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Title of Data Analysis: How do Global Events influence Singapore's Economic Growth?

Questions to answer to gain deeper insights into dataset:

Question 1: How does global demands influence Nature of Retrenchments in Singapore's Economy, given the fluctuations in Contributions to GDP Growth?

Question 2: How much impact does global events on the Nature of Retrenchments in Singapore?

Question 3: Is there a strong correlation between the GDP Growth Rate and Nature of Retrenchments in Singapore

Url of Annual Contribution to Growth in Gross Domestic Product in Chained 2015 dollars Dataset: https://data.gov.sg/dataset/contribution-to-growth-in-gdp-in-chained-2015-dollars-by-industry-ssic-2015-annual (https://data.gov.sg/dataset/contribution-to-growth-in-gdp-in-chained-2015-dollars-by-industry-ssic-2015-annual)

Url of Annual Retrenched Employees (By Industry) Dataset: https://data.gov.sg/dataset/retrenched-employees-by-industry-and-occupational-group-annual?resource_id=21c9e4c1-1524-47db-b8c0-59ad89df2a6f (https://data.gov.sg/dataset/retrenched-employees-by-industry-and-occupational-group-annual?resource_id=21c9e4c1-1524-47db-b8c0-59ad89df2a6f)

Url of Annual Short Work-Week & Temporary Layoffs (By Industry) Dataset: https://data.gov.sg/dataset/short-work-week-temporary-layoffs-annual?resource_id=65c5e391-d2a9-43b3-8004-9287e0936521 (https://data.gov.sg/dataset/short-work-week-temporary-layoffs-annual?resource_id=65c5e391-d2a9-43b3-8004-9287e0936521)

Breaking Down the Nature of Retrenchments in Jobs (By Industry) Dataset:

The nature of the dataset for retrenched employees contains the retrenchment of permanent jobs, retrenchments of Term Contract (Temporary) Jobs as well as total retrenchments from the year 1998 to 2019 due to redundancy, sorted by the various industries (manufacturing, construction, services, others).

Defining Terminologies:

1. Retrenchment refers to the termination of permanent employees due to redundancy and early termination of term contract employees due to redundancy. Permanent Jobs typically do not have a predetermined end date to employment.

2. Retrenchment of Term Contract Employees refers to early termination of term contract employees due to redundancy. Term Contract (Temporary) Jobs refers Jobs that are fixed-term contracts which can be terminated by employers upon expiry of a specific term or period (such as a date), unless it is renewed.
3. Total Retrenchments refers to Retrenchments inclusive of Permanent Jobs as well as Term Contract (Temporary) Jobs.

Redundancy refers refers to a situation whereby an employer reduces their workforce in the event that a certain jobs are no longer needed. Such situations may arise due to exterior factors due to the global economic enviroment which has resulted in businesses closing down, the employer needing to cut expenses, the advent of artificial technology (AI) or other technologies that have made that job unnecessary.

Defining Various Industries:

- The Manufacturing Industry comprises mainly of Electronics, Chemicals, Biomedical Sciences, Logistics and Transport engineering.
- The Construction Industry comprises mainly of Construction of Singapore Residential and Non-Residential Buildings.
- The Services Industry comprises mainly of Wholesale & Retail Trade, Recreation, Community & Personal Services and Business services.
- Others refers to Industries that do not belong to any of specific sectors listed in Manufacturing, Construction and Services Industries.

Why is the Number of Job Retrenchments by Industry important?

During a recession, there will be a significant decline in economic activity spreading across the various industries in Singapore, due to a lack of demand for goods and services caused by global environment economic factors. As a result, business and firms in Singapore may be forced to reallocate resources, scale back production and limit losses and as a result, retrench their employees.

Therefore, the number of retrenchments in Singapore is a very important economic indicator of how badly impacted the various type of industries. These data helps the government in considering how they are able to better design and implement policies to help the badly-affected employees who were retrenched due to the economic situation in Singapore.

Breaking Down the Nature of Jobs affected by Short Work Week and Temporary Layoff (By Industry) Dataset:

The nature of the dataset for short work week and temporary layoff contains the number of jobs that implemented short work week, the number of jobs that have been temporary laid off as well as the total number of jobs from the year 1998 to 2019, sorted by the various industries (manufacturing, construction, services, others).

Defining Terminologies:

1. Short Work-Week are employees whose normal number of working days per week has been temporarily reduced due to lack of work, at any time during the reference period.

2. Temporary Layoffs are employees whose services are suspended temporarily due to lack of work, at any time during the reference period. They may or may not have been paid during this period.

Defining Various Industries:

- The Manufacturing Industry comprises mainly of Electronics, Chemicals, Biomedical Sciences, Logistics and Transport engineering.
- The Construction Industry comprises mainly of Construction of Singapore Residential and Non-Residential Buidlings.
- The Services Industry comprises mainly of Wholesale & Retail Trade, Recreation, Community & Personal Services and Business services.
- Others refers to Industries that do not belong to any of specific sectors listed in Manufacturing, Construction and Services Industries.

Why is the Nature of Jobs affected by Short Work Week and Temporary Layoff by Industry important?

During a recession, there will be a significant decline in economic activity spreading across the various industries in Singapore, due to a lack of demand for goods and services caused by global environment economic factors. As a result, business and firms in Singapore may be forced to reallocate resources, scale back production and limit losses and as a result, retrench their employees.

Some businesses and firms may consider implementing alternative measures as they would like to keep their businesses viable while still supporting their employees during period of economic downturns, reducing the number of jobs losses. In liew of such economic environment, businesses and firms will be able to learn how to better handle excessive manpower so that while achieving their objective of restructuring their businesses, the employees' interest will still not be compromised.

These not only reduces the number of job losses due to retrenchments, it also enhances the business and firm's individual competiveness in the industry. This information also provides a strong gauge of the type of industries that adopt alternatives to retrenchments instead of immediate termination of employees.

Write Python code that uses the pandas package to extract useful statistical or summary information about the data

In [2]:
```
import pandas as pd
import numpy as np

retrenchments_by_industry = pd.read_csv("./Datasets/retrenchment-by-industry-leve
short_work_week_and_temporary_layoffs_by_industry = pd.read_csv("./Datasets/short

#Merging retrenchments dataframe with short work week and temporary layoff datafr
df_all = pd.merge(retrenchments_by_industry, short_work_week_and_temporary_layoff

#Shape of Retrenchments, Short Work Week and Temporary Layoffs by Industry Datase
print(f"Shape of Retrenchments, Short Work Week and Temporary Layoffs by Industry

#Index of Retrenchments, Short Work Week and Temporary Layoffs by Industry Datase
print(f"Index of Retrenchments, Short Work Week and Temporary Layoffs by Industry

#Column of Retrenchments, Short Work Week and Temporary Layoffs by Industry Datas
print(f"Columns of Retrenchments, Short Work Week and Temporary Layoffs by Indust

#Renaming the column names
df_all.rename(
    columns=
    {"year":"Year",
     "industry1":"Type_of_Industry",
     "retrench":"Total Retrenchments",
     "retrench_permanent": "Retrenchment of Permanent Jobs",
     "retrench_term_contract":"Retrenchment of Term Contract (Temporary) Jobs",
     "total": "Short Work Week and Temporary Layoffs (Total)",
     "short_work_week": "Short Work Week",
     "temporary_layoff":"Temporary Layoff"}
    ,inplace=True)

#First 5 rows of Retrenchments, Short Work Week and Temporary Layoffs by Industry
print("\n\t\tFirst 5 rows of Retrenchments, Short Work Week and Temporary Layoffs
display(df_all.head())

#Last 5 rows of Retrenchments, Short Work Week and Temporary Layoffs by Industry
print("\n\t\tLast 5 rows of Retrenchments, Short Work Week and Temporary Layoffs
display(df_all.tail())

#Display Summary information of Retrenchments, Short Work Week and Temporary Layo
print("\n\t\tSummary Information of Retrenchments, Short Work Week and Temporary
display(df_all.info())

#Display Statistical Information of Retrenchments, Short Work Week and Temporary
print("\nStatistical infomation of Retrenchments, Short Work Week and Temporary L
list_of_variables = ["Total Retrenchments", "Retrenchment of Permanent Jobs", "Re
for variable in list_of_variables:
    display(df_all.groupby(["Type_of_Industry"])[[variable]].describe(percentiles

df_all = df_all.set_index("Year").drop(2019).reset_index()
```

```
Shape of Retrenchments, Short Work Week and Temporary Layoffs by Industry Dat
aset:
(88, 8)
```

```
Index of Retrenchments, Short Work Week and Temporary Layoffs by Industry Dat
aset:
RangeIndex(start=0, stop=88, step=1)

Columns of Retrenchments, Short Work Week and Temporary Layoffs by Industry D
ataset:
Index(['year', 'industry1', 'retrench', 'retrench_permanent',
       'retrench_term_contract', 'total', 'short_work_week',
       'temporary_layoff'],
      dtype='object')
```

First 5 rows of Retrenchments, Short Work Week and Temporary Layoffs Dataset

	Year	Type_of_Industry	Total Retrenchments	Retrenchment of Permanent Jobs	Retrenchment of Term Contract (Temporary) Jobs	Short Work Week and Temporary Layoffs (Total)	Short Work Week	Tempo La
0	1998	manufacturing	20700.0	18930.0	1770.0	3940.0	3230.0	7
1	1998	construction	2450.0	1210.0	1240.0	90.0	70.0	
2	1998	services	9630.0	8940.0	690.0	420.0	400.0	
3	1998	others	30.0	0.0	30.0	0.0	0.0	
4	1999	manufacturing	8370.0	7990.0	380.0	660.0	570.0	

Last 5 rows of Retrenchments, Short Work Week and Temporary Layoffs Dataset

	Year	Type_of_Industry	Total Retrenchments	Retrenchment of Permanent Jobs	Retrenchment of Term Contract (Temporary) Jobs	Short Work Week and Temporary Layoffs (Total)	Short Work Week	Temp L
83	2018	others	0.0	0.0	0.0	0.0	0.0	
84	2019	manufacturing	2790.0	2580.0	220.0	490.0	480.0	
85	2019	construction	860.0	500.0	370.0	110.0	80.0	
86	2019	services	7000.0	6700.0	300.0	290.0	250.0	
87	2019	others	30.0	30.0	0.0	0.0	0.0	

Summary Information of Retrenchments, Short Work Week and Temporary Layoffs Dataset

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 88 entries, 0 to 87
Data columns (total 8 columns):
 #   Column                                  Non-Null Count  Dtype
```

```
---  ------                                                 --------------  -----
 0   Year                                                   88 non-null     int64
 1   Type_of_Industry                                       88 non-null     object
 2   Total Retrenchments                                    88 non-null     float64
 3   Retrenchment of Permanent Jobs                         88 non-null     float64
 4   Retrenchment of Term Contract (Temporary) Jobs         88 non-null     float64
 5   Short Work Week and Temporary Layoffs (Total)          88 non-null     float64
 6   Short Work Week                                        88 non-null     float64
 7   Temporary Layoff                                       88 non-null     float64
dtypes: float64(6), int64(1), object(1)
memory usage: 5.6+ KB
```

None

Statistical infomation of Retrenchments, Short Work Week and Temporary Layoffs Dataset Sorted By Type

Total Retrenchments

Type_of_Industry	count	mean	std	min	20%	40%	50%	60%	80%
construction	22.0	1044.090909	607.106009	70.0	540.0	842.0	940.0	1030.0	1622.0
manufacturing	22.0	7373.181818	4484.219300	2570.0	4132.0	5084.0	5890.0	7320.0	9500.0
others	22.0	70.909091	89.597464	0.0	10.0	20.0	30.0	50.0	98.0
services	22.0	6748.636364	2428.196069	2990.0	4150.0	6042.0	6640.0	7156.0	8874.0

Retrenchment of Permanent Jobs

Type_of_Industry	count	mean	std	min	20%	40%	50%	60%	80%
construction	22.0	597.272727	309.979751	20.0	374.0	482.0	535.0	672.0	840.0
manufacturing	22.0	6768.636364	4092.023944	2280.0	3724.0	4806.0	5435.0	7062.0	8656.0
others	22.0	61.818182	88.351913	0.0	2.0	10.0	20.0	42.0	80.0
services	22.0	6265.000000	2364.796880	2390.0	3930.0	5350.0	6315.0	6644.0	8336.0

Retrenchment of Term Contract (Temporary) Jobs

Type_of_Industry	count	mean	std	min	20%	40%	50%	60%	80%	max
construction	22.0	448.636364	351.639635	30.0	134.0	308.0	350.0	406.0	780.0	1240.0
manufacturing	22.0	605.000000	563.659387	90.0	226.0	310.0	405.0	496.0	700.0	2030.0
others	22.0	7.272727	21.861429	0.0	0.0	0.0	0.0	0.0	8.0	100.0
services	22.0	484.545455	230.872615	110.0	254.0	444.0	505.0	550.0	682.0	1010.0

Short Work Week and Temporary Layoffs (Total)

Type_of_Industry	count	mean	std	min	20%	40%	50%	60%	80%	max
construction	22.0	109.545455	112.227544	0.0	30.0	54.0	85.0	100.0	168.0	41
manufacturing	22.0	2025.454545	3122.137130	130.0	434.0	616.0	655.0	930.0	2076.0	1137
others	22.0	1.818182	5.010811	0.0	0.0	0.0	0.0	0.0	0.0	2
services	22.0	500.000000	731.729849	30.0	76.0	140.0	185.0	246.0	748.0	278

Short Work Week

Type_of_Industry	count	mean	std	min	20%	40%	50%	60%	80%	max
construction	22.0	70.454545	84.935677	0.0	12.0	34.0	40.0	60.0	104.0	31
manufacturing	22.0	1838.181818	2869.492466	120.0	376.0	546.0	610.0	902.0	1848.0	1073
others	22.0	1.818182	5.010811	0.0	0.0	0.0	0.0	0.0	0.0	2
services	22.0	445.000000	644.225264	20.0	66.0	118.0	145.0	212.0	696.0	225

Temporary Layoff

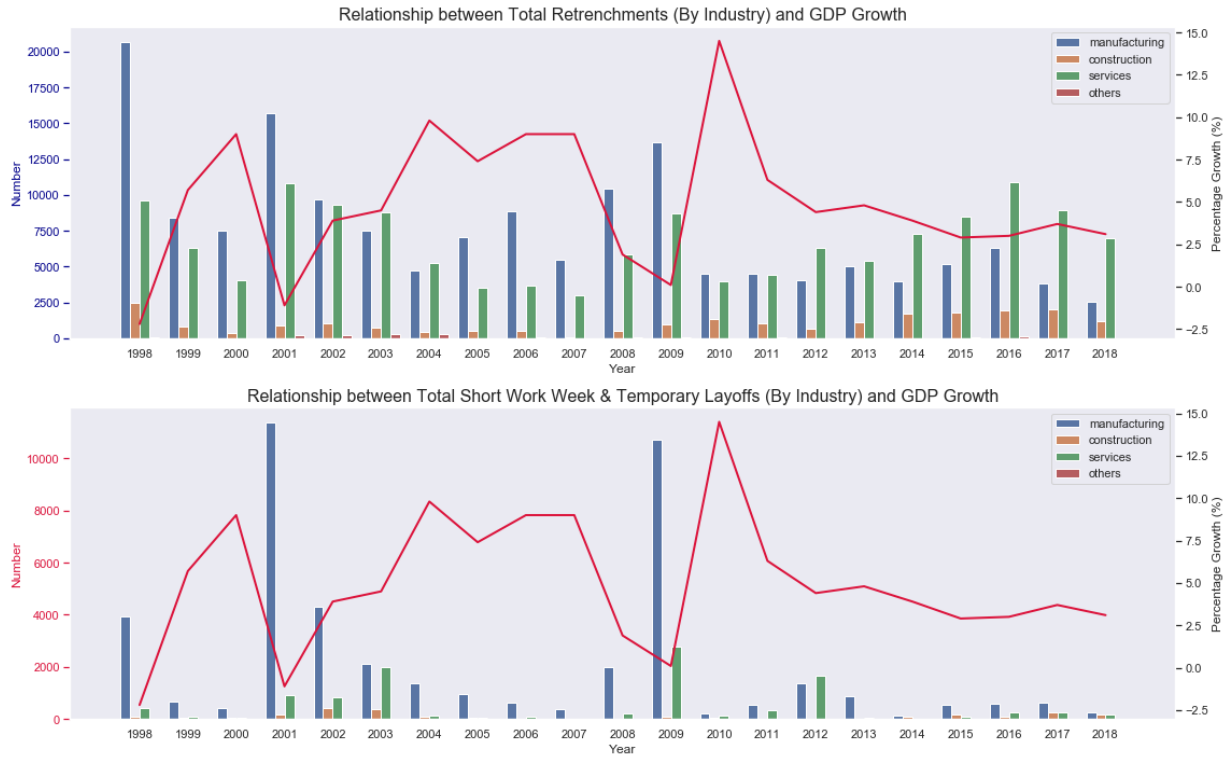
Type_of_Industry	count	mean	std	min	20%	40%	50%	60%	80%	max
construction	22.0	40.909091	38.285779	0.0	10.0	20.0	30.0	36.0	70.0	140.0
manufacturing	22.0	187.727273	283.866699	10.0	20.0	34.0	40.0	108.0	252.0	1090.0
others	22.0	0.000000	0.000000	0.0	0.0	0.0	0.0	0.0	0.0	0.0
services	22.0	54.545455	111.343624	0.0	10.0	20.0	30.0	30.0	40.0	530.0

Write Python code that uses Python Visualisation Package (Matplotlib/Seaborn..) to produce useful data visualizations that explain the data.

Data Visualisation 2: Grouped Bar Graphs with Line Graphs (Seaborn & Matplotlib)

In [8]:
```
import seaborn as sns
import matplotlib.pyplot as plt
import matplotlib.ticker as ticker

#set style of Seaborn Graph background to dark
sns.set(style="dark")

#read from csv file
gdp_growth = pd.read_csv("./Datasets/contribution-to-growth-in-gross-domestic-pro

#Renaming the column names
gdp_growth.rename(columns=
    {"year":"Financial Year",
     "value":"Percentage Growth (%)"}
    ,inplace=True)

#dropping level 1 columns which identifies each row as the GDP Growth Rate
gdp_growth.drop(["level_1"],axis=1,inplace=True)

#declare fig and axes object to plot
fig,ax = plt.subplots(2,1,figsize=(16,10))

#First Graph for Retrenchments

#convert column for total retrenchments to type and Column values to row values
df_melt_retrenchment = df_all.melt(value_vars=df_all[["Total Retrenchments"]],var

#declare ax0 to plot on the first subplot
ax0 = plt.subplot(211)

#using seaborn barplot function to plot retrenchments by type of industry
sns.barplot(x='Year', y='Number', hue='Type_of_Industry', data=df_melt_retrenchme

#display legend
ax0.legend()

#creating a twin axes to plot gdp growth
ax1 = ax0.twinx()

#using seaborn lineplot to plot gdp growth
sns.lineplot(ax0.get_xticks(), gdp_growth["Percentage Growth (%)"].loc[1998:2018]

#set title for first graph plotting
ax0.set_title("Relationship between Total Retrenchments (By Industry) and GDP Gro

#Second Graph for total short work week and temporary layoff

#convert column for total short work week and temporary layoff to type and Columr
df_melt_short_work_week_and_temporary_layoff = df_all.melt(value_vars=df_all[["Sh

#declare ax2 to plot on the first subplot
ax2 = plt.subplot(212)

#using seaborn barplot function to plot total short work week and temporary layof
sns.barplot(x='Year', y='Number', hue='Type_of_Industry', data=df_melt_short_work
```

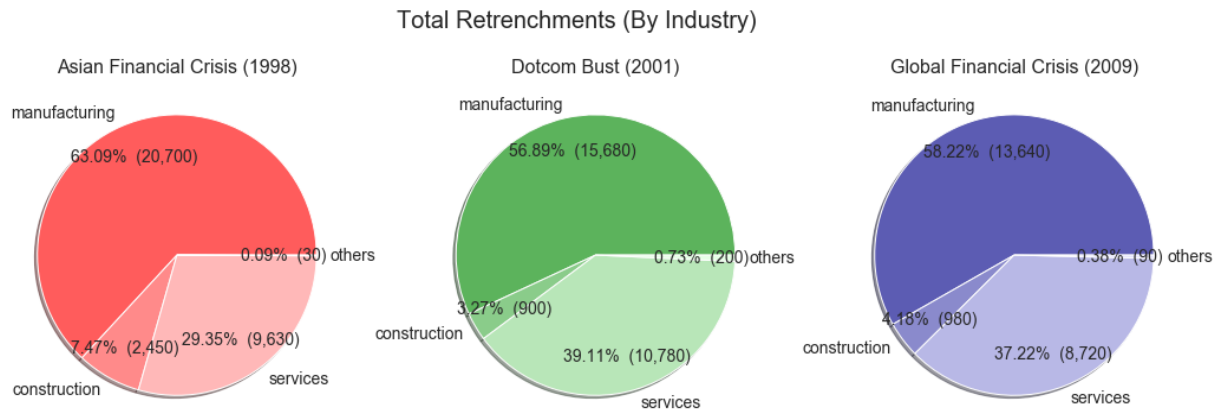
```
#display legend
ax2.legend()

#creating a twin axes to plot gdp growth
ax3 = ax2.twinx()

#using seaborn lineplot to plot gdp growth
sns.lineplot(ax2.get_xticks(), gdp_growth["Percentage Growth (%)"].loc[1998:2018]

#set title for first graph plotting
ax2.set_title("Relationship between Total Short Work Week & Temporary Layoffs (By

#Setting color to differentiate both graphs

#setting tick params to darkblue and crimson to differentiate between both graphs
ax0.tick_params(axis='y', colors='darkblue'), ax2.tick_params(axis='y', colors='c

#setting x and y labels to darkblue and crimson to differentiate between both gra
ax0.yaxis.label.set_color('darkblue'), ax2.yaxis.label.set_color('crimson')

#to display both graph together nicely
fig.tight_layout()

#display graph
plt.show()
```



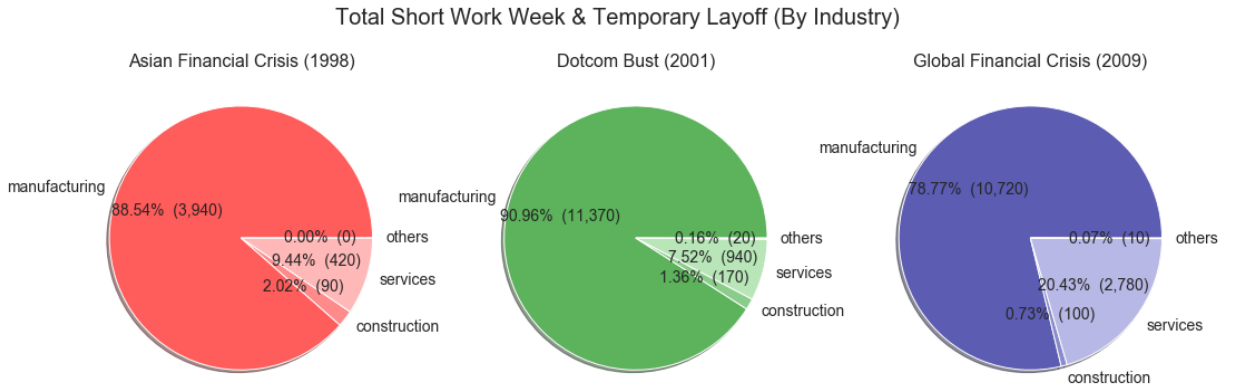
Data Visualisation 3: Pie Charts (Matplotlib)

Given the high number of Retrenchments and Short Work Week & Temporary Layoff in 1998, 2001, 2009, these years will be picked from the dataframe for analysing the industries most affected as well as the underlying reasons behind it.

In [3]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

#set index to year, extract years where there are high retrenchments, drop the ty
df_retrenchment = df_melt_retrenchment.set_index("Year").loc[["1998","2001","200

#declare fig and axes object for three different pie charts
fig, axes = plt.subplots(1,3,figsize=(18,6))

#declare list for color of individual years, title and count
color = [["#ff5c5c","#ff8a8a","#ffb8b8","#ffe5e5"],["#5cb35c","#8acc8a","#b8e6b8"
title = ["Asian Financial Crisis", "Dotcom Bust", "Global Financial Crisis"]
count = 0

#using zip and for loop to iterate and plot all three pie charts in one figure
for ax,(groupname,subdf) in zip(axes,df_retrenchment.groupby('Year')):
    values = subdf.Number.tolist()
    ax.pie(subdf.Number, labels=subdf.Type_of_Industry, autopct=lambda p : '{:.2f
    ax.set_title(f"{title[count]} ({groupname})",fontsize=16)
    count += 1

#set title above all three pie charts
fig.suptitle("Total Retrenchments (By Industry)",fontsize=20)

#display graph
plt.show()
```

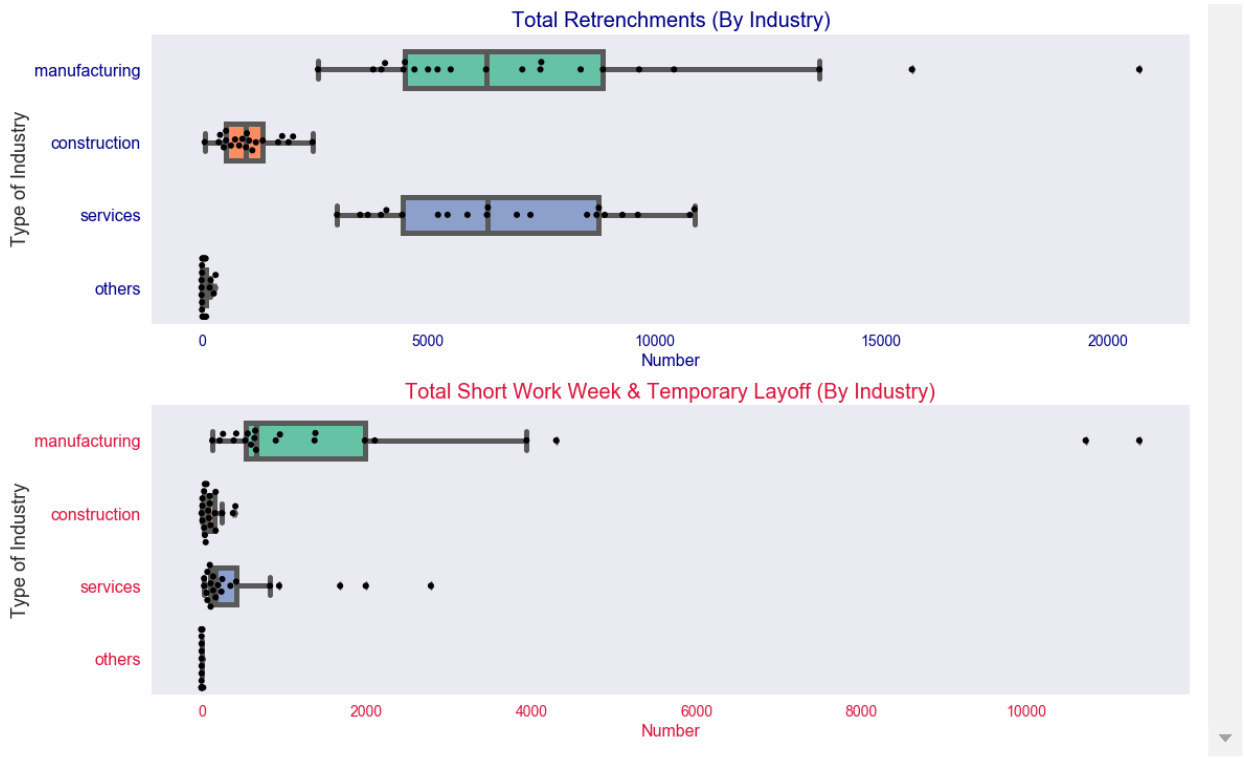


In [4]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

#set index to year, extract years where there are high short work week and tempoe
df_short_work_week_and_temporary_layoff = df_melt_short_work_week_and_temporary_l

#declare fig and axes object for three different pie charts
fig, axes = plt.subplots(1,3,figsize=(18,6))

#declare list for color of individual years, title and count
color = [["#ff5c5c","#ff8a8a","#ffb8b8","#ffe5e5"],["#5cb35c","#8acc8a","#b8e6b8"
title = ["Asian Financial Crisis", "Dotcom Bust", "Global Financial Crisis"]
count = 0

#using zip and for loop to iterate and plot all three pie charts in one figure
for ax,(groupname,subdf) in zip(axes,df_short_work_week_and_temporary_layoff.grou
    values = subdf.Number.tolist()
    ax.pie(subdf.Number, labels=subdf.Type_of_Industry, autopct=lambda p : '{:.2f
    ax.set_title(f"{title[count]} ({groupname})",fontsize=16)
    count += 1

#set title above all three pie charts
fig.suptitle("Total Short Work Week & Temporary Layoff (By Industry)",fontsize=20

#display graph
plt.show()
```



Data Visualisation 4: Boxplots & Swarmplots (Seaborn and Matplotlib)

In [12]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

#declare fig and axes object to plot
fig, ax = plt.subplots(2,1,figsize=(16,10))

#declare ax0 to plot on the first subplot
ax0 = plt.subplot(211)

#plotting boxplot graph
sns.boxplot(x="Number", y="Type_of_Industry", data=df_melt_retrenchment, width=0.

#plotting swarmplot graph on top of boxplot graph
sns.swarmplot(x="Number", y="Type_of_Industry", data=df_melt_retrenchment, color=

#set title for first subplot
ax0.set_title("Total Retrenchments (By Industry)", fontsize=20, color='darkblue')


#declare ax1 to plot on the second subplot
ax1 = plt.subplot(212)

#plotting boxplot graph
sns.boxplot(x="Number",y="Type_of_Industry", data=df_melt_short_work_week_and_tem

#plotting swarmplot graph on top of boxplot graph
sns.swarmplot(x="Number", y="Type_of_Industry", data=df_melt_short_work_week_and_

#set title for second subplot
ax1.set_title("Total Short Work Week & Temporary Layoff (By Industry)", fontsize=


#set fontsize, color for x labels, y labels, x ticks and y ticks
ax0.set_ylabel('Type of Industry', fontsize=18), ax1.set_ylabel('Type of Industry

ax0.set_xlabel('Number', fontsize=16, color='darkblue'), ax1.set_xlabel('Number',

ax0.tick_params(axis="x", labelsize=14, colors='darkblue'), ax1.tick_params(axis=

ax0.tick_params(axis="y", labelsize=16, colors='darkblue'), ax1.tick_params(axis=

#to display both graph nicely
fig.tight_layout()

#display graph
plt.show()
```



For the chosen datasets, explain the nature of that dataset (i.e. what is in that dataset) or any pecularities about it you wish to highlight and explain the process you went through to analyse that dataset, . Where possible, you should specifically mention how you used the Pandas, Matplotlib, Seaborn functions to achieve a certain outcome e.g. to transform the data or to produce a certain visualization:

Pecularities to highlight:

Duriny years where the number of retrenchments are high, the number of total short work week and temporary layoff is also quite high as well. However, there were significantly lower short work week and layoffs in 1998 (Global Financial Crisis) compared to year 2001 (Dotcom Bust) and 2009 (Global Financial Crisis).

Process of using Pandas, Matplotlib or Seaborn functions to transform the data:

Using Pandas to transform the data

Firstly, I read the excel file from retrenchments and short work week and layoffs and store it in two variables. Then, I merge both dataframes into one and store it as df_all. After that, I display the shape, index and column names of the df_all dataset so that I am able to rename the column names. Moving on, I used the head and tail method to display the first and last five rows. To gather summary information of the data, I used the info method. To display Statistical Information of Retrenchments, Short Work Week and Temporary Layoffs in the df_all dataset, I used a for loop to iterate the list of variable and display the statistics using the groupby function and describe method with varying percentiles.

Using Matplotlib or Seaborn functions to transform the data:

Data Visualisation 2: Grouped Bar Graph with Line Graph

Firstly, I set style of Seaborn Graph background to dark and read from the gdp growth excel file. After that, I rename the column names for gdp growth and dropped level 1 columns which identifies each row as the GDP Growth Rate.

In order to make a comparison between the retrenchments, short work week and temporary layoff and the GDP Growth, I created another variable to read from the gdp growth excel file. Then, I rename the column names and drop level 1 columns which indentifies each row as the GDP Growth Rate. Then, I declare the fig and axes object such that both graphs will display on the same figure, using subplots.

Afterwards, I convert the column for total retrenchments to type and Column values to row values, declare ax0 to plot on the first subplot, and use seaborn barplot function to plot retrenchments by type of industry and display the legend. Then, I called twin axes to declare share another y axis to plot the gdp growth using seaborn lineplot function and setting the title. Similarily, the process of plotting the total short work week and layoff is the same. In order to differentiate both graphs, I specify the colors for both graphs to crimson and darkblue for yticks and labels for y-axis. Then, I call fig tight layout so that both graph will not interfere one another and plt show to display the graph.

Data Visualisation 3: Pie Charts

As pie charts is only able to show the distribution for the retrenchments/short work week and layoff based on individual years, only the number of years where there are high number of the values are selected from the df_retrenchments and df_short_work_week and temporary layoff dataset. The years are 1998,2001 and 2009. First, I set the index to year, extract years where there are high retrenchments rates, drop the type and reset index from the df_retrenchments dataset. Then, I declare fig and axes object for three different pie charts and list for color of individual years, title and count. Then, I use zip and for loop to iterate and plot all three pie charts in one figure set the title above the three pie charts. Similarly, the process of plotting total short work week and temporary layoff is the same but just with different variables.

Data Visualisation 4: Boxplots & Swarmplots

Firstly, I declare fig and axes object to plot. Then, I declare ax0 on the first subplot and plot the graph using seaborn boxplot and swarmplot using df_melt_retrenchment dataframe. Then, I set the title for the first subplot. Similarly, the process to plot total short work week and temporary layoff is the same but on different subplots and using different variables. In order to differentiate between both graph, the color and fontsize of retrenchments and short work week & layoff is set to darkblue and crimson. Then, I call fig tight layout so that both graph will not interfere one another and plt show to display the graph.

For each dataset, highlight the insights you have gained from analysing the data and any conclusions or recommendations you want to make as a result of the analysis:

Data Visualisation 2: Grouped Bar Graph with Line Graph

From the graph, we are able to tell that there is a very strong correlation between total retrenchments, short week and layoff when comparing to GDP Growth. During years where there are low retrenchments rates and short week and layoff, Singapore is experiencing the fastest GDP Growth. This is evidently seen from the year of 2010 after the global financial crisis, which Singapore experiences the fastest GDP Growth and the lowest retrenchments and short work week and layoff. During times where there are high number of retrenchments and short work week and layoff, the GDP Growth rate is inevitably the lowest in year 1998, 2001 and 2009.

Besides that, we are also able to infer that manufacturing industry is always one of the hardest hit during an economic downturn. This can be seen from the graph where the total number of retrenchments during economic crisis for the manufacturing sector is always higher compared to the services and construction sector, with the number of retrenchments being around 20 thousand during 1998 Asian Financial Crisis, 15 thousand during 2001 dotcom bust and 12 thousand during 2009 Global Financial Crisis. The number of short work week and layoffs is also one of the highest during that period, at around 4000, 11000 and 10000 respectively.

Data Visualisation 3: Pie Charts

Given the high number of Retrenchments and Short Work Week & Temporary Layoff in 1998, 2001, 2009, these years will be used to further analysed the industries that are most affected.

After analysing the graph, I are able to tell that the retrenchments for the manufacturing sector is always the hardest hit, followed by the service sector and construction sector.

To understand why manufacturing sectors is always has the highest number of retrenchments, we will use 2001 dotcom bust as an example. The manufacturing sector has always been one of the greatest contributors to GDP Growth in Singapore, accounting to about 20-25% between 1990s and 2000s. The electronics sector in particular has always been the largest contributor to the manufacturing output of Singapore's economy. During the year leading up to 2001 dotcom bubble, there is excessive speculation of technology companies over the potential technology boom and popularizing use of the internet in the US. This sector contributed close to two-thirds of Singapore's non-oil domestic exports (products that were manufactured in Singapore and sold to foreigh countries) back then. As a result, when the technology bubble finally burst in 2001, there were massive retrenchments for people that work in the electronics sector, who were responsible for producing and manufacturing semiconductors, mobile products and computer chips.

Besides that, I am also able to infer that due to the nature of demand of the various industries in Singapore, companies tend to retrench employees instead of employing alternatives to retrenchments such as total short work week and layoff. This can be seen when during the asian financial crisis, the number of retrenchments is at 20000 while alternatives to retrenchments (short work week and layoff) is only around 4000. However, there seems to be increasing awareness of responsible employer practices as the total number of short work week and layoff has increased during economic downturn and the number of retrenchments has decreased. This could be due to the fact that the Singapore Government (Ministry Of Manpower) encourages and provide support for employers to retain and provide guidelines for managing excessive manpower.

Data Visualisation 4: Boxplots & Swarmplots

Besides retrenchments and alternatives to retrenchments due to economic crises, Employers also tend to retrench or layoff their workers due to other reasons as well. In order to better understand the nature of retrenchments and alternative to retrenchments, the boxplot is used to show the distribution of total retrenchments by Industry as well as total short work week and layoff by industry.

Given the nature that employers tend to only impose short work week and layoffs during economic downturn, it is not surprising to see that the various industries tend to have close to zero number of total short work week and layoff. Therefore, plotting boxplot to find the distribution of total short work and layoffs is not a wise decision as there are many outliers. However, I still plotted the boxplot so as to show the comparison between the distribution of total retrenchments and distribution of total short work week and layoffs.

Moving on to retrenchments, economic downturn is not the only reason why employers retrench their workers. There are several reasons why Companies retrench their employees. One of the possible reasons is due to the ageism. The middle aged and older workers tend to be vulnerable to retrenchments as there is a pervasive assumption in Singapore that they are less productive regardless of their actual abilities.

Companies tend to retrench older workers because they are deemed to be less flexible, outdated, not technologically orientated and much more expensive hires compared to younger workers. Hence, there is a wider distribution of the data for retrenchments sorted by the various industry.

An interesting thing to note is that the mean (average) retrenchment rates for the manufacturing sector is the same as the services sector. This could be attributed to the fact that advancements in technologies has resulted in automation and robots replacing job in the service industry.

Therefore, there is always a degree of retrenchments in Singapore.