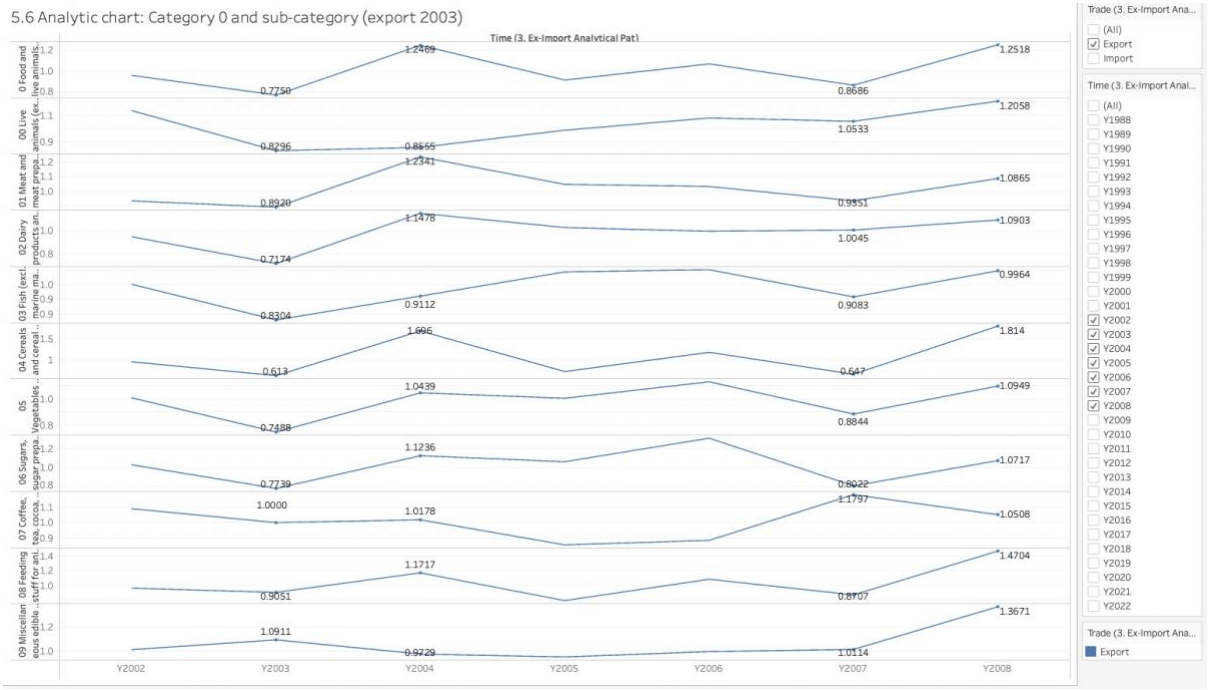
these categories consistently increase as well. These trend analyses will be demonstrated more carefully below.

Figure 5.5 demonstrates the first growth period in export from 1992 - 1994, where the main categories Food and Live animals (0) and most sub-categories maintained high growth rates for three consecutive years. Regardless, categories 01 and 08 experienced some unusual drop in 1994. The strongest categories growth in this period are 06 Sugar, 00 Live Animal, 02 Diary and 07 Coffee.



As mentioned above, the import of food and live animals from 2003 - 2008 fluctuated the most. Regardless, not all sub-categories was impacted during these period according to Figure 5.6. For instance, Coffee (07) remains unchanging while Miscellaneous (09) increases slightly during the 2003 drop. Alternatively, during the 2007 drop, Coffee (07) survived this category's decline again with an 18% increase. Cereal (04) experienced the worst drop of 31% in 2003, as well as 35% in 2007.

5.6 Analytic chart: Category 0 and sub-category (export 2003)



Cereal (04) is also the sector with the most noteworthy growth the following year, with an increase of 70% in 2004 and 81% in 2008. The global demand for Australian Cereal still has much potential.

5.7 Analytic chart: Category 0 and sub-category (2013-2016)

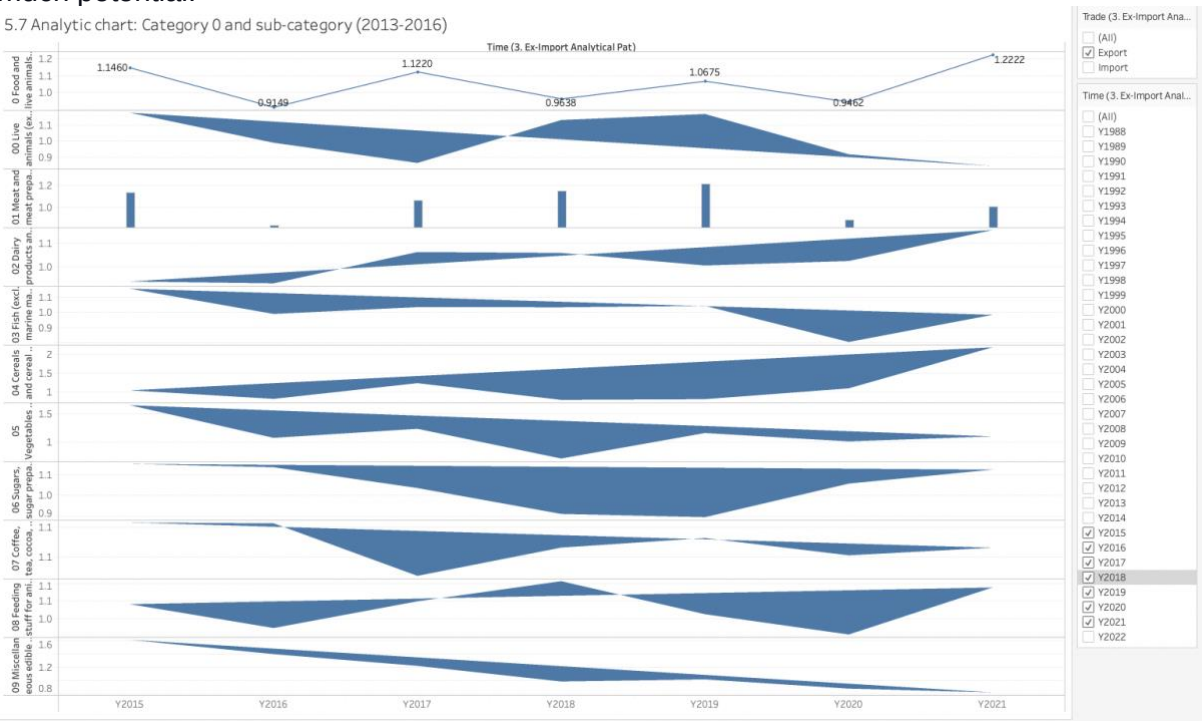


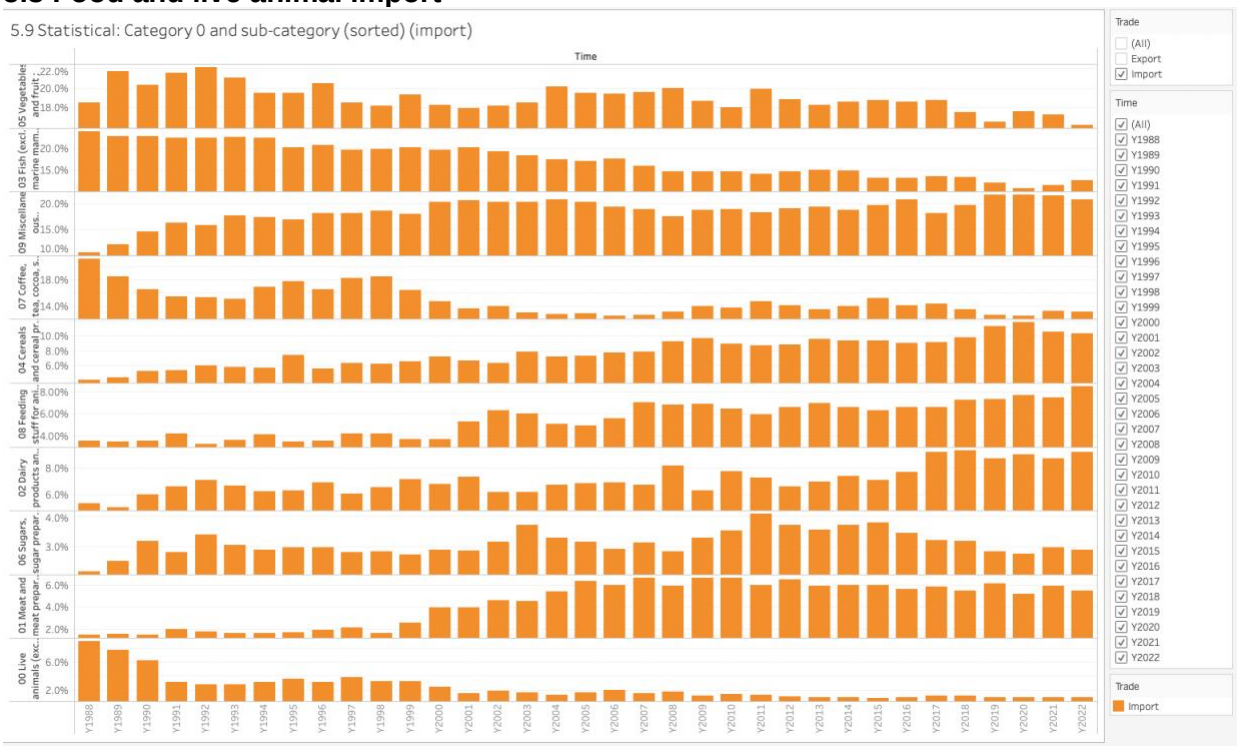
Figure 5.7 demonstrate the second volatile period, 2015 – 2020. There are some unusual variations in the evolution of the sub-categories. The worst performer is Cereals (04), with three out of six years dropping around 20%. The 2018 decline significantly impacted 04 Cereal on 05 Vegetables, where these two categories dropped 22% and 30% correspondingly. In contrast, Miscellaneous products (09) have the best performance with great first three years, but the demand for this product has seen decline during the recent year.

5.8 Analytic chart: Category 0 and sub-category (2021 - 2022)

The most outstanding sub-categories in the expansion of 2021 and 2022 are the Cereal sector (04) which increased by 119% and 46%, correspondingly. On the other hand, the live animal sector has two consecutive decreasing years.

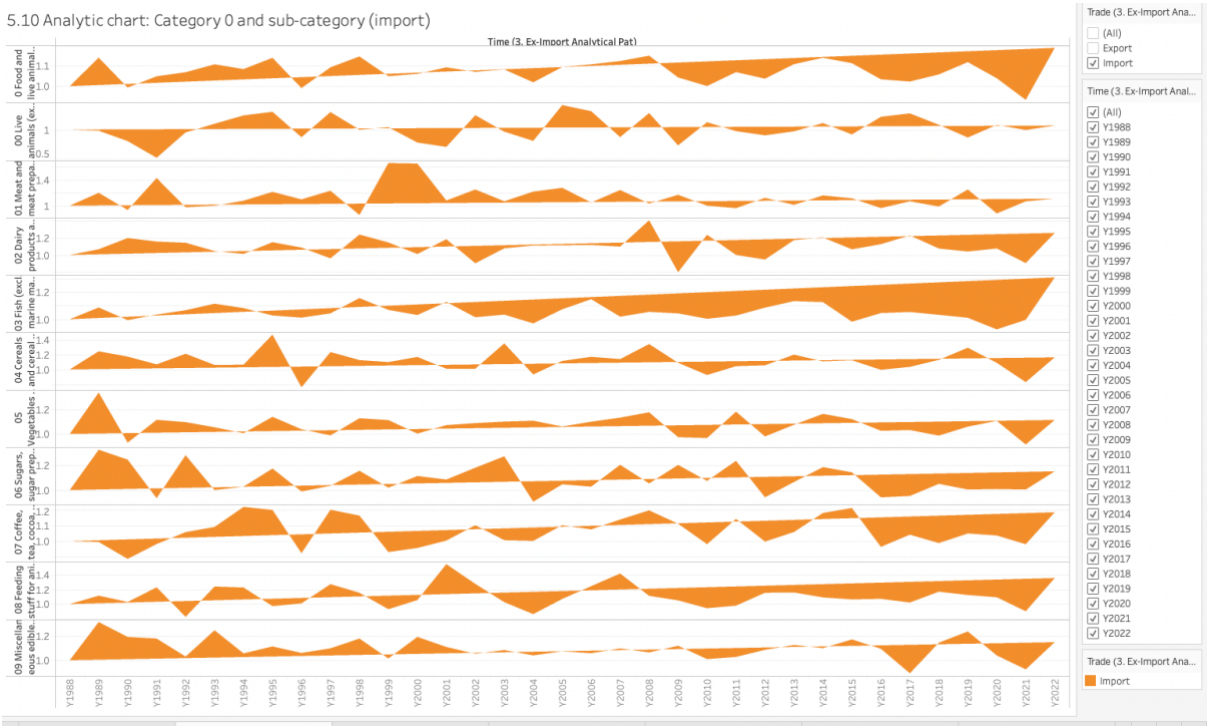
5.3 Food and live animal import

5.9 Statistical: Category 0 and sub-category (sorted) (import)



On the other hand, the import of food and live animal demonstrate a weaker increasing trend compared to export. However, the standard deviation is also much lower.

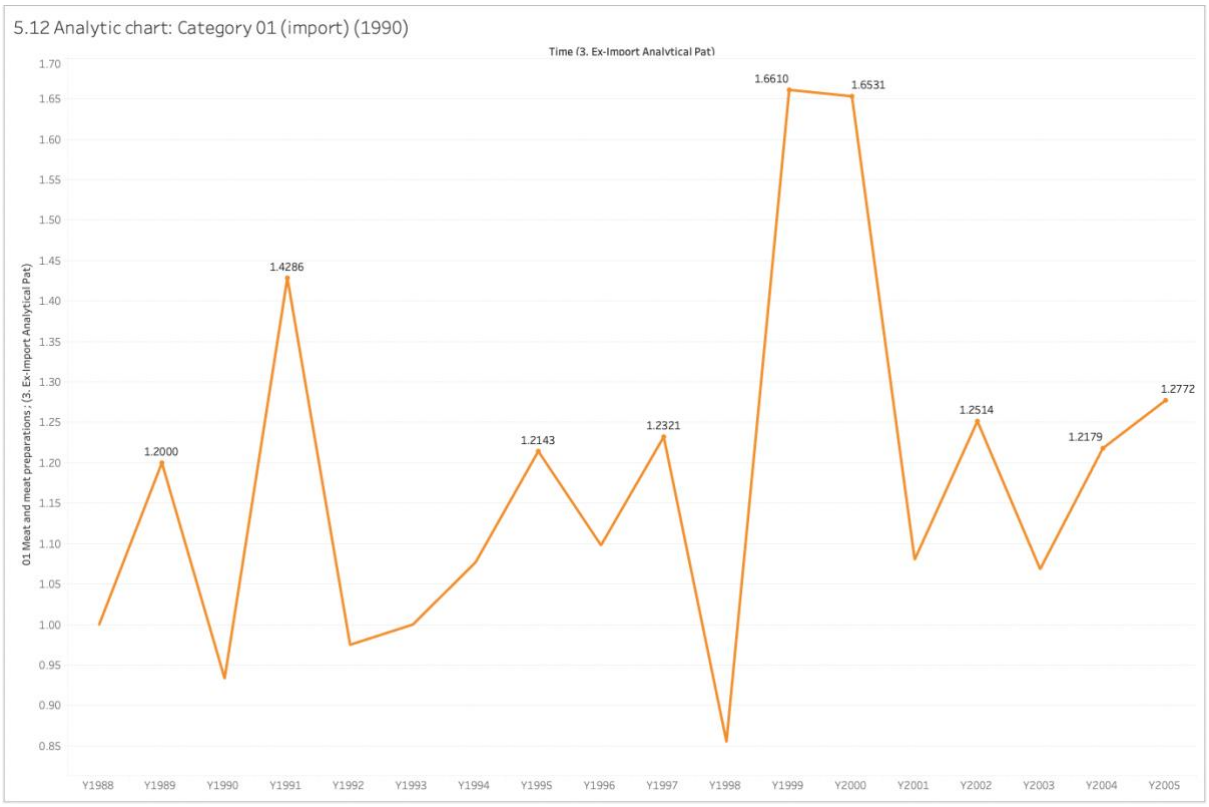
Throughout thirty-five years, there are only three times that the changes are negative. There is a slight decrease in the years of 1%, which are 1990 and 1996. For 2021 though, the food and live animal import dropped to the lowest of negative 6.79%. However, 2022 also experienced the highest increase in history at 19%. The reduction in 2021 is offset by the massive import in 2022. Australia experienced the highest demand for imported food from 1997 to 2008, as 70% of the years have a growth rate of fluctuating around 9 - 15%. The most volatile categories are 01, 05, 08, with the gap between the highest and lowest period are 50%.



5.4 Food and live animal import sub-categories

Since most of the time, the main category is experiencing growth, it would be more meaningful to analyse each import sub-category with a relatively unique trend.
The weakest sub-category is the Live animals (00) because there are more than ten periods that this sector has dropped below 90%. This is relatively high since most of the changes by year for imports are positive.

The demand for meat and meat preparation (01) was relatively high before 2005, with many years of growth ranging from 20% - 65%, as shown in Figure 5.12. The volatility of this category was relatively high before 2005 but mainly increasing. Figure 5.12 reveals that 1998 and 1999 are the two years that Australia demanded this product the most.



Among the ten sub-categories, the 00 Live Animal is the most stable category, where the change by year is relatively flat from 1988 to 2022. Figure 5.8 demonstrate that the change each year is relatively stable, around -10 to +15%. Overall, the cereal industry (04) experienced an uptrend. 1995 and 1996 are the two years with the highest (47.3%) and lowest (-24%) change. A few essential growth years are 1995, 2003, and 2009 above 30%

The Fish (03) subcategory volatility is relatively low, with a consistently increasing trend. There are only a few years when the changes are negative but insignificant. The influential drop is in 2020, where this category encountered a reduction of 7.5%, the lowest throughout 35 years. The highest expansion of this category was 30% in 2022.

Pre-GFC in 2008, category 08 also experienced a lot of high-demand periods, especially in 2001 and 2007. After that, the growth has been more stabilised around -10 to +10% excep for 2022 where the growth exceed 30%

5.13 Analytic chart: Category 08 (import) (1990-2007)

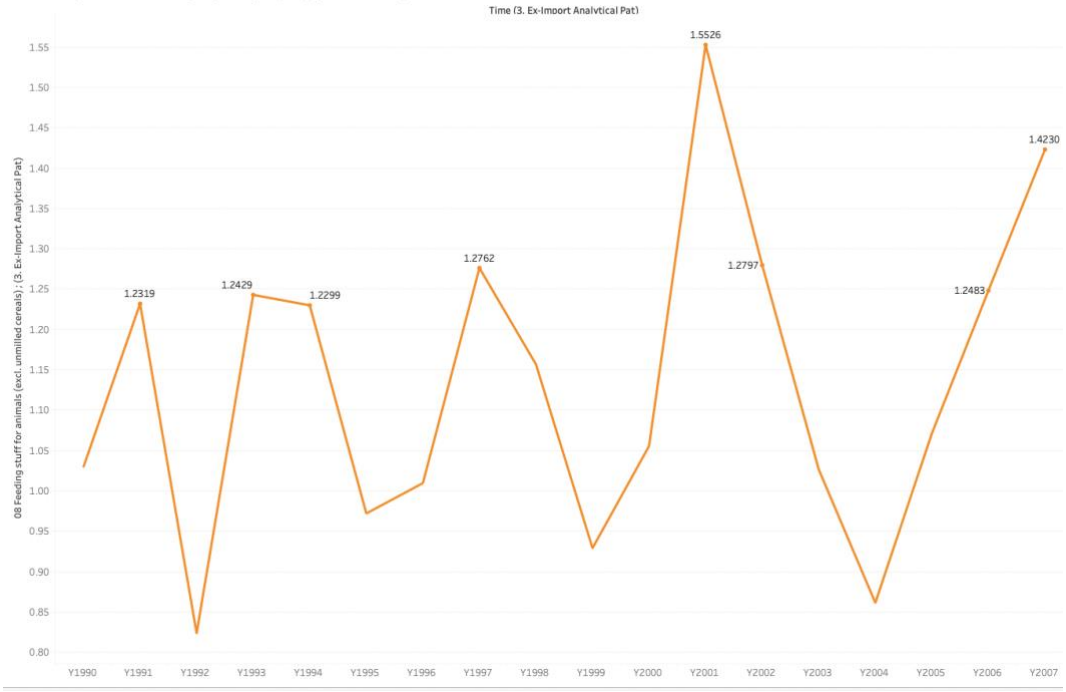
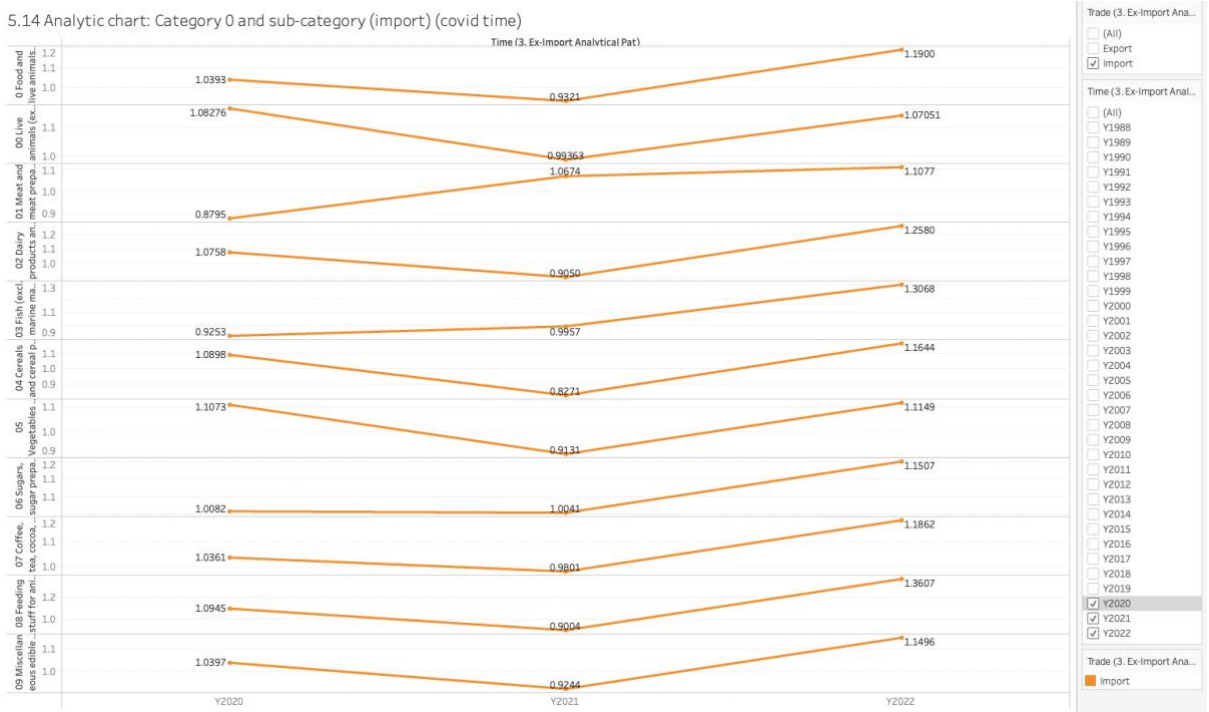


Figure 5.10 demonstrated that the overall trend of import for most sub-categories during the covid-19 period was decreased significantly in 2021 and increased substantially in 2022. Only the demand for Meat (01) and Sugar (06) increased in both periods. Cereal (04) was impacted the most with a reduction of 17%.

5.14 Analytic chart: Category 0 and sub-category (import) (covid time)

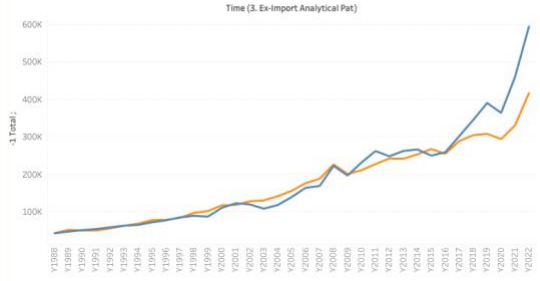


Visualisation Technique 3. Visual Dashboard

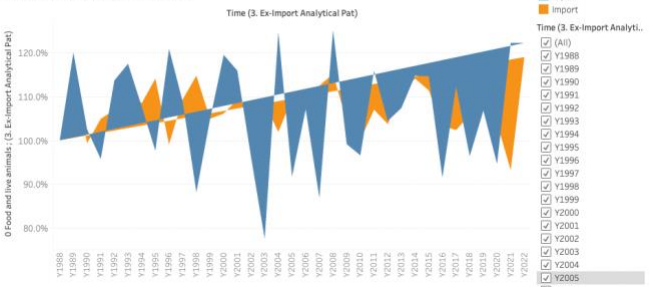
6. Visual Dashboard

6.1 Dashboard: General statistical and analytical data

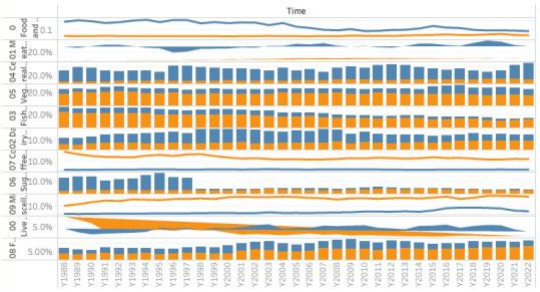
5.0 Analytic chart: Total import and export



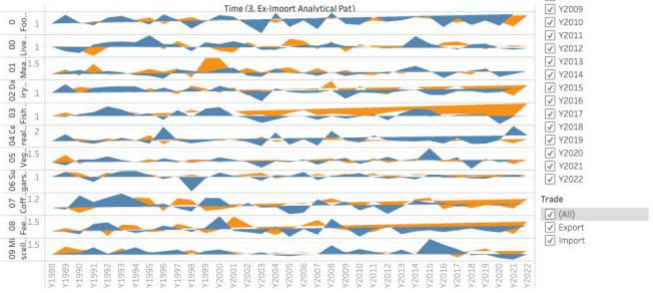
5.1 Analytic chart: category 0



5.2 Statistical: Category 0 and sub-category (sorted)



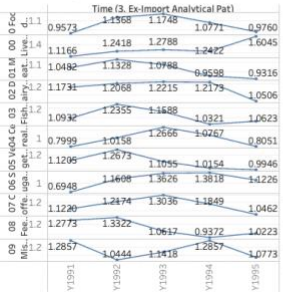
5.3 Analytic chart: Category 0 and sub-category



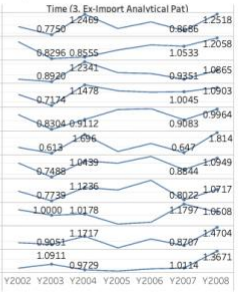
6.2 Dashboard: Export

5.16 Statistical: Category 0 and sub-category (export)

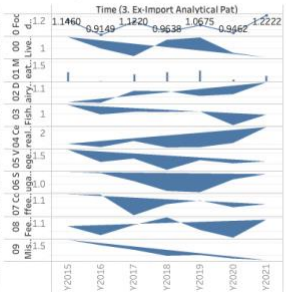
5.5 Analytic chart: Category 0 and sub-category (export) (1992 - 1994)



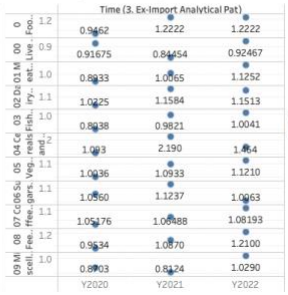
5.6 Analytic chart: Category 0 and sub-category (export 2003)



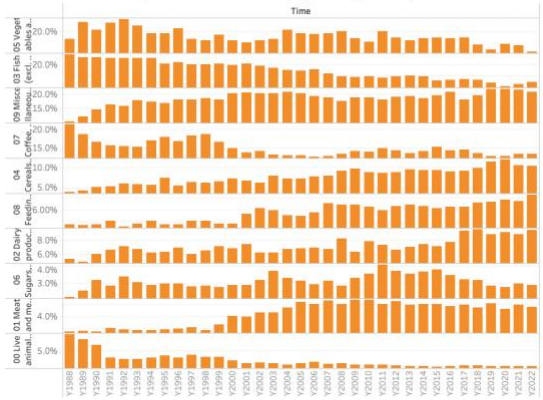
5.7 Analytic chart: Category 0 and sub-category (2013-2016)



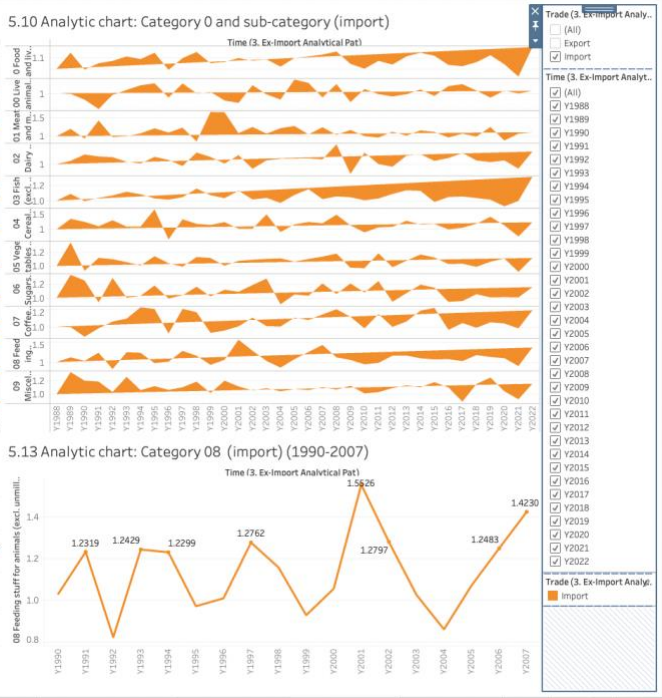
5.8 Analytic chart: Category 0 and sub-category (2021 - 2022)



5.9 Statistical: Category 0 and sub-category (sorted) (import)



5.10 Analytic chart: Category 0 and sub-category (import)

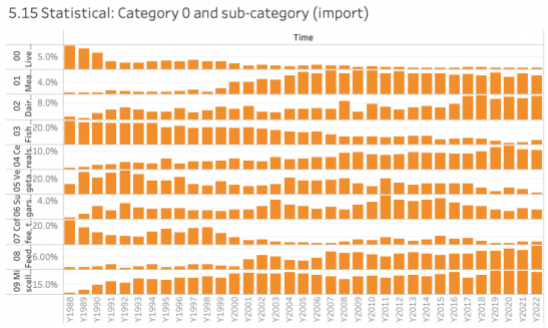


5.12 Analytic chart: Category 01 (import) (1990)

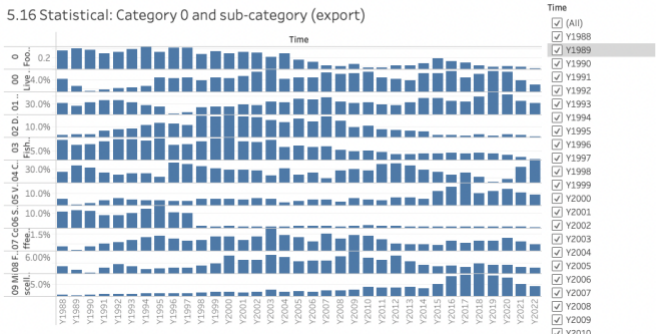
5.13 Analytic chart: Category 08 (import) (1990-2007)

6.4 Dashboard Import vs export

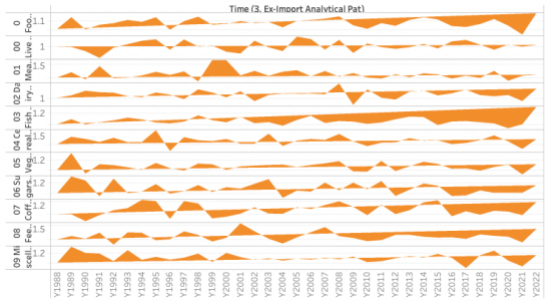
5.15 Statistical: Category 0 and sub-category (import)



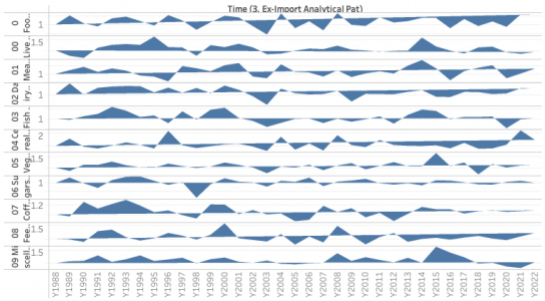
5.16 Statistical: Category 0 and sub-category (export)



5.10 Analytic chart: Category 0 and sub-category (import)

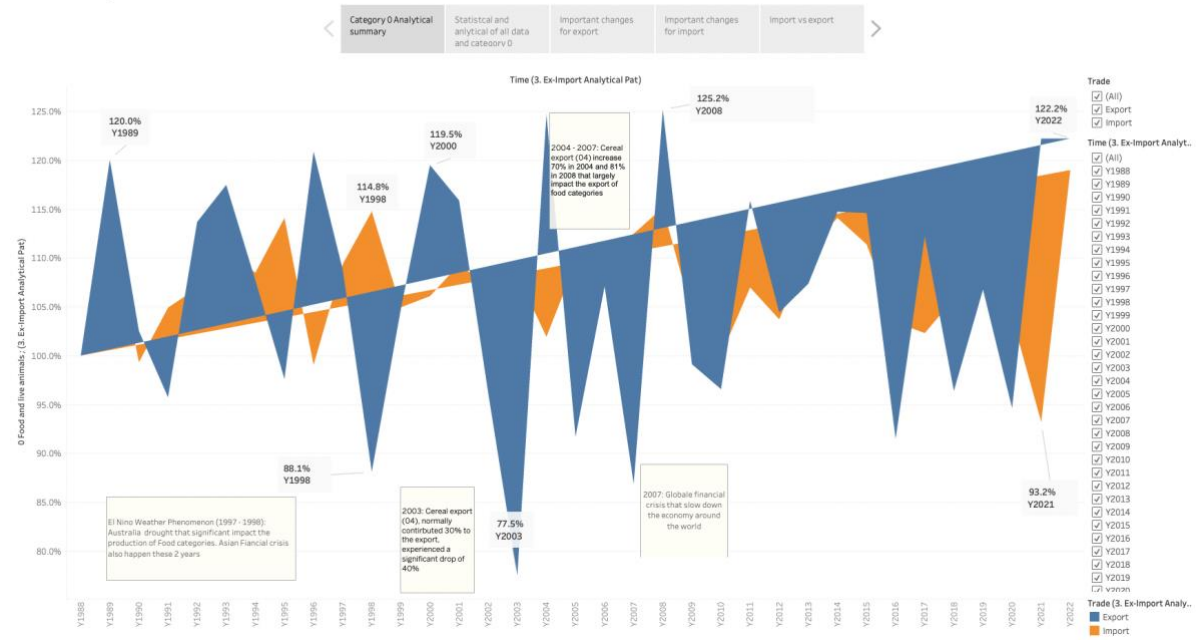


5.4 Analytic chart: Category 0 and sub-category (export)

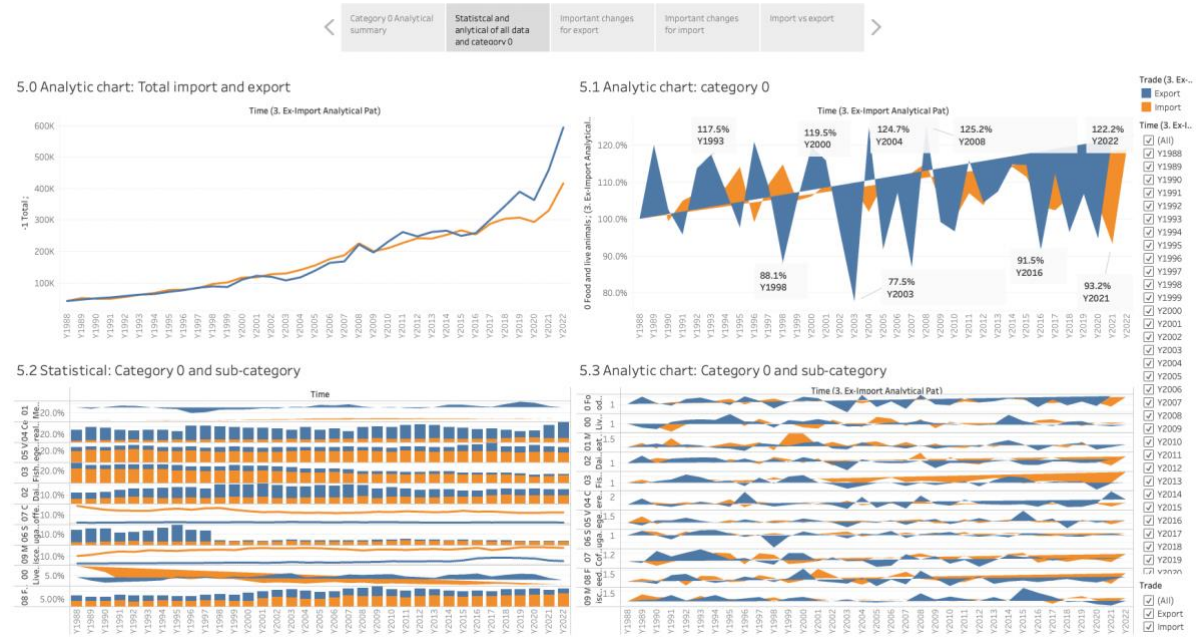


7. Visual Storyboard

7. Visual storyboard



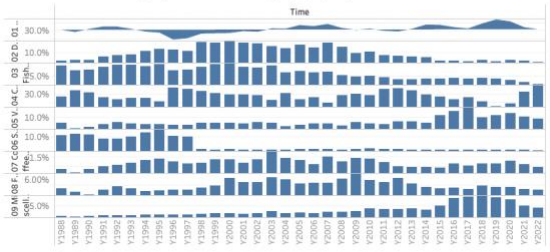
7. Visual storyboard



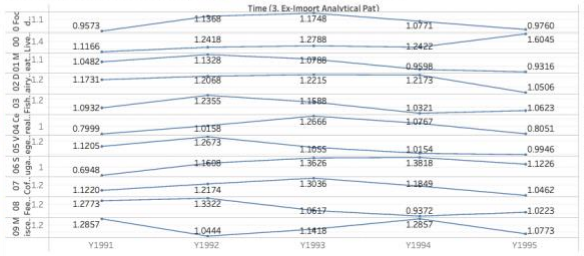
7. Visual storyboard

6.2 Dashboard: Export

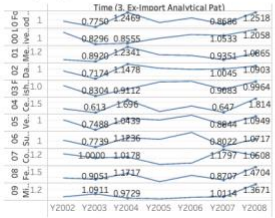
5.16 Statistical: Category 0 and sub-category (export)



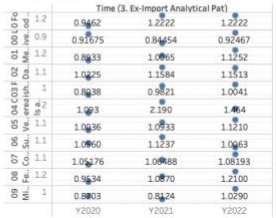
5.5 Analytic chart: Category 0 and sub-category (1992 - 1994)



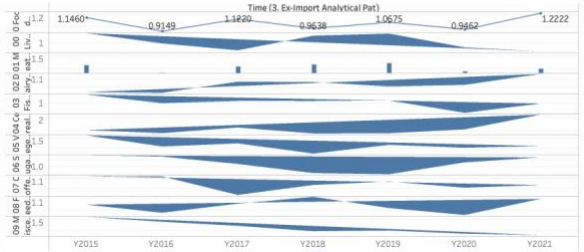
5.6 Analytic chart: Category 0 and sub-category (2002 - 2008)



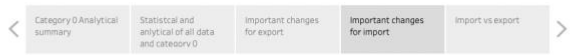
5.8 Analytic chart: Category 0 and sub-category (2021 - 2022)



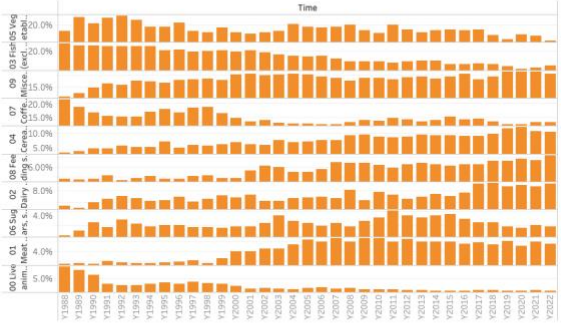
5.7 Analytic chart: Category 0 and sub-category (2013-2016)



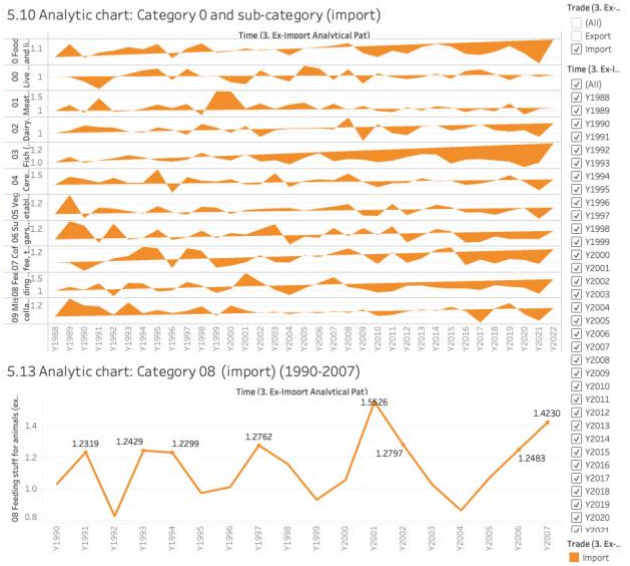
7. Visual storyboard



5.9 Statistical: Category 0 and sub-category (sorted) (import)



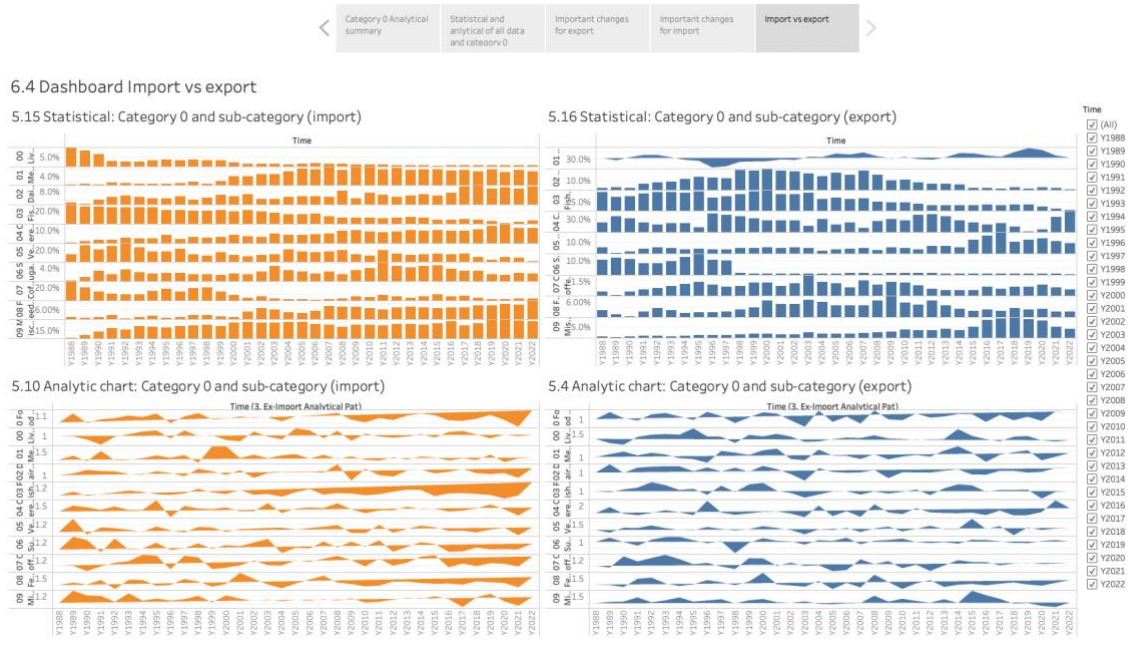
5.10 Analytic chart: Category 0 and sub-category (import)



5.12 Analytic chart: Category 01 (import) (1990)

5.13 Analytic chart: Category 08 (import) (1990-2007)

7. Visual storyboard



Summary: Visual Dashboard & Visual Storyboard

8. Visual dashboard and storyboard highlights and advantages.

1. **Different visualisation combinations:** Sometimes, each visualisation alone does not convey the entire story. Alternatively, viewing the visualisation from a different perspective can convey more meaningful stories.
2. **Interactiveness between visualisation graphs:** Ability to navigate between graphs and charts and interact with data from different locations.
3. **Ability to link and alter filters between datasheets immediately:** Visual dashboard allows users to link one filter to multiple datasheets or selected worksheets only. These instant changes to the data visualisation are very convenient when the actual requirement is unknown. The data can be analysed and compared between different periods, variables, and frequencies. This could be very helpful in revealing the correlation between variables in the data sets.
4. **Ability to compare data from different data sources:** For instance, the statistical and analytical patterns can be combined to create a combined story that has a more meaningful story. This ability allows data analysts to comprehend and compare easier.
5. **Easy worksheet manipulation:** The worksheet can be easily drag-and-drop around to different locations depending on the purpose of the visualisation. Without any specific question or hypothesis, this ability has unlimited potential and outcomes.
6. **Visualisation graphs automated resize:** Nowadays, people work with different screen sizes. Tableau can resize the storyboard and dashboard automatically.
7. **Personal preferences:** There are a variety of customisations that users can utilise to achieve individual's requirements.
8. **Easier trend identification:** Combining different visualisation allows easier trend identification through patterns and breakthrough points. The ease of data alteration using the filter allows the user to have many trial and error.
9. **Labelling and annotation:** Many customised annotations can be utilised to enhance readability or any other highlights.

9. Findings and Recommendation

By combining the statistical and analytical trends, we able to focus on the major changes of the sub-categories that significantly contribute toward the Food and live animals(00) category.

The Visual storyboard indicates that the Australian total export and import general trend is consistently increasing. This is not the case for the main category: Food and live animals (00). This category experienced many years of expanding before 2000 with just a few years of decreasing. We can clearly observe in Figure 3.1 that the export contribution toward total export has decreased gradually from 20% to less than 10% in recent years. The import increased slightly over the year from 3-4% to constantly varied around 5-6% in the last 10 years. The sub-categories of export and import had some distinguished evolutions. There are many years and periods where the export and imports changes are completely opposite like 1995,1998,2004,2005 and 2006. From this period onward, the export and import of category 0 have shown a slightly high positive correlation.