Impact of COVID-19 related behavioural response on stock price volatility: an econometric investigation

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11 July 2022

Image: Carnegie Mellon University (2014)

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Please note these views are my own and should not be taken to represent the position of the Department of Health or Australian Government.

Image: Carnegie Mellon University (2014)

Introduction

This study seeks to quantify the short term relationship between changing behavioural states and stock market volatility.

Survey data has been used to categorise human behaviour in Australia into three categories: fearful, careful and complacent as three series that have propensity to change over time.

Stock price volatility (SPV) is measured using Generalised Autoregressive Conditional Heteroscedasticity (GARCH) methodology. In addition, this study sought to investigate whether any short-term interactions measured via Vector Error Correction Model (VECM) methodology exists between behavioural status and SPV.

Research question

Is there a significant short run relationship between behavioural status and volatility in the Australian Securities Exchange (ASX), hereon referred to as stock price volatility (SPV)?

Relevant literature

Google search behaviours as a proxy for COVID-19 related behaviour

- Sun et al. (2022): abnormal google search behaviours as a proxy for COVID-19 related fear. Proxy found to be linked to negative returns in the European stock market.
- Lyocsa et al. (2022): similar proxy methodology, however expanded the analysis to conclude that COVID-19 related fear was predictive of market variance and volatility across 10 country stock indices, including the ASX. The authors deployed a GARCH methodology in a similar manner to this study.

Macroeconomic factors as a proxy for COVID-19 related behaviour

- Kusumahadi and Permana (2021): deployed exchange rates as a metric to measure negative stock market responses. Using GARCH methodology, the authors conclude that the emergence and presence of COVID-19 in each country under analysis (excluding the United Kingdom) impacted stock market volatility.

COVID-19 cases as a proxy for behaviour change

- Brueckner and Vespignani (2020): Using vector autoregression modelling and associated impulse response functions the authors estimated impacts on the Australian stock market in the Australian context. The primary insight details a significant positive effect of COVID-19 infections on the performance of the ASX. The authors deploy a VAR approach which is similar to this study which establishes a vector error correction model.

Motivation

- Human behaviour has and will continue to be a major driver of COVID-19 related economic consequences.
- Research to date has not sufficiently captured how different behavioural states, generated in response to COVID-19, may impact the broader economy.
- Due to the volatile and unexpected nature of the COVID-19 pandemic, this study argues that an analysis of economic outcomes (in this instance stock market closing prices) requires analysis of series volatility in addition to level changes.
- This implies that instead of simply looking at the impact of COVID-19 behavioural status on price changes in one direction or another, analysis is required to understand how COVID-19 behaviours increase or decrease volatility in the modelled outcome.

Methodology

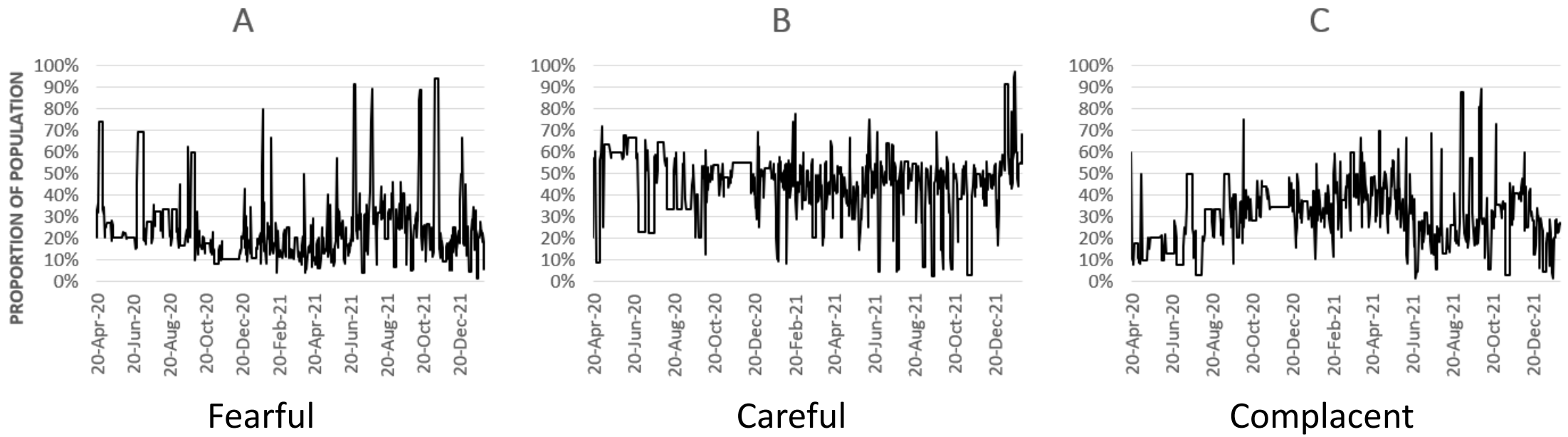
"[Have you] avoided going out in general?"

- **Fearful:** *"Always [avoid going out in general]"*;
- **Careful:** *"Sometimes [avoid going out in general]"* or *"Frequently [avoid going out in general]"*, and
- **Complacent:** *"Rarely [avoid going out in general]"* or *"Do not at all [avoid going out in general]"*.

Daily data was collected from the YouGov COVID-19 behaviour tracker for the period of 20 April 2020 to 31 January 2022.

Methodology

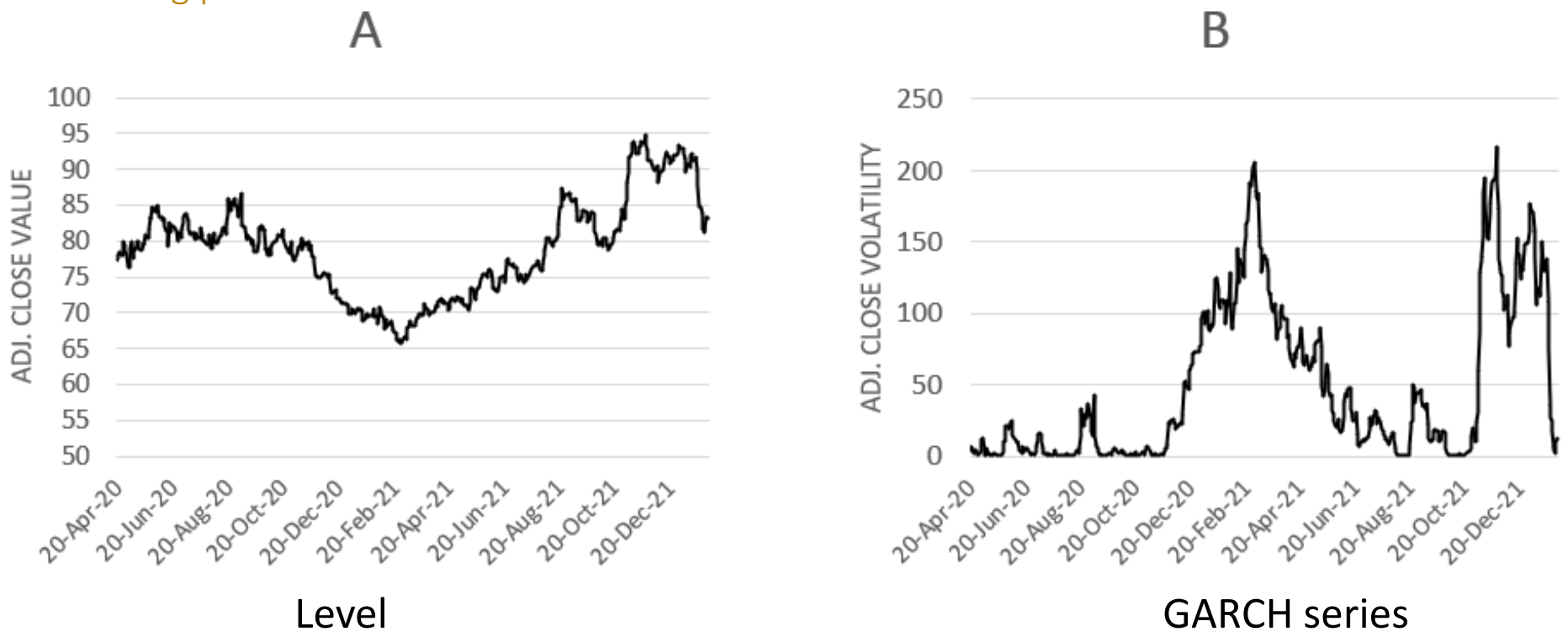
Figure 1. Proportion of the population by behavioural compartment



Methodology

- Daily closing price data for the period 20 April 2020 to 31 January 2022 (pane A).
- Stock market volatility was measured using a GARCH model
- Closing prices are subject to a GARCH (1,1) process to develop a GARCH variance series (pane B)

Figure 2. ASX closing prices



Level

GARCH series

Methodology

- Stationarity tested using Augmented Dickey Fuller test.
  - The behavioural variables = stationary, however
  - stock price volatility = non-stationary
  - Therefore VECM was chosen for analysis.

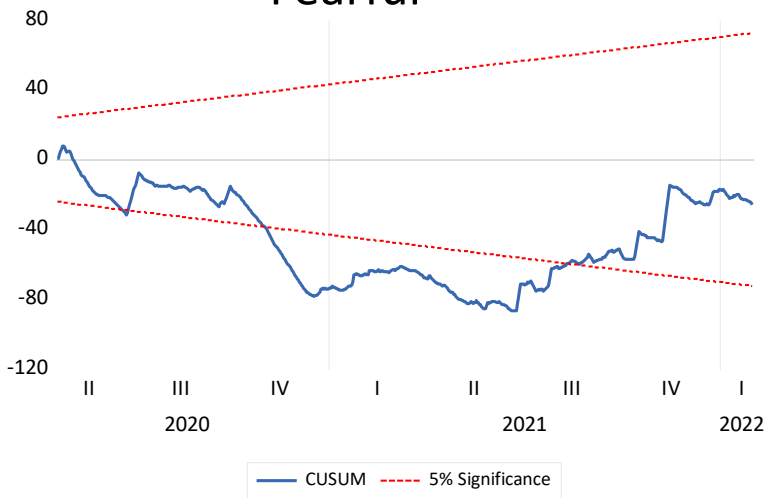
- Results of the Johansen cointegration test found significant cointegrated relationships between stock volatility and fearful, careful and complacent behaviour respectively.

- Optimal lag length was selected based on the Akaike Information Criterion (AIC).

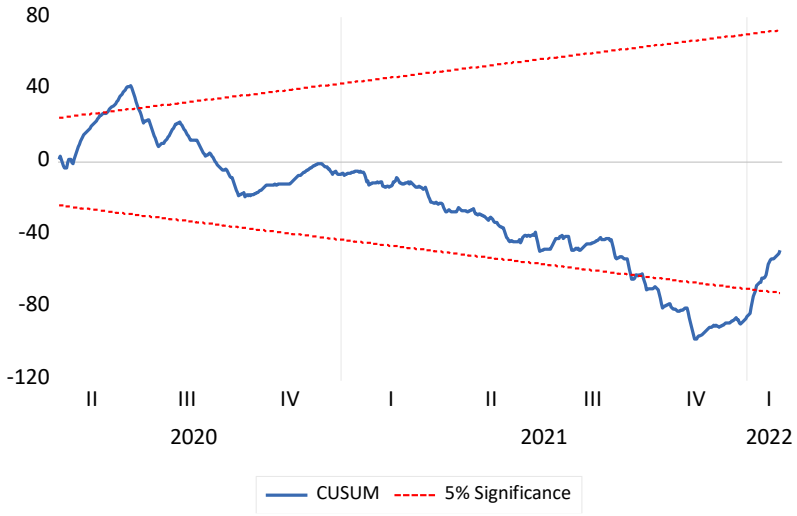
- For completeness, stability testing and Granger Causality testing was deployed to uncover any lagged effects between the variables.

Results

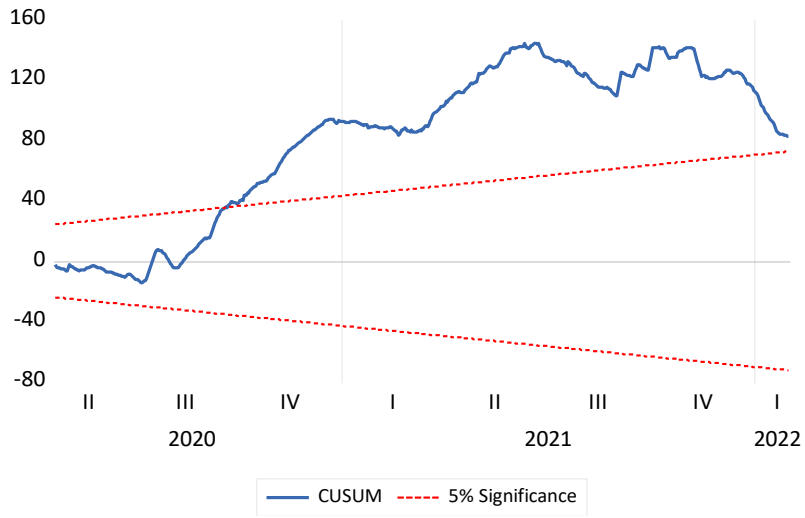
Fearful



Careful



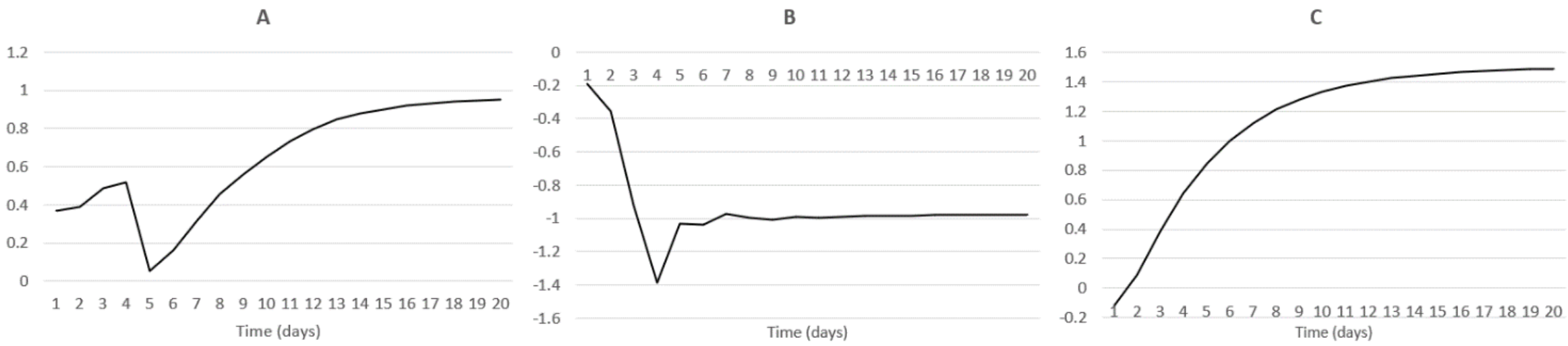
Complacent



Results

- Impulse response functions defined as a Cholesky 1 standard deviation (d.f. adjusted) shock applied to each behaviour category which in turn affects stock market volatility.

Figure 3. IRF to Cholesky shock by behavioural compartment

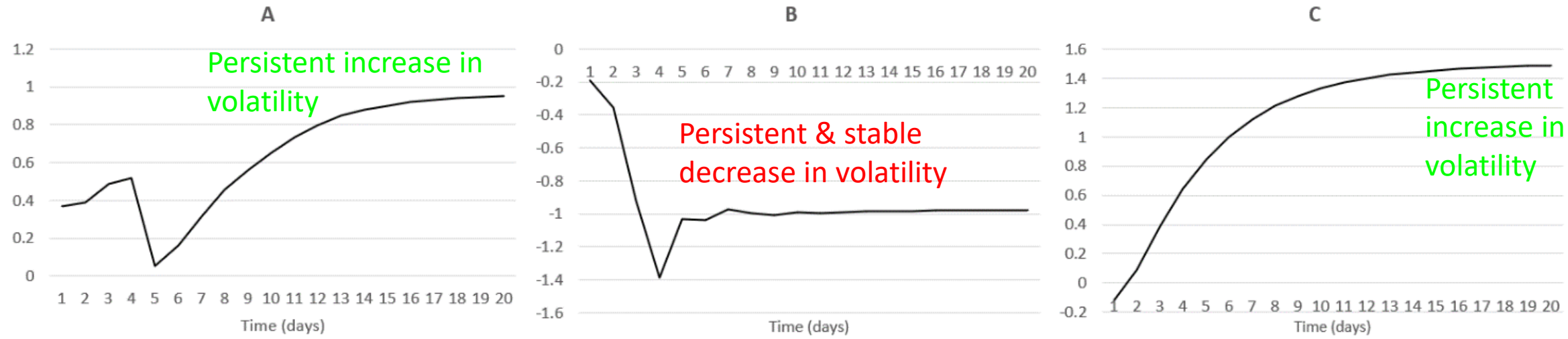


Fearful Careful Complacent

Results

1. Fearful: a shock to the proportion of the population that is fearful implies an increase, followed by a sharp decrease, then persistent increase in SPV over the 20 days post innovation.
2. Complacent: an initial decrease in volatility on the first day, followed by ever increasing volatility in the days thereon.
3. Careful: a shock to the proportion of the population that is careful details an initial sharp decline in volatility, which after a brief recovery, remains negative for the duration of the horizon length (20 days).

Figure 4. IRF to Cholesky shock by behavioural compartment



Fearful Careful Complacent

Results

Table 1. Least squares regression results

	Closing prices
Fearful	+
Careful	n.s.
Complacent	-

Figure 5. Behavioural Granger causal relationships

$$Fearful \rightarrow Complacent$$

Significant from lag 1 – 4

Figure 6. SPV Granger causal relationships

$$SPV \rightarrow Fearful$$

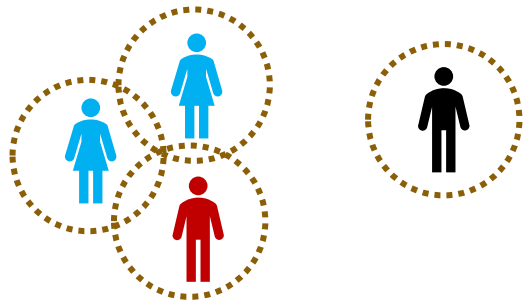
Significant from lag 9 - 24

Results

- What this means is that there are real and tangible benefits to the population behaving carefully. Any shock in either extreme end (fearful or complacent) is associated with increased volatility on the stock market.
- On the other hand, a shock to the number of careful agents is found to reduce volatility on the stock market.
- In terms of level differences, while both fearful and complacent shocks increase volatility, fearful agents have greater power to drive up closing prices where complacent agents drive closing prices down.
- Looking to granger-causal relationships, note that fearful agents were found to granger cause complacent agents for selected lag periods, and SPV was found to granger cause fearful agents for selected lag periods.
- These results capture the essence of the role of behavioural status in driving macroeconomic outcomes.

Conclusion

- This study has presents a novel approach to quantifying the impact of COVID-19 behaviours on stock price volatility. In order to better understand and forecast SPV, further analysis is required to incorporate elements of human psychology and decision making into modelling efforts.

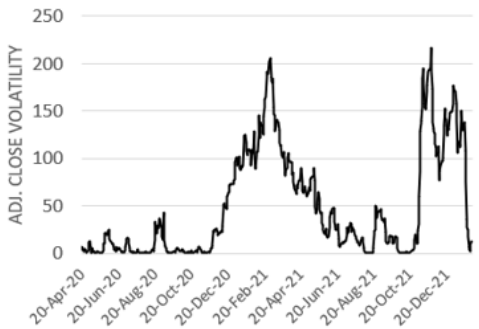


Disease spread outcomes

Behavioural status informs mixing

Fearful Careful Infected

Short term macroeconomic volatility



Long term macroeconomic trends

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THANK YOU

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