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EXOGENOUS
EVENTS,
ECONOMIC
STIMULUS AND ITS
FUTURE
TRAJECTORY

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ECON594 Thesis

Table of Contents

Introduction	1-11
Chapter One: Background	12-16
Chapter Two: Theoretical Discussion	17-24
Appendix:	25-26
Chapter Three: Natural Disasters	27-61
Appendix: Natural Disasters	62-83
Chapter Four: Terrorist Attacks	84-102
Appendix: Terrorist Attacks	103-121
Chapter Five: Pandemics	122-129
Appendix: Pandemics	130-133
Chapter Six: Precautionary Savings	134-142
Appendix: Precautionary Savings	143-146
Chapter Seven: Discussion of Results at the Aggregate and Economic Policy	147-167
Conclusion	168-170
Data Appendix	171
References	172-194

Introduction:

Our world's history books show society is continuously faced with significant exogenous events. The present worldwide COVID-19 pandemic shows how impactful exogenous events can be, particularly from an economic point of view. Gita Gopinath, the International Monetary Fund (IMF) chief economist anticipated that 2020 would have the worst economic contraction since the 1930s (Giles, 2020). Looking at the past shows policy makers use monetary and fiscal policy to respond to exogenous events; however, the jury is not out for the superior policy or combination of policies to react to exogenous events.

Policy makers are extremely powerful, such influence is evident when analysing the European Central Bank (ECB) President, Mario Dragó's 'Whatever it takes' speech in 2012 that arguably saved the Eurozone from a debt crisis and within the PIIGS nations led to strong bond market rallies (Nelson, 2017). Therefore, policy makers hold significant responsibility to make adequate decisions to reduce the long-term cost of exogenous events. The current COVID-19 pandemic shows all countries are not enacting plays from the same game book, policy makers have taken distinct policy responses globally. Having an understanding of successful historical policy responses to exogenous events can be helpful for policy makers to ensure they take effective and adequate responses in a timely manner.

Subsequently, my primary research question is to determine the most effective and successful economic policy response to exogenous events by using insight from a historical perspective. The exogenous events that will be analysed include natural disasters, terrorism and pandemics. These are events that come from outside economic models and systems; however, they still have a substantial effect on the economy. Each exogenous event category produces shocks that have varying demand and supply shocks that originate from different sources thereby allowing for a holistic analysis to take place.

Further research questions include analysing whether there is any significant difference in the influence on macroeconomic variables between different policy mixes or the lack of policy response. In addition, given the three categories of exogenous events have varying supply and demand shocks another key research question is determining whether there are any differences in the success of policy responses between the different categories of exogenous events. Last research question includes analysing whether the differences in the nature of the exogenous events impacts uncertainty and precautionary saving levels which can impact economic policy responses success in stimulating aggregate demand.

The key hypotheses to these research questions include firstly, monetary and fiscal policy to have non-linear benefits. Specifically, historically monetary policy can be seen to have diminishing returns therefore arguably there can be greater focus on the role of fiscal policy. A further hypothesis is that policy is used most effectively when monetary and fiscal policy is used in unison, however in saying this, one anticipates policy makers must be wary of the diminishing returns from policies to ensure policy is implemented when most needed. Further hypothesis anticipates there will be key differences in the magnitude and areas of supply and demand shock between the different exogenous event categories that could influence the type of policy responses needed under each category. For instance, the current COVID-19 pandemic is prolonged in nature which could have an impact in the type of policy response needed and its relative effectiveness. Last hypothesis includes greater uncertainty and in turn precautionary savings levels will occur post pandemics due to the greater restrictiveness that comes from the crisis and the invisible and prolonged threat compared to that of natural disasters and terrorist attacks.

Literature Review:

The economic impact of exogenous events through the likes of natural disasters, terrorism and pandemics has been widely explored and studied within academic literature.

Furthermore, academic literature has thoroughly examined the mechanisms monetary and fiscal policy work to influence key macroeconomic variables to stimulate economies.

However, limited study has been conducted around the most successful way to use monetary and fiscal policy as an economic response to exogenous events. Some pre-existing literature has to a certain extent analysed the economic response to previous exogenous events in silo or for a small collection of exogenous events. However, very few analyses have conducted a wide-ranging study on several exogenous events from different categories. This literature review will highlight where there are gaps in understanding within the academic literature.

A dynamic stochastic general equilibrium model was used in one analysis to articulate a counter argument that the Federal Reserve should have raised interest rates post Hurricane Katrina (Keen & Pakko, 2011). The study outlined that natural disasters cause significant destruction to capital and adverse technology shocks which can cause a decrease in output, in turn an increase in prices from firms, resulting in subsequent inflation (Keen & Pakko, 2011). Therefore, the analysis argues that if one was to implement monetary policy through the Taylor rule then the larger inflation impact should dominate the smaller output impact,

thus the need for an increase in interest rates (Keen & Pakko, 2011). The key downfall in this study was the failure to use real data to test whether in fact the inflation rate dominates the output effect (Keen & Pakko, 2011). Consequently, this is an important area of study and a clear gap in academic literature, there is a need to use real world data post exogenous events to test whether economic theory in fact holds.

An additional branch of academic literature uses compare and contrast methods to evaluate the effectiveness of economic responses to exogenous events. One academic article compared the fiscal response of the 1995 Kobe earthquake and the 2011 Tohoku earthquake and tsunami (Schnell & Weinstein, 2012). The study acknowledged the economic environment occurring in Japan prior to the natural disasters as well as the differences in responses and the subsequent impact on key economic factors such as private consumption, industrial production and GDP growth (Schnell & Weinstein, 2012). A notable finding from the study was government spending rose significantly post the 1995 earthquake, however the difference in spending only accounted for 8% in the differences in Japan's GDP values post the earthquakes. The analysis argued that the most significant impact causing the differences in recovery rates was the difference in the impact on energy production post the earthquakes (Schnell & Weinstein, 2012).

In line with this, the Bank of England (BOE) carried out a study which also used a compare and contrast method to evaluate important factors that need to be considered when deciding suitable economic responses to disasters. The two disasters that were studied had conflicting policy responses, firstly Hurricane Katrina where the Federal Reserve decided to continue with their plan to increase interest rates and the earthquake and tsunami in Japan where the Bank of Japan (BOJ) implemented expansionary monetary policy. The analysis asserted that the factors that drove the success of the policies included size and persistence of the exogenous event (Batten et al., 2016).

A compare and contrast methodology has also been used to examine policy responses to terrorism attacks. One study compared the September 11th 2001 terrorist attacks and the 2004 Madrid attacks. The study argues that the reason why policy response was enacted post September 11th and not the Madrid attacks was due to the difference in economic climate prior to the attack (Johnston & Nedelescu, 2006). Other key factors included the target of the attack. The terrorist for 9/11 targeted the financial sector and the US air space was closed for several days which delayed everyday financial operations, exacerbating the situation. In turn,

causing the Federal Reserve to take action to provide liquidity into the market to restore confidence. Whereas the target of the Madrid attacks did not have such an impact (Johnston & Nedelescu, 2006).

Clearly academic literature has provided insight into the factors that influence the success of monetary and fiscal policy post a disaster and terrorist attack. Furthermore, the literature has captured arguments for when and how central banks and governments should intervene. However, there is scope for further analysis to be conducted. Particularly by using quantitative data analysis to identify the success of economic policies taken, or a lack of policy taken and to do this analyse a range and larger quantity of exogenous events to provide a more holistic view.

Previous work has explored the impact pandemics have on economies, however until recently little focus has been placed on suitable economic policy responses. One study with a UK context analysed the macroeconomic impact of influenza. The analysis used a COMPACT model to extend previous UK influenza pandemics to be more significant pandemics (Keogh-Brown et al., 2010). In the most extreme case, the study found several reasons as to why inflation may rise post a pandemic, suggesting the need for a contractionary monetary policy (Keogh-Brown et al., 2010). Therefore, this article provides a different perspective to the current policies being introduced in response to COVID-19.

Additionally, a study by the Asian Development Bank examines the economic impact of the SARS pandemic and evaluates the role of fiscal policy to react to the pandemic (Fan, 2003). The article argues that it is imperative for governments to be fiscally responsible and have budget surpluses as fiscal policy is needed in response to pandemics (Fan, 2003). However, the study does mention that pandemics cause high degree of uncertainty and a psychological fear and a key drawback with fiscal policy is that it may not easily restore confidence in the economy hence fails to stimulate aggregate demand (Fan, 2003). This thesis aims to expand the knowledge surrounding suitable economic responses for pandemics, by looking at real-world data to compare and contrast between past pandemics and the current COVID-19 crisis.

Furthermore, academic literature has evaluated the role fiscal policy can play in preventing exogenous events from happening in the first place. One academic article used data from the US economy and financial markets to determine that a 7% permanent tax would be justified if the tax reduces the impact of exogenous shocks by 15% (Pindyck & Wang, 2013). This

research shows the importance of being constantly prepared for exogenous events; this thesis plans to further examine this line of thought as exogenous events continue to be unpredictable in nature hence policy makers will continuously need to know how best to respond to such crisis.

In addition, academic literature has examined how debt can minimise the impact from exogenous events overtime and the effectiveness of debt in absorbing the shock from exogenous events. One study examined the importance of commitment to policies to ensure adequate debt levels for governments (Niemann & Pichler, 2011). The study used a benchmark economy to an economy without disasters. The conclusion was that disasters can increase uncertainty and when policy makers are not committed to policies then when government debt increases it could result in governments to be incentivised to create surprise inflation. Such inflation would impact businesses and household's inflation expectations, in turn the level of debt governments can use to respond to the exogenous events (Niemann & Pichler, 2011). Hence this study shows a stable policy can help minimize the adverse impacts caused by these exogenous events. This thesis will attempt to enhance the knowledge in this area and analyse how uncertainty levels can impact the success of economic policy responses.

Lastly, in terms of analysing precautionary savings levels, previously empirical analysis has been concerned with identifying the mechanisms that result in precautionary savings through for example, using the Euler equation (Carroll & Kimball, 2006). Additionally, structural estimation and regression analysis has been used to determine the difference in uncertainty faced by households, in turn the difference in saving levels (Dardanoni, 1991). Issues that arise with this type of empirical work include identifying the variations in uncertainty across households and over estimating risks households face (Carroll & Kimball, 2006).

The analysis in this thesis is less concerned with identifying differences in uncertainty and subsequently saving levels between households. Instead, due to the exogenous events being idiosyncratic and this analysis studying real world aggregate data, comparisons will be made to identify any significant differences in saving levels between actual figures and what savings levels would have been expected to be if the exogenous event did not take place. Hence overcoming the issues of estimation and identifying uncertainty as previously mentioned.

Savings levels will be statistically analysed through use of synthetic controls. Previous academic literature has used synthetic controls to analyse how terrorist attacks influence

democratic elections (Montalvo, 2011) and analyse the long-term economic impact of natural disasters (Coffman & Noy, 2012). Furthermore, synthetic controls have been applied in some contexts of precautionary savings, with one study looking at the impact the 2008 Sichuan earthquake had on savings behaviours (Luo & Kinugasa, 2018). My analysis will extend this line of research by studying a range of exogenous events to produce a holistic analysis. This is because, as previously discussed, each exogenous event have their own idiosyncratic features with varying demand and supply shocks resulting in various levels of uncertainty. Therefore, similarities and/or differences can be analysed.

Overall, the literature review reveals there is a varying body of academic literature that has examined economic policy responses to exogenous events. Additionally, the literature has touched on a vast variety of theories to raise viewpoints on conflicting policy responses. Notably in comparison, until recently, greater analysis has been produced for natural disasters and terrorist attacks than for pandemics. The key gaps in literature this thesis aims to address is comparing and contrasting real world aggregate demand between a range of exogenous events to allow for improved holistic conclusions to be made, that is grounded by real world data rather than what is expected to occur under economic theory. In addition, in terms of analysing uncertainty, particularly in regards to precautionary savings, this thesis aims to fill the gap in academic literature by comparing and contrasting the savings rates from a variety of exogenous events, rather than looking at exogenous events and subsequent savings rate in silo.

Methodology:

The methodological approach taken within this research is deductivism. Such an approach uses generalized principles to deduce specific conclusions. Essentially the approach uses quantitative data to derive results in order to confirm or reject a hypothesis and reflect on initial theory (Hausman, 1989). The key advantage of deductivism is that it is a simple and relevant tool that includes several aspects of modern economics including econometrics, macroeconomics and microeconomics (Hausman, 1989).

My analysis will use the methodological approach similar to that of an event study methodology, to analyse each exogenous event at the individual level. The essence of an event study is to analyse the difference in the impact on a variable when an event took place and the expected value unconditional on the event taking place (Kothari & Warner, 2007). An event study methodology has been used by many disciplines, however it was initially

commonly used to evaluate the impact a specific event such as earning announcements and acquisitions have on the value of a firm (MacKinlay, 1997). The process of an event study methodology is as follows, firstly one establishes the variables they want to analyse and over the specific time period, the 'normal' variable is then calculated (MacKinlay, 1997). For example, if one was wanting to estimate the 'normal' returns of a stock for an affected firm, this can be calculated by an estimation window to determine what the stock returns should have been for the affected firm on the day of the event and for several days post the event, if the event did not take place (MacKinlay, 1997). The next step is to calculate the abnormal returns by deducing 'normal returns' from the actual returns. Next, statistical analysis is used to evaluate whether the abnormal returns are statistically significant (MacKinlay, 1997).

Therefore the main purpose of an event study is to determine whether movements around a variable are consistent with normal returns, or whether they can be considered abnormal at a statistically significant level (Konchitchki & O'Leary, 2011). The event study methodology has been extended to be used in other contexts, one study used elements of an event study methodology when analysing the long-run economic consequences of pandemics (Jordà et al., 2020). The study asserted that history is usually a valid predictor for how the future unfolds, hence the analysis used past values to make predictions and then compared the predictions to how the future in fact did unfold after the pandemic (Jordà et al., 2020). The study made reference to the idea that this form of methodology holds analogues to a randomized control trial (Jordà et al., 2020). This follows the ideology of randomly allocating subjects to two or more groups with different treatments applied to each group and then comparing the difference in response between the two groups (Jordà et al., 2020).

Therefore, by following an event study methodology within my analysis, allows for non-experimental data to be re-structured and solves for the missing information problem (Angrist & Pischke, 2014). This problem arises as countries only have one existence; we do not know the difference in outcomes for a country if they experienced an exogenous event and subsequent economic policy support or not. One cannot simply compare the country before and after the exogenous event and any subsequent economic policy response as the rest of the world has advanced (Angrist & Pischke, 2014). Hence if one was to do this, they would be analysing the countries information in two separate time periods, with two different economic and social climates, which would have implications for any conclusions drawn. It would reduce the confidence in inferences made regarding what was caused by the treatment (event and potential economic policy response) and what was merely due to changes in the

environment (Angrist & Pischke, 2014). Therefore, the presence of a non-participant group allows for the development of causality conclusions.

The event study methodology will be applied to key macroeconomic variables within a two-year period post the exogenous event. To analyse how macroeconomic variables responded with the economic response introduced or lack of economic response as a result of the exogenous event, to determine any significant abnormal results. Abnormal results will be calculated by the difference between the predicted normal return and the actual return and a t-test will be conducted to determine whether the abnormal value for each macroeconomic variable is statistically significantly different to zero.

The macroeconomic variables that will be analysed include GDP, unemployment, inflation, investment, consumer spending, business confidence, consumer confidence and foreign direct investment (FDI). These macroeconomic variables have been chosen as they are not as susceptible to idiosyncratic features to a particular nation and provide a holistic overview of the state of the economy. In addition, a two-year period has been chosen as it is a reasonable length to provide accurate forecasting, as the further away one predicts the greater caution must be applied to the predictions. In addition, whilst monetary and fiscal policy can have delays in filtering through the economy, one can argue that two years is long enough to indicate any signs of recovery or conversely any adverse impacts on the economy. Further to this, as previously mentioned, our world is inherently chaotic and there are frequent shocks occurring that have impacts on macroeconomic variables hence a relatively short-term viewpoint is appropriate.

Possible forecasting methods to use in an event study analysis include a rolling window, expanding window and an ARIMA model. A rolling window analysis uses a constant amount of observations, contrastingly an expanding window uses an increase in observations (Eviews, 2016). Notably the strength of predictions increases with sample size thus expanding window analysis can cause consistency concerns (Eviews, 2016). An ARIMA model is a forecasting algorithm which is based on the idea that for time series variables, future values can be predicted by using past values (Eviews, 2020). One predominant benefit of an ARIMA model is that it can allow forecasts to be seasonally adjusted improving the validity of findings which is why this study has used an ARMA model (Eviews, 2020). Further description and benefits of using an ARIMA model will be explained later in conjunction with the empirical evidence.

Notably each exogenous event has a different magnitude and scalability of impact, therefore to allow for some comparisons to be drawn, analysis will be conducted on how the exogenous event influenced key variables in the short term after the event. This analysis will be conducted by looking at what central banks and treasuries of the nation who suffered the exogenous event forecasted key macroeconomic variables to be in the year of the event, versus what the actual values were for the macroeconomic variables.

When forecasts from central banks are not available forecasts from other reliable sources such as the IMF will be used. Further to this, the forecast figures from the ARIMA model will be used in the event study calculations rather than the forecast figures from central banks, IMF etc, as each institution have their own unique macroeconomic variables they forecast and time frequency of forecasts they provide. Therefore, using ARIMA forecasts allows for wider variety and greater consistency in variables analysed between each exogenous event. In addition, analysis will be conducted on data from key stock market indexes applicable to the country in question after the exogenous event and after the economic responses had been introduced/implemented. As will be mentioned later, key theories surrounding the stock market show that prices within the stock markets reflect all available information and include future expectations, hence provide an idea of how the event initially impacted expectations.

Notably there is alternative approaches to study the impact of policy on macroeconomic variables. For example, structural equation modelling allows relationships between one or more independent variables to one or more dependent variables to be analysed (Ullman & Bentler, 2003). Such an approach can be better suited to explicitly comment on the direct relationships between policy and the impact on macroeconomic variables. As a limitation with a time series and ARMA based approach is that one cannot explicitly detail what role policy as opposed to other factors such as the economic environment at the time, the resilience of the economy and population dynamics influence was on the macroeconomic variables.

Therefore, this analysis overcomes this limitation by recognizing this analysis is not focused on being able to determine specific numerical conclusions, such as expansionary fiscal policy resulted in investment spending to increase by two percent, six months post the Japanese earthquake. Rather, the extent of this research is to provide holistic overarching worldwide

analysis on how macroeconomic variables changed at the aggregate level post a range of exogenous events and economic policy responses.

As previously asserted, this area of research evaluates a key gap in academic literature. Providing a springboard for other academic studies is important in order to progress the understanding of economic policy responses to adapt to an evolving society. The nature of the modernized economy has arguably become more dynamic and fluid, therefore having a silo frame of analysis is not as insightful when trying to analyse the appropriateness of economic policy responses to exogenous events. As seen with the current COVID-19 crisis, there is increasing pressures from a range of exogenous events that call for more timely economic policy responses. Policy makers need to adapt and consider all the evolving changes in our society to ensure economic policy stimulus is used in the most effective and efficient manner. Therefore, this research aims to progress the understanding of how best to respond to exogenous events in order to improve future responses.

Consequently, a time series and ARMA based approach is best suited for the research questions of this analysis as it is a less data demanding approach and one that allows a fairly good fit of a model at ease, in turn, allowing for a holistic analysis to take place within the scope of this analysis. In addition, notably this research lays the foundational work to analyse the conclusions found in this research into greater depth through use of modelling such as structural equation modelling when the scope of analysis allows it.

Furthermore, the statistical tool that will be used to study precautionary savings levels post the exogenous events analysed, is synthetic controls. Within the synthetic control, the treatment is the exogenous event and subsequent economic policy response or lack of response. Synthetic controls allow one to analyze an exogenous event that does not have a natural control group. This is done by analyzing the data prior to treatment and taking a weighted average of the most similar non-treated units to the treated units (Abadie et al., 2010). Next, the effect of the treatment is measured as the difference between the treated unit and the synthetic control (Abadie et al., 2010).

The statistical tool of synthetic control was used in this analysis to identify any potential casual effects between occurrence of an exogenous event and subsequent economic response or lack of response and its impact on savings rates. The synthetic control restructures non-experimental data to solve for the missing information problem as previously mentioned (Angrist & Pischke, 2014). For each exogenous event, the synthetic control includes the

saving rates for the first, middle and last year before the treatment period, to select from the donor pool of countries, to determine the weights. Data from the savings rates of every year was not used due to concerns of over fitting the model.

There is no typical t-test used with synthetic controls rather an in-space placebo test is used. This test shows what would happen to other countries in the donor pool if they experienced a shock during the treated period. From here, calculations are made to determine how many times observations have actual minus synthetic values larger than the actual minus synthetic value for the treated country (Abadie et al., 2010). Thus, calculating the probability of making a type one error. The synthetic control is conducted over the short-term (2 years) after the exogenous event, as was done in previous statistical analysis. As savings levels can be impacted by a range of factors and additional shocks in the long term.

Chapter Outline:

Introduction

Chapter One- Discussion of the fundamentals of monetary and fiscal policy and the supply and demand shocks commonly experienced under each exogenous event category.

Chapter Two- Discussion of applicable economic theory.

Chapter Three- Discussion of natural disasters.

Chapter Four- Discussion of terrorist attacks.

Chapter Five- Discussion of pandemics.

Chapter Six- Discussion of precautionary savings.

Chapter Seven- Discussion of results at the aggregate and subsequent findings on economic policy.

Conclusion

Chapter One: Background:

The aim of this chapter is to provide analysis and recognition of foundational theoretical frameworks to allow for improved understanding when analysing each exogenous event. The scope of this research is not intended to study in depth the mechanisms and transmission channels that monetary and fiscal policy influence to stimulate an economy, which has been thoroughly assessed within academic literature, rather a basic analysis will be provided. In addition, this chapter will discuss the type of demand and supply shock that can occur under each exogenous event category. The importance of this is to give an overview on how the economy, specifically consumers and businesses can respond to such events, in turn, this base analysis provides understanding for subsequent comparing and contrasting between the different exogenous events and economic policy responses.

The primary role of central banks is to coordinate monetary policy to achieve low and stable inflation and maintain a healthy economy (IMF, 2019). Central banks around the world have their own unique objectives, the Taylor rule is one key theory that describes the Federal Reserve historical interest rate behaviour. The formula, $r_0 - r_S = 0.5(\pi_0 - \pi^T) + 0.5(y_0 - y_e)$ shows that the Federal Reserve should raise interest rates when inflation is higher than target, or when employment has exceeded full employment levels (El-Erian, 2017). In essence, it proposed a simple rule for central banks to follow, with feedback to inflation and output. Whilst such philosophies are still key aims for central banks, the operations of central banks has experienced extensive change over recent decades (IMF, 2019).

In the lead up to the Great Financial Crisis (GFC) the governor of Banuqe de France, Christian Noyer distinctively articulated “central banks have been considered the only game in town” (Noyer, 2014) and raised the question on whether such pressure and power could backfire on central banks in the future (Noyer, 2014). A short time later this question came to fruition with the occurrence of the GFC. The GFC resulted in modern central banking and global finance to change to previous unimaginable ways (El-Erian, 2017). Many argued it was the start of a new phase of even greater artificiality and distortions (El-Erian, 2017). In reaction to the GFC, many central banks in developed nations applied expansionary monetary policy, thereby reducing interest rates in the hope to stimulate the economy. However, for many nations this resulted in rates to be close to the zero lower bound therefore there was little room to cut rates further to stimulate the economy (El-Erian, 2017).

Consequently central banks turned to unconventional monetary policy measures including quantitative easing (QE), forward guidance, negative interest rate policy (NIRP) and term lending (IMF, 2019). Just like what occurred during the GFC, our world's history books are continuously filled with new exogenous events that many central banks deem necessary to respond with unconventional monetary policy responses. Arguably applying an unconventional monetary policy response can be seen as a necessity when responding to exogenous events that occur during an already challenging economic environment where economies are situated facing the zero-lower bound, seen during events such as the 2011 Japan earthquake and tsunami. The current COVID-19 pandemic has shown central bankers once again are taking dramatic action to stimulate economies. However, as will be explained some key issues develop with the continuous use of unconventional monetary policy and there is not as much room to use unconventional monetary policy as there was in 2008. Resulting in many governments around the world having to co-ordinate with central banks to have cohesion with fiscal policy responses (Hildebrand, 2020).

Conventional monetary policy affects aggregate demand, through the use of interest rates via four main channels. Firstly, if central banks decrease interest rates this impacts market rates by making borrowing more desirable and saving less desirable, resulting in aggregate demand to increase (Carlin & Soskice, 2014). Secondly, when interest rates fall it results in asset prices to increase which in turn increases household's wealth thereby increasing consumption through the permanent income hypothesis and wealth theory. This theory claims that unanticipated changes in income should impact household's consumption, in turn this impacts aggregate demand (Carlin & Soskice, 2014). Thirdly, low interest rates can signal central banks' commitment to accommodative policy actions in the future which can drive confidence in the market, in turn aggregate demand (Carlin & Soskice, 2014). Lastly, a decrease in interest rates results in investments in the home market to be less attractive to overseas investors, resulting in home currency to depreciate. In turn, exports become more price competitive in the overseas market which improves the trade balance and stimulates aggregate demand (Carlin & Soskice, 2014).

In regard to unconventional monetary policy looking firstly at QE. Quantitative easing was experimented by the BOJ in the 'loss decade' years (Girardin & Moussa, 2011). Since this QE has been implemented on a large scale the four key global central banks, including the Federal Reserve, ECB, BOJ and BOE to varying effects (Girardin & Moussa, 2011). The transmission channels within QE are blurred compared to conventional monetary policy.

Quantitative easing involves the buying of government bonds or mortgage backed securities from entities, in the hope to stabilize aggregate demand and provide confidence (Carlin & Soskice, 2014). Quantitative easing directly impacts asset prices and can prop up prices, which like conventional monetary policy increases household's wealth thereby consumption again through the permanent income hypothesis and wealth effect (Carlin & Soskice, 2014). Secondly, QE provides a policy signal which essentially demonstrates that central banks are prepared to do what is necessary to prevent a deflation trap and help anchor inflation expectations to target rates (Carlin & Soskice, 2014). In addition, QE results in essentially a portfolio rebalancing, the money received from bonds being sold to the central bank can be used to buy subsequent financial assets, which in turn lowers yield and boosts demand (Carlin & Soskice, 2014). Further to this point, it provides greater liquidity within the market, which encourages trading during a time of economic and fiscal distress. Lastly, a greater amount of deposits into the financial institution can encourage bank lending, which can increase spending and income to stimulate aggregate demand (Carlin & Soskice, 2014).

In brief, forward guidance is a tool that has been used in a far greater manner by central bankers post the GFC and used in response to exogenous events. The Federal Reserve now publishes a dot plot, central bankers publish their meeting minutes with greater transparency and their communication with the markets is far greater. The current COVID-19 pandemic shows many central banks like the Reserve Bank of New Zealand (RBNZ) have used forward guidance. In March 2020, RBNZ asserted that the official cash rate (OCR) will be held at 0.25 percent for at least 12 months to provide certainty and confidence to the markets (RBNZ, 2020d).

A further unconventional monetary policy tool that has been used by a handful of central banks includes NIRP. The two central banks that have tried NIRP is the BOJ and ECB (Tett, 2019). With the current COVID-19 crisis, other central banks have started to discuss the use of negative interest rate scheme in the hope to stimulate the economy seen with the RBNZ (IMF, 2020). Term lending is another key tool used by central bankers and has particularly been used in response to COVID-19. As an example, the BOE has targeted loans to banks providing more lending capacity, lending to small and medium sized businesses and insurance on defaults (BOE, 2020). Ultimately, if the funds can get to the small and medium size firms to keep them operating and paying staff, then the liquidity crisis will not turn into a solvency crisis, greatly benefiting the wider economy.

Fiscal policy is another tool that policy makers use to stimulate an economy through changing government spending levels and/or tax rates. Fiscal policy can be explicitly explained through the basics of Keynesian economics, which is aggregate demand is proportionately influenced by the public sector (Blinder, 2008). Governments can change tax levels and public spending which impacts macroeconomic factors such as inflation, output and employment (Blinder, 2008). Just like monetary policy, fiscal policy is an important tool that policy makers have used around the world to respond to exogenous events, some argue it is the 'sister' strategy to monetary policy (Blinder, 2008).

Fiscal policy can be thought of, as a means to redistribute income. Governments can use debt or taxes to gain monetary amounts, which is then redistributed through transfers as a form of government spending. Fiscal policy stimulates the economy via the multiplier effect, the ideology that government spending impacts consumption and investment levels in the economy. The size of the multiplier determines the amount that additional government spending impacts income levels (Carlin & Soskice, 2014). Additionally, the impact of government spending and the mechanisms that fiscal policy works through, depends on the initial conditions of an economy (Carlin & Soskice, 2014).

For instance, several exogenous events result in the economy to experience a significant negative aggregate demand shock, shown by the movement of the IS curve to IS (A', G) within Figure One. When this negative shock occurs and when the economy is near the zero lower bound, monetary policy is no longer as effective, thereby resulting in fiscal policy to be used (Carlin & Soskice, 2014). As government spending increases, this results in a rightward shift of the IS curve to IS (A', G1) (Carlin & Soskice, 2014). Then, as shown on the graph, an increase in government spending can result in inflation to begin to increase, resulting in the Philips curve (PC) to shift upwards as inflation has now increased to π_1 (Carlin & Soskice, 2014). Output is above equilibrium level of output at point C, the multiplier is at play, therefore governments will begin to gradually reduce government spending, resulting in the IS curve to shift back to point A, where the economy is in equilibrium (Carlin & Soskice, 2014). At this new point as shown in the graph, interest rate is unchanged whilst government spending has increased. Overall fiscal policy is another effective tool that can be used post exogenous events, however, notably there is key considerations with fiscal policy that policy makers must be cautious about which will be explored.

It is commonly accepted that natural disasters, terrorist attacks and pandemics have the ability to cause significant economic impact. Whilst all three of these types of exogenous events can result in supply and demand shocks there is some individualistic characteristics to each category which will be mentioned in further detail later. For example, natural disasters supply side shock tends to stem through destruction of physical capital and disruptions to supply chains. On the demand side there can be a surge in demand for necessity items and rebuild efforts could stimulate aggregate demand, however if there is significant economic impact, loss of jobs and income from an economic downturn could outweigh the gains from the rebuild. In terms of terrorism the same analysis can be applied to the sources of supply and demand side shocks, notably however the demand shock can also be driven by elements of fear of safety carrying out daily activities. Lastly, for pandemics this fear element driving demand shocks can be even greater due to significant restrictions that are placed on individuals during a pandemic. In terms of the supply side, whilst rebuild elements may not be as prevalent as under natural disasters and terrorist attacks, supply chains are likely to be impacted due to the common restrictions on regular business operations being introduced during pandemics.

Chapter Two: Theoretical Discussion

This chapter will explain the economic theoretical frameworks that will be discussed throughout this thesis. The purpose of this chapter is to support and assist in discussion surrounding the empirical findings of the effectiveness of monetary and fiscal policy responding to the exogenous events. In turn, assist in later discussion in the thesis surrounding answering the key research questions to this analysis.

Efficient Market Hypothesis:

The efficient market hypothesis presents the idea that security prices are efficient at reflecting information, not only information regarding a specific stock but the stock market on the whole (Malkiel, 2003). Therefore, when any new information arises this information is quickly distributed and filtered throughout the market. In turn, resulting in this new information to be reflected in prices, hence a natural conclusion from this theory is that it is hard to beat the market (Malkiel, 2003). Forward looking behaviour and rational expectations fits within this hypothesis, as investors not only use information in the present but also future expectations and predictions to add to their knowledge endowment regarding stocks and the market (Carlin & Soskice, 2014).

Therefore, stock markets arguably can be a valuable real time indicator of how stakeholders view the current and future stock market. In line with this, a wide range of stakeholders contribute into the stock market, including banks, government agencies, central banks, pensioners, private investors, retail and institutional investors and so on, thereby stock market prices represent a holistic economic view for a wide range of stakeholders (Carlin & Soskice, 2014). However, as will be mentioned in greater depth later, the stock market is not the economy and in recent times even greater discrepancies has been evident between the two.

Wealth Effect:

Another key theory is the wealth effect, this theory first came to light with work done by Franco Modigliani in 1971, who claimed that a dollar increase in wealth leads to an increase in consumer spending by approximately 5 cents (Lettau & Ludvigson, 2004). It follows a simple philosophy; the idea is that stocks and housing represent a significant proportion of household's wealth. Households can with relative ease monitor the pricing of their wealth in stocks and whilst housing is less transparent in its prices, households can still obtain a reasonable gauge of the value of their houses by information gathered from real estate

sources (Rickards, 2014) . Therefore, when the price of these assets go up, the wealth effect theory concludes that households will feel wealthier, which in turn will make them less likely to save and rather increase consumption (Rickards, 2014).

The ideology of the wealth effect provides justification to central banks extensive conventional monetary policy usage despite the possibility of driving the economy to the zero lower bound and use of unconventional monetary policy, via means of QE to provide liquidity to the markets. The mechanisms of the wealth effect are as follows. If interest rates are low it means a greater proportion of households can afford mortgages, subsequently increasing home buying which props up house prices (Rickards, 2014). Similarly, arguably the financial accelerator is at play in unison with the wealth effect further increasing house prices. The philosophy of the financial accelerator is as follows. Credit constrained households can borrow based on the value of the collateral they own, for instance the value of their houses (Carlin & Soskice, 2014). Therefore, as house prices increase, households can now afford to borrow more, particularly if the economic environment has relaxed credit constraints which often central banks introduce with low interest rates to allow for effective stimulus (Carlin & Soskice, 2014). This leads to an increase in household borrowing, this borrowing can be used for consumption and further housing purchases. This greater demand once again pushes house prices up resulting in the process to repeat itself and create a true financial accelerator process (Carlin & Soskice, 2014).

Whilst both the wealth effect and financial accelerator are at play, there is also a substitution effect transpiring. It is commonly accepted that investors like to receive a positive return on investments. Therefore, if interest rates are close to zero within bank accounts this incentivises households to divert money away from bank accounts towards stocks and housing (Carlin & Soskice, 2014). Which is again a further aspect contributing to the rising house and stock prices (Rickards, 2014). Looking at data for America post GFC, stock prices increased substantially from 2009-2014 and house prices began to recover in mid-2012 (Executive Office Of The President, 2014). Hence, by looking at the numbers on paper, the wealth effect had well and truly taken place in terms of rising wealth, but the question was raised whether the subsequent component of the wealth effect had taken place which is the increase in consumer spending.

The impact of the wealth effect has been a key area of debate for many economists, questioning whether the wealth effect truly increases consumer spending (Rickards, 2014).

Typically, the wealth effect is measured as the percentage increase in consumer spending that has occurred with the given increase in wealth. Several studies have shown that the wealth effect from house prices can be between 1.7 percent up to 21 percent (Steindel & Ludvigson, 1999). Showing not only the difficulties of the research in this area but also the degree of uncertainty of the impact of the wealth effect. A key study by the Federal Reserve Bank of New York raised significant doubt on the wealth effect. The study analysed the impact that occurred when consumption was forced to have a one period lag, the findings was that an impact to the growth of wealth had an insignificant impact on consumption growth (Steindel & Ludvigson, 1999). Overall, the study concluded that, “forecasts of future consumption growth are not typically improved by taking changes in existing wealth into account” (Steindel & Ludvigson, 1999, p.29-30).

Other economists provide further support to this view point, David K Backus, chairman of the economics department at New York University claimed that the data of the late 1990s showed that the stock market boom increased the wealth of Americans but there was no empirical evidence of a significant change in consumption values (Rickards, 2014). A further key study empirically showed that only permanent changes in wealth have a significant impact on consumption. However, a significant proportion of wealth effects are only transitory shocks and do not impact aggregate consumption, thus proving little evidence for the wealth effect occurring in practice (Lettau & Ludvigson, 2004). Therefore, the wealth effect is a key area of thought when reflecting the success of monetary policies in the pursuit of stimulating the economy after exogenous events. Unless the policy is resulting in permanent changes in wealth it may have limited impact on increasing consumption, which is of key importance to stimulate aggregate demand post these exogenous events.

Debt Sustainability:

A key theory when analysing the success of fiscal policy is the idea of debt sustainability. Post the GFC many governments debt to gross domestic product (GDP) ratio increased significantly which arguably can cause areas of concern. Looking at the government budget equation below, the debt dynamics equation can be derived which outlines how debt to GDP ratio can change over time (Carlin & Soskice, 2014).

$$\text{Gov't budget identity: } \underbrace{G_t}_{\text{gov't exp.}} + \underbrace{i_t B_{t-1}}_{\text{interest}} \equiv \underbrace{T_t}_{\text{tax revenue}} + \underbrace{\Delta B_t}_{\text{new bonds}} + \underbrace{\Delta M_t}_{\text{new money}} \quad (\text{in nominal terms}).$$

Debt Dynamics Formula: $\Delta b = d + (r - \gamma_y)b$

Notations:

Δb - change in debt/GDP ratio

d- budget deficit as % of GDP

r- real interest rate

γ_y - growth rate of GDP

b- debt/income ratio

With the debt dynamics formula, two scenarios could occur. First case is when real interest rate is above the growth rate of the economy. As shown in Figure 2, there is a positive slope as if the interest rate is greater than growth rate it results in a positive relationship between b (debt/GDP ratio) and Δb (the change in the debt/GDP ratio). Looking at the top diagram, when an economy is in a primary deficit and starting at point A the economy moves in the direction of the arrows. Therefore, the situation worsens as Δb will increase due to the interest rate being greater than the growth rate, thereby the debt of the country will start to continuously increase in the future and compound, while r continuously tends to be greater than the growth rate. The debt to GDP ratio is unstable and begins to grow without limit (Carlin & Soskice, 2014).

Likewise, if a country is in a primary surplus as shown by the bottom graph and at point B, whilst at this point, debt is exactly counter balanced by a primary surplus, in other words just enough to keep the change in the dept/ GDP ratio constant. However, this is still an unstable position, as if there is even a slight increase in the debt/GDP ratio to the right this puts the economy into a position where the surplus is not sufficient to service an increase in debt levels. Therefore, this could result in the debt/GDP ratio to grow without limit as suggested by the direction of the arrows within the diagram (Carlin & Soskice, 2014).

The second case is when the real interest rate is less than the growth rate of the economy. As shown in Figure 3, there is a negative slope. As there is now a negative relationship between the debt/GDP ratio and the change in dept/GDP ratio. When the economy is in a primary deficit as shown by the top graph and operating at point B the change in the debt/GDP ratio is equal to zero, therefore the debt/GDP ratio is stabilized. This occurs even when the government is in a deficit as the growth in the economy is strong, therefore the economy is doing just enough to counterbalance the deficit to stop the debt/GDP ratio increasing without

limit. At point A the economy will be pushed back to point B as shown by the direction of the arrows, again the growth rate is greater than r , therefore the debt ratio will begin to fall back towards B overtime. The same logic applies for when an economy is in a primary surplus and the growth rate is greater than the interest rate (Carlin & Soskice, 2014). Therefore, debt sustainability is a factor that needs to be considered when implementing fiscal policy in response to exogenous events. Not only to be concerned for the debt/GDP ratio increasing without limit and fear of a default, but also the impact debt unsustainability has on aggregate demand. This is captured through the theory of Ricardian equivalence.

Ricardian Equivalence:

A further key theoretical consideration that policy makers must be aware of when implementing fiscal policy, is the theory of Ricardian equivalence and the permanent income hypothesis. This is the idea that households are forward looking and factor in the government budget constraint when making consumption decisions (Seater, 1993). Therefore, if a government is undertaking fiscal policy through debt financing and even if fiscal policy is increasing a household's income through means such as a wage subsidy or fiscal stimulus cheque, this could result in little change in consumer spending and thus aggregate demand (Seater, 1993). This is because households will be aware of what's coming around the corner, in other words, households will know they need to save to pay off future increases in taxes that governments could impose on households to pay off debt (Seater, 1993). However, there is counter arguments to whether this theory holds, some argue that households are credit constrained, therefore consumption smoothing does not occur as extensively in practice. Furthermore, there is argument that if governments have low interest rates then households prefer debt financing over tax financing (Carlin & Soskice, 2014) . Therefore, this is a key area of debate that impacts the extent of success obtained with fiscal policy measures.

There is the argument that fiscal consolidation, by means of either decrease government spending or increase in taxes or a combination of both, can be used as an effective stimulus for aggregate demand. This is because, when an economy is in financial distress it can provide reassurance to uncertain households, which in turn can boost income and consumption, in turn stimulating aggregate demand (Carlin & Soskice, 2014). However, many argue applying fiscal consolidation too early post an exogenous event can prove determinantal to the economic recovery (Carlin & Soskice, 2014).

Another viewpoint is that debt sustainability can be achieved through an increase in real growth, which could occur through effective government stimulus (Rickards, 2014). Hence essentially policy makers must ensure that government spending is effective enough to stimulate economic growth and warrant the increase in government spending (Rickards, 2014). In addition, monetary policy can be used in unison with fiscal policy, where central banks can use monetary policy to manipulate interest rates to create inflation to lessen the government deficit to a more sustainable level (Rickards, 2014). Overall, it truly is a balancing act when implementing fiscal policy to ensure adequate but effective spending takes place that is still within sustainable deficit levels.

Complexity Theory:

Complexity theory has ignited a new frame of thought for many economists. The theory was founded in 1960s by Edward Lorenz within his research of meteorology (Lorenz, 1963). He was analysing atmospheric flows and discovered that slight changes in initial conditions could result in significantly different outcomes (Lorenz, 1963). The work highlighted clear insight into how complex systems behave and provided the foundation of the famous “butterfly effect” to come to light. The idea that a butterfly flapping its wings, moving molecules of air, is capable of starting a hurricane on the other side of the planet (Lorenz, 2000).

Historically economic thinking has been centred around the ideology that economic systems tend to be in equilibrium, if there is a shock to the system, after time, there is a tendency to move back to steady state equilibrium (Helbing & Kirman, 2013). In other words, economic theory has been based around neoclassical equilibrium-based foundations (Hartwell, 2017). However, now with greater understanding of complexity theory, economic systems are increasingly being viewed as complex dynamic systems (Helbing & Kirman, 2013). Where systems may spend prolonged periods away from equilibrium, have unstable equilibria and the potential for multiple equilibria (Helbing & Kirman, 2013).

Whilst the terms complex and complicated can be used interchangeably, there are clear distinctions between the two. A clock can be thought of as a complicated mechanism, a system that is constrained but not complex (Rickards, 2014). A complex system is a mechanism that incorporates moving parts, sometimes acknowledged as autonomous agents (Rickards, 2014). These agents have four key characteristics within a complex system; they are diverse, connected, interactive and adaptive (Rickards, 2014). There becomes an infinite

combination of outcomes in regards to interaction and adaption (Rickards, 2014). Therefore, in essence one can know that such combinations can lead to negative outcomes but never know exactly why it transpires (Rickards, 2014).

A common example used to illustrate complexity theory is the occurrence of an avalanche. Avalanches stem from a snowflake which disturbs other snowflakes, together combining to form the avalanche (Rickards, 2014). The avalanche is an example of a complex system going through a phase transition period, from a steady state to a new steady state, different to the initial steady state (Rickards, 2014). The uncertainty surrounding complex systems should not drive policy makers to do nothing or take ineffective action, rather be encouraged by the ability to undertake adequate risk management (Rickards, 2014).

In the avalanche example whilst skiers can never know what snowflake will initiate the avalanche, they are aware of conditions that are more likely to cause the avalanche, such as air temperatures and wind speeds (Rickards, 2014). Additionally, they are aware of adequate precautions, for instance locating villages away from chutes on the mountain (Rickards, 2014). Hence academics have claimed that policy makers need to look at the tipping points and warning signals for complex systems such as financial markets (Battiston et al., 2016). One study argued that a modern and realistic network model could have identified warning signals of the GFC, 3 years before the crisis occurred (Battiston et al., 2016). Hence, findings from such studies argue for the need for academics from different backgrounds including economists, complexity scientists, social scientists, ecologists, epidemiologists and financial researches to work together to form new improved economic modelling grounded in complexity theory (Battiston et al., 2016). Arguably, this would allow academics to stress test the global socioeconomic and financial systems to particular exogenous events (Battiston et al., 2016).

Clearly natural disasters can be thought of in the same light as an avalanche being considered a complex system. Terrorism and pandemics are further examples of complex systems. Arguably there are clear signals suggesting greater likelihood of natural disasters occurring in particular locations. For instance, Wellington in New Zealand has been viewed as a hotspot in the future for a potential earthquake and studies are constantly analysing the threat of such an earthquake (Rhoades et al., 2004). Furthermore, many argue there was clear signals of evidence to suggest the occurrence of 9/11 terrorist attacks, whether it be through the financial markets or linking terrorist to flying lessons (Rickards, 2014). Lastly, many argue

the occurrence of the current COVID-19 pandemic was not a question of if, rather when, the writing was clearly on the wall (Daszak, 2020). However, just as one cannot predict the snowflake that will cause the avalanche, one cannot predict the exact time an earthquake will transpire in Wellington or the exact location and type of virus that would cause a pandemic. Whilst these predictions cannot be made, or exogenous events cannot be entirely eliminated what one can do with complexity theory is analyse the underlying dynamics of the complex system to make judgement statements of the degree of instability present in the system in its entirety.

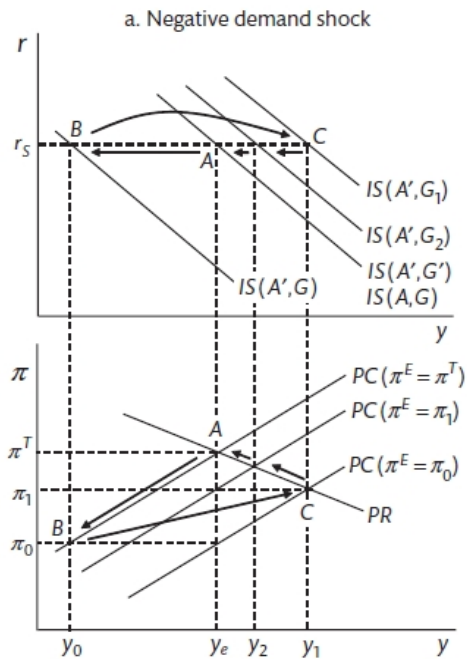
Risk Aversion and Precautionary Savings:

Risk aversion and precautionary savings are two key theories which provide insight into how individuals respond to uncertainty and how such behavioral changes can impact the success of monetary and fiscal policy. Risk aversion is the idea that when individuals are susceptible to uncertainty, they will attempt to decrease this uncertainty. Therefore, they are likely to take a lower payoff with greater certainty than risk a more uncertain event with a higher payoff (Guiso & Paiella, 2008). Many studies have clearly established that a key contributor to the level of risk aversion an individual possesses, is down to the consumers environment (Guiso & Paiella, 2008). Individuals who are more exposed to face income uncertainty or be liquidity constrained, which are all situations that could come as a result of exogenous events, experience a higher degree of risk aversion (Guiso & Paiella, 2008). This follows in line with the idea of precautionary savings. This theory stipulates that when consumers are faced with uncertainty, particularly in their future income levels, they will tend to be risk averse and start to increase savings, known as precautionary savings (Leland, 1978) .

Therefore, due to exogenous events causing a high degree of uncertainty, these theories represent the added complexities policy makers must consider in terms of behavioral responses in their decision making when deciding economic policy responses. Hence, whilst much of this analysis focuses on macroeconomic factors, it was important to include some consideration of microeconomic variables. As has been previously mentioned, the microeconomic foundations can cause significant impact to the success of the macroeconomic policies of monetary and fiscal policy.

Appendix:

Figure One: Negative Demand Shock



Note: Graph in Figure One is sourced from (Carlin & Soskice, 2014).

Figure Two: Scenario 1 $r > \gamma_y$

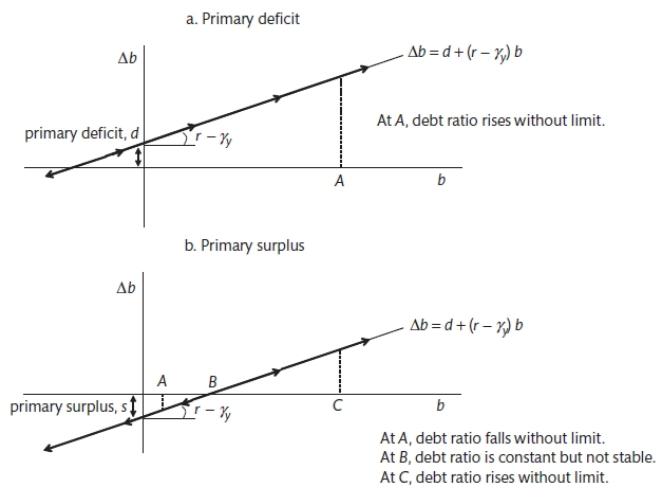


Figure 14.3 The government debt ratio. Case 1: the real interest rate exceeds the growth rate.

Note: Graph in Figure Two is sourced from (Carlin & Soskice, 2014).

Figure Three: Scenario 2 $r < \gamma_y$

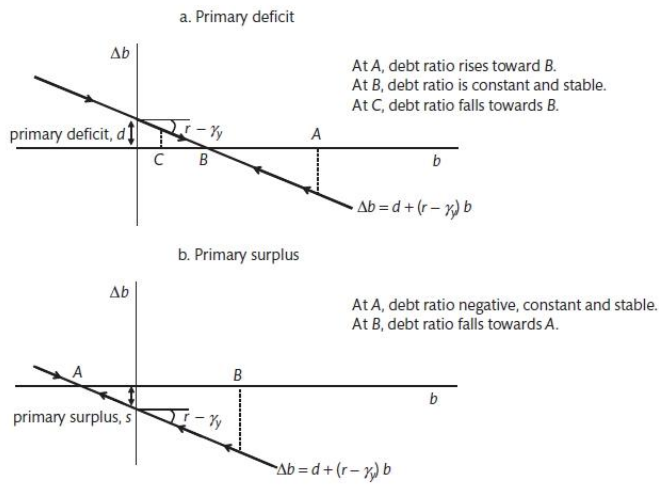


Figure 14.4 The government debt ratio. Case 2: the growth rate exceeds the real interest rate.

Note: Graph in Figure Three is sourced from (Carlin & Soskice, 2014).

Chapter Three: Natural Disasters:

This chapter will explore natural disasters, the combination of natural disasters chosen include a hurricane, earthquake and a combination of an earthquake and tsunami to allow for a holistic analysis. For each natural disaster the context of the disaster will be explored to provide an understanding of the nature and scale of the disaster. Next, the economic policy response implemented post the disaster will be examined followed by the empirical results. Analysis will also be provided on other relevant economic factors at the time to provide a holistic study on the macroeconomic variables over the two-year period in relation to the economic environment at the time, the exogenous event and economic policy response. These findings will then be referenced later in the thesis when comparing and contrasting all exogenous events and providing value assessments and recommendations on policy responses to exogenous events.

The table below provides key summarisation of the three natural disasters studied:

Natural Disaster	Date of Disaster	Domestic Cost of Disaster in terms of GDP/RGDP	Monetary Policy Response	Fiscal Policy Response
Hurricane Katrina	August 29 th , 2005 (CNN, 2019)	\$160 billion USD- approximately 1% of America's RGDP.	No direct response taken.	Expansionary fiscal policy response.
Tohoku Earthquake and Tsunami	March 11 th , 2011 (CNN, 2020)	\$15 trillion Yen- approximately 3% of Japans GDP.	Expansionary monetary policy response.	Expansionary fiscal policy response.
Christchurch Earthquake	February 22 nd , 2011 (Parker & Steenkamp, 2012)	\$40 billion NZD in 2015 dollars- approximately 10% of NZ GDP.	Expansionary monetary policy response.	Expansionary fiscal policy response.

Hurricane Katrina:

As President George Bush acclaimed on the 8th of September 2005, “Hurricane Katrina was one of the worst disasters in our Nation’s history.” (United States. Executive Office of the President, 2006, p. 5). Whilst hurricanes are a relatively common occurrence for America, Hurricane Katrina was anything but a normality (United States. Executive Office of the President, 2006). The total damages and losses from Hurricane Katrina and Hurricane Rita, which occurred shortly after, was estimated to total \$160 billion, approximately one percent of America’s RGDP (Kliesen, 2017).

Predominately Hurricane Katrina caused a negative supply side shock. There were small components of demand shocks in the most impacted states through a loss of income due to high unemployment. It was estimated that the hurricane destroyed 300,000 homes, thereby causing mass displacement of individuals (United States. Executive Office of the President, 2006). A significant proportion of the impacts of the natural disaster was felt locally, between August and September in the most affected areas of Louisiana and Mississippi unemployment rate doubled from 6 to 12 percent (United States. Executive Office of the President, 2006). In addition, salaries and wages in these areas were estimated to have fallen 1.2 billion in the third quarter of 2005 (United States. Executive Office of the President, 2006).

Overall, the significant impact that was felt nationwide stemmed from the supply side. The hurricane resulted in prolonged shutdowns for many crude oil and natural gas operations in the Gulf of Mexico causing petrol prices to surge nationwide and significant supply side shocks (United States. Executive Office of the President, 2006). Petrol and oil are key components of supply chains, thereby a rise in petrol prices had influential flow on effects to companies cost nationwide, impacting households. Overall for the time period of August 26th 2005- January 11th 2006 114 million barrels of oil production capacity was left underutilised, this equated to over one fifth of the yearly output in the Gulf of Mexico (United States. Executive Office of the President, 2006).

Fiscal policy was one primary tool policy makers used to respond to Hurricane Katrina. Whilst many regarded the response to initially be slow, eventually the government adhered to the severity of the crisis (Orszag, 2007). On September the 2nd, 4 days after Hurricane Katrina impacted Americas coastline the President and Congress of America approved \$10.5 billion to be contributed towards the Federal Emergence Management Agency (FEMA) (Orszag,

2007). Six days later on the 8th of September a second bill was passed which gave an additional \$50 billion to the FEMA (Orszag, 2007).

Furthermore on the 21st September 2005, the US Department of Treasury reached agreement on Hurricane Katrina's emergency tax relief bill (US Department of the Treasury, 2005). The bill had various benefits including enabling taxpayers to deduct personal property losses from their taxable income (Orszag, 2007). Overall, the tax relief reduced government revenues by approximately \$6 billion in 2006 and 2007 (Orszag, 2007). The fiscal policy response was substantially debt financed through the sale of treasury bonds, rather than funding the spending through an increase in taxes or re distributing funds from other government spending programs (Schoen, 2005).

The Federal Reserve did not take any direct monetary policy response to address the economic impact of the disaster. Many speculated that the occurrence of Hurricane Katrina would result in the Federal Reserve to put a suspension to the speculated increase in interest rates. However, the Federal Reserve increased interest rates from 3.5% to 3.75% in September 2005 (FOMC, 2005) . Whilst the Federal Reserve clearly acknowledged the impact of Hurricane Katrina with the Federal Open Market Committee (FOMC) stating, “the widespread devastation in the Gulf region, the associated dislocation of economic activity, and the boost to energy prices imply that spending, production and employment will be set back in the near term” (FOMC, 2005, p. 1). Furthermore the Federal Reserve detailed in greater depth that the impacts from the hurricane would have a negative impact on consumer demand, as jobs and income are adversely impacted for those directly affected by the Hurricane (The Federal Reserve Board, 2005b). In addition, the rise in energy prices would negatively impact consumers and businesses, again adversely impacting aggregate demand (The Federal Reserve Board, 2005b). Lastly, the Federal Reserve clearly asserted that uncertainty in itself could play as a contributing factor to a slowdown in households and businesses spending (The Federal Reserve Board, 2005b).

However, the Federal Reserve noted that, “while these unfortunate developments have increased uncertainty about near-term economic performance, it is the Committee's view that they do not pose a more persistent threat” (FOMC, 2005, p. 1). In addition, the Federal Reserve acknowledged within its commentary that Hurricane Katrina's disruptions to oil and gas production, resulted in the price of West Texas Intermediate crude oil to rise above \$70 per barrel (Greenspan, 2005). This was further exacerbated by a lack of access to foreign

supplies, pushing prices further (Greenspan, 2005). Therefore the FOMC made reference to these higher prices, asserting that “higher energy and other costs have the potential to add to inflation pressures” (FOMC, 2005, p. 1) the FOMC claimed that the change in interest rates “ would likely be below the level that would be necessary to contain inflationary pressures, and further rate increases probably would be required” (Lagomarsino & Jones, 2005). Therefore, clearly the Federal Reserve was aware of the economic impact of Hurricane Katrina but given the inflationary climate at the time there was inadequate justification to abandon their plan to raise interest rates.

Prior to the occurrence of Hurricane Katrina on July 20th, 2005 the Federal Reserve Board submitted a report to Americas Congress which included economic projections for the remainder of 2005, as seen in Figure Four (The Federal Reserve Board, 2005a). Figure Five shows the forecast values against the real values that occurred for the period using data from the Federal Reserve Economic Database (FRED). The data showed that the actual figures were within range and were exactly equal for Real GDP and the unemployment rate respectively and a slight positive figure of 0.2 for the PCE price index. Hence indicating minor deviations occurred in the remainder of 2005 between what was predicted and what actually occurred.

Next, as previously mentioned, stock market data is a useful indicator to see the reaction to an exogenous event and subsequent economic policy responses in the immediate aftermath. Notably it is commonly accepted that a market correction is measured as a 10% drop (Landsman, 2020) and a bear market is measured by a 20% decline in the stock markets (Adamczyk, 2020). Figure 6a shows on August the 30th 2005, one day after Hurricane Katrina made landfall, the S&P 500 closed at an insignificant drop of 0.32%, this downward trend was short-lived, for the following two days the S&P 500 closed with positive figures. Therefore, showing that even though Hurricane Katrina was the costliest natural disaster in Americas history, it did not have a significant impact on the stock markets in the days after the event. Overall, over an eight-day period the S&P market showed a 3% rally and over a 38-trading day period post the Hurricane S&P was merely 2.4% lower (Nasdaq, 2011).

Furthermore, looking at Figure 6b the tables show the S&P 500 reaction to the American governments fiscal policy response. Overall, between the two fiscal contributions to the FEMA and the emergency tax relief bill, the largest upward percentage change in the market was 1.2%. Therefore, whilst the stimulus package was welcomed by many as there was

extensive need for policy reaction in the areas devastated by the hurricane, clearly there was no major impact felt in the stock market (Nasdaq, 2011) . Figure 6c shows the market reaction to the Federal Reserve raising the federal fund rate. Whilst this was not a policy response taken in direct response to Hurricane Katrina it did happen less than a month after the event. The day after the announcement, the markets closed with a downward value and for the second and third day a slightly elevated figure. Again, there was no significant percentage change in closing figures in the short term to signal any substantially significant impact in the stock market.

All the subsections under Figure 7 shows the empirical results for Hurricane Katrina. Majority of data sets were quarterly and sourced from the FRED, allowing for reliable and relatively frequent data to be analysed. Apart from the data set for business confidence which was sourced from the OECD and data was recorded at monthly frequency, this does not result in any significant implications, as whilst monthly data could have been adjusted to a quarterly basis, making use of higher frequency data is beneficial as it enhances the validity of forecasts. Moreover, all data sets are relatively the same size including values dated back around 1950-1960. Whilst a greater number of data variables gives forecasting figures greater power, overall, all data sets were of appropriate size to make forecasts thereby causing no concern for varying data sets. Further to this point, it is sensible to include all available data for each macroeconomic variable to improve the validity of the forecasting values for each specific macroeconomic variable to the highest potential.

The macroeconomic variable that produced abnormal values which generated statistically significant t-test values at the 5% level, was the unemployment rate. Notably as has been previously mentioned with a time series ARMA analysis one cannot attribute the changes in macroeconomic variables to be solely attributed to the policy responses. Hence the summaries in this empirical analysis will give a holistic analysis and analyse relevant economic and societal factors at the time to provide an overarching assessment in pursuit of answering the research questions and objectives of this analysis. The same rationale applies for all other discussions of empirical results.

Firstly, the use of ARIMA forecasting method will be explained in the context of the unemployment rate, the same principle applies for all other forecasting computed with ARIMA models within this research analysis. The ARIMA forecasting function in EViews allows for an efficient ARIMA model to be determined, which in turn can be used for

forecasting. An autoregressive moving average model provides a parsimonious model of two polynomials, one for autoregression and the second for a moving average (Stock & Watson, 2007). The AR division of the model involves regressing the variable on its own lagged values (past values) and the MA division of the model represents the error term as a linear combination of error terms occurring during the same time period and at various times in the past (Stock & Watson, 2007). The benefit of using an ARMA model is that MA consolidates information, therefore it is a parsimonious model that uses less degrees of freedom. Next, the autoregressive integrated moving average model (ARIMA) is a generalization of an autoregressive moving average model. An ARIMA model is applied in cases when the data shows evidence of non-stationarity, hence presence of a unit root (Stock & Watson, 2007).

The process of determining an appropriate ARIMA model begins with selecting the transformations of the dependent variable, for example logs (Eviews, 2019a). A comparison is made between the test statistic for log values versus no log, if the test statistic is lower for the log model then the log model is used (Eviews, 2019a). Often natural logs are needed when variables have an exponential growth rate, this can cause the data to suffer from heteroskedasticity and taking the logs resurrects this problem (Eviews, 2019a). The next step in the process is determining whether the data is stationary or non-stationary. A stationary data set is one where the mean, variance and autocorrelation functions do not change over time, contrastingly a non-stationary time series is one that does change over time (Wooldridge, 2006). If a data set is non-stationary, then a unit root is present and therefore a nonstationary time series can be made stationary by differencing the series one or more times (Wooldridge, 2006). Hence EViews uses consecutive unit root tests to decide the correct level of differencing needed for the series (Eviews, 2019a). It is important that differencing takes place, as some key issues arise when using a non-stationary series. Including, if one was to conduct a statistical analysis on a non-stationary series that is steadily increasing over time, then the sample mean and variance will increase as the size of the sample increases. Hence resulting in the mean and variance to be underestimated in the future (Wooldridge, 2006).

The next stage in the process is using model selection to determine the appropriate ARMA order. Known as the identification process in the Box- Jenkins approach. Model selection determines the values of p and q , p represents the order of the autoregressive section and q is the order of the moving average section. The process is repeated and EViews estimates numerous ARMA models, then the information criteria that is used to select between models is Akaike Information Criterion (AIC) (Eviews, 2019a). AIC is a commonly used

measurement that considers the goodness of fit and parsimony of the model, overall, the model with the lowest AIC value is chosen to be used to produce forecasts (Eviews, 2019a). Notably, if an ARMA model is correctly specified then the residuals should be white noise. This is checked by producing residual diagnostic, specifically in this analysis a correlogram was used. In the interest of brevity, just the Q statistic is reported for the relevant time period, however full results are available on request. The null hypothesis is that there is no serial correlation, therefore if the Q statistic is smaller than chi square distribution, one can accept the null. Further to this a visual evaluation can be made as to whether any bars in the partial autocorrelation extend beyond the dashed line to indicate serial correlation.

Therefore, as shown in Figure 7a for unemployment, an ARMA model of (3,4) (0,0) was used. Hence clearly autoregressive to a lag of three is included within the model and four moving averages of the error term is included. The data set for unemployment was seasonally adjusted and there were no differences between the seasonally and non-seasonally adjusted ARIMA model. However, it is worth mentioning that the Box and Jenkins 1976 approach recommended the use of seasonal autoregressive (SAR) and seasonal moving average (SMA) for monthly or quarterly data that have seasonality components (Eviews, 2019b). Therefore, whilst most of the data sets was sourced from seasonally adjusted data sets for each macroeconomic variable and for each exogenous event a non-seasonally and seasonally adjusted ARIMA model was still produced. This was to ensure that the seasonality in the data set had been correctly identified.

The ARMA model of (3,4) (0,0) was used to produce forecasted values, the Q-stat values indicate the residuals were white noise. The abnormal returns produced a t-test value of 4.688 which is statistically significant at the 5% level as shown in Figure 7a. The forecasted graph shows that the unemployment rate was trending downward prior to Hurricane Katrina. Forecasted figures (shown as the values beyond the vertical line) anticipated that after Hurricane Katrina there would be a slight continuation of this downward trend, a level off, then a gradual increase until the end of the two-year period post Hurricane Katrina. However, the actual values of the unemployment rate showed a continuous decrease in the unemployment rate up until the first quarter of 2007, where there was a slight increase, then a levelling off. Therefore, there is significant evidence to conclude a difference between the actual and predicted values. Despite the disaster causing significant adverse effect in employment rates in the states impacted by the disaster, clearly there was no evidential impact in the national figures and businesses continued to add jobs over the two-year period

resulting in the unemployment rate to fall (Board of Governors of the Federal Reserve System, 2007a).

Figure 7b shows the empirical results for consumer spending, the ARMA model of (2,4) (0,0) was chosen as the suitable model. However, looking at the Q statistic values and the correlogram there is insignificant evidence to suggest the residuals are white noise. Thereby impacting the reliability of using forecasted figures to calculate abnormal returns and in turn interpret the t-test value. Therefore, instead just looking at the actual values, the graph shows that historically consumer spending has been increasing with an exponential trend. The actual figures showed that consumer spending steadily increased over the two-year period. Therefore, there was not a significant decline in consumer spending at the nationwide level during and in the short term after Hurricane Katrina rather spending levels continued on the historical exponential trend.

For business confidence the data was sourced from the OECD. A value above 100 indicates improved confidence in future performance whilst numbers below 100 foreshadows pessimistic views towards future performance (OECD data, 2020). Figure 7c shows the empirical result for business confidence the ARIMA model of (4,4) (2,2) was chosen as the best suited model. However, looking at the Q statistic values and the correlogram there is insignificant evidence to suggest the residuals are white noise. Thereby impacting the reliability of using forecasted figures to calculate abnormal returns and interpret the t-test value.

Therefore, instead just looking at the actual values, the graph shows historically business confidence has had significant fluctuations around the 100 mark with prominent peaks and troughs. Prior to Hurricane Katrina business confidence for the United States was overall trending downwards from a peak of 102.01 in the second month of 2004 down to 100.36 in July 2005. As evident historically on the graph, the dips in business confidence tended to be relatively prolonged. However, the actual figures for business confidence indicated a rise in confidence from August 2005 till October 2005. From here there was a general downward trend until slight indications of an upward movement in the middle months of 2007. Whilst undoubtedly business confidence would have been adversely impacted for those businesses in the disaster areas of the crisis, the Federal Reserve acknowledged other factors contributing to a decline in business confidence nationwide. Including the housing market cooling off substantially and in the later part of 2006 there was a decline in the production of light motor

vehicles (Board of Governors of the Federal Reserve System, 2007a). Overall, whilst caution must be applied with the forecasting figures, looking at purely the actual figures did not show any significant shock to business confidence in the short term after Hurricane Katrina compared to historical standards and as mentioned there was other factors influencing business confidence at the time.

Figure 7d shows the empirical results for investment. Investment was measured by the total value of real gross private domestic investment and the data set was seasonally adjusted. An ARMA model of (6,6) (0,0) was used for the log of investment to produce forecasted values, the Q-stat values indicate the residuals are white noise. The abnormal returns were calculated with a t-test value of -1.838 hence not statistically significant at the 5% level. The forecasted graph in Figure 7d shows a general upward trend in real gross private domestic investment from 1947 through to the second quarter of 2005, pre-Hurricane Katrina, with some noticeable dips. The forecasted values for the two-year period anticipated a dip in investment and then a rise back up to investment levels higher than the second quarter of 2005. Actual values showed similar movements, a steady increase in investment for the three quarters post Hurricane Katrina, up until the second quarter of 2006 when a slight decline began. However, this was short lived with an increase beginning again in the second quarter of 2007. The decline in investment levels was partly attributed to a decline in purchases of equipment linked to construction and motor vehicle manufacturing as previously mentioned (Board of Governors of the Federal Reserve System, 2007a). Therefore, there was no significant adverse impact on nationwide domestic investment after Hurricane Katrina, rather other factors were at play as well causing movements in investment after the disaster.

Figure 7e shows the empirical results for FDI, notably whilst the ARMA model of (3,4) (0,0) produced the smallest AIC value for all the models tested, it was still a relatively large AIC value of 24.327. Hence impacting the ability to make any statistically significant conclusion from the abnormal results. Therefore, just looking at the actual values, revealed that FDI did show fluctuations with an overall increase occurring up until the first quarter of 2007 when the values began to decrease. Consequently, there was no significant adverse shocks to FDI levels into America during the time of Hurricane Katrina and in the two-year period post the event, FDI followed similar historical trends.

Consumer confidence did not produce statistically significant t-test values, Figure 7f shows the empirical results and the graph for consumer confidence shows large fluctuations

historically around the 100 mark. The actual values indicated significant decreases in consumer confidence for the two quarters post Hurricane Katrina and fluctuations for the remainder of the two-year period, the forecasted figures predicted similar patterns. Therefore, whilst consumer confidence declined in the period post Hurricane Katrina it was predicted this was likely to occur without factoring in the occurrence of Hurricane Katrina. Other economic factors at the time including the levelling off of the boom in the housing market and the growing government deficit attributed to the Iraq war combined with Hurricane Katrina would have all been contributing factors, negatively impacting consumer confidence at the time (Board of Governors of the Federal Reserve System, 2007a). Therefore, clearly whilst Hurricane Katrina would have impacted consumer confidence in the regions impacted by the disaster, the impact on the nationwide level was not statistically different to what was forecasted for the period.

Additionally, RGDP did not produce a statistically significant t-test value, the empirical results are within Figure 7g, the forecasted graph shows RGDP was expected to continue to increase on the same path as it had been historically and the actual values reflected similar results. RGDP continued to on average steadily increase in the two-years post Hurricane Katrina. Therefore, whilst Hurricane Katrina was a devastating disaster for many states it did not have a determinantal impact to Americas RGDP at the nation-wide level. Lastly, in terms of inflation, empirical results in Figure 7h shows an insignificant t-test value once again. The forecasted graph shows that the consumer price index (CPI) had faced key fluctuations historically and the forecasted values anticipated inflation to fluctuate and then level off over the two-year period. Actual values showed similar movements, notably there was an increase in CPI after Hurricane Katrina. The occurrence of Hurricane Katrina did result in a substantial increase in energy prices which had wide ranging flow on impacts to a broad range of goods and services that use petroleum-based goods as raw materials. This did result in a rise in prices for some consumer goods for household's nation-wide in America (The Federal Reserve Board, 2006).

The data showed that crude oil prices continued to rise until the first two quarters of 2006. Not only due to Hurricane Katrina but also other geopolitical factors occurring at the time (Board of Governors of the Federal Reserve System, 2007b). Including the Lebanon-Israel war of 2006 and concerns around Iran's nuclear program which increased uncertainty around supply, in turn rising oil prices (The Federal Reserve Board, 2006). However, for the second half of 2006 crude oil prices declined sharply, resulting in total consumer price inflation to

decline in 2006 (Board of Governors of the Federal Reserve System, 2007b). Notably, the federal rate continuously increased in the period post Hurricane Katrina and then was held at 5.25 during the fall in CPI in the last half of 2006 (Board of Governors of the Federal Reserve System, 2020).

Therefore, clearly the contractionary monetary policy did not adversely impact the CPI to cause substantial deviations in inflation levels. Subsequently whilst there was concerns initially of whether a delay in contractionary monetary policy was needed to allow for economic stimulation post Hurricane Katrina. Clearly the empirical results at the nation-wide level show that Hurricane Katrina did not result in a prolonged adverse impact on key macroeconomic variables. Hence Hurricane Katrina added greater concerns to already rising prices nationwide through the increase in energy prices, specifically in the states impacted most by Hurricane Katrina. Therefore when looking at monetary policy through the lens of the Taylor rule the Federal Reserve observed that the higher inflation rate was dominating the lower output effect, naturally leading to a rise in the nominal interest rate (Keen & Pakko, 2007).

Looking at Hurricane Katrina at the state-wide level, one area that was hit particularly hard by the Hurricane was New Orleans. Prior to the earthquake New Orleans economy relied on three key areas; tourism, port operations and educational services (Dolfman et al., 2007). New Orleans is one of the most visited cities in the United States; in 2004, the year prior to the hurricane there was an estimated 10.1 million visitors into New Orleans, spending a total of \$4.9 billion (Elliott, 2015). However, in the year after the storm there was a significant decrease to only 3.7 million visitors spending an estimated \$2.8 billion (Elliott, 2015). Thus, this resulted in significant job losses in the area (Dolfman et al., 2007). Notably however, for the United States on the whole, there was not a significant decline in nationwide international tourist numbers after the hurricane rather an increase in tourist numbers in 2006 (World Bank, 2020h).

In addition, New Orleans ports deal with the greatest proportion of bulk tonnage in the world and handles more trade with Latin America than anywhere else in the US (Dolfman et al., 2007). The main exports out of this port include grain and food products from middle eastern farmers and petroleum products sourced from the Gulf of Mexico (Dolfman et al., 2007). On a nation-wide level there was an insignificant impact on import levels, however in terms of exports, there was an increase in shipping costs. Growth of exports did decline to 10% in

2005 compared to growth figures of 13% in 2004 (Parsons, 2016). However, it was found that a significant proportion of trade was re-routed to nearby ports hence on a nation-wide level there was limited trade disruptions as a result of the disaster (Friedt, 2018). However, there was still a significant economic impact felt in New Orleans, during the 10-month period post the hurricane, there was a loss of 3,500 jobs surrounding port operations totalling approximately \$136.1 million in wages (Dolfman et al., 2007).

Additionally, the educational sector was another key area that suffered as a result of the disaster with approximately 1,910 jobs lost, totalling an estimated \$66.4 million in wages (Dolfman et al., 2007). Overall, when looking at the data and making a year on year comparison over a ten month period post Hurricane Katrina, up until June 2006, job losses totalled 92,900 with an estimated loss of wages of \$2.9 billion (Dolfman et al., 2007). Hence clearly the impact to the states directly struck by Hurricane Katrina was significant but there was minimal significant flow on impact felt throughout the nation's economy. Therefore, the targeted fiscal policy response for the most impacted areas was needed, however many argue the recovery was slow and not effective due to inefficiencies made within the fiscal policy response.

Firstly, Hurricane Katrina resulted in the biggest housing rebuild in Americas history and initially the Federal Reserve planned to have a fiscal stimulus program that was efficient and honest. However, many argue that the Federal Reserve was too slow to respond initially and in reality the program they introduced had significant amounts of red tape which delayed recovery, exacerbating the problem (The New York Times, 2013). Additionally, the individual states were in control of distributing the federal funds, hence there was no unison in response and in certain states there was corruption in administration, resulting in money to be wasted (The New York Times, 2013). A review conducted under The White House and the George Bush administration further highlighted these short comings, by agreeing that the Feds response was bureaucratic and inefficient (United States. Executive Office of the President, 2006).

Additionally, the FEMA failed to identify the true needs of those impacted by the disaster, in turn not solving the root of the problem. Further mistakes made in the government's fiscal policy response included failing to provide coordination in the infrastructure rebuild. The Federal government did not coordinate actions between State and local rebuilding efforts (United States. Executive Office of the President, 2006). In addition, the Federal Reserve

failed to coordinate overall efforts of recovery from different divisions. For example, an energy company had generators shipped to facilities to restore oil supply to the mid-Atlantic of America. However, these generators were needed in hospitals and hence diverted. Showing that overall there was competing needs between different sectors and a lack of unison between all sectors towards a common goal of recovery (United States. Executive Office of the President, 2006). These are just a few of the many short comings that was apparent in Americas fiscal policy response to Hurricane Katrina.

Whilst the slow and inadequate responses didn't delay Americas growth or have an adverse impact on key macroeconomic variables nationwide, it did cause significant delay in recoveries for those states most impacted by the natural disaster. Ten years on after the hurricane, the city of New Orleans was still not back to normality, with significant population numbers still down and old problems coming to light once again and being further exacerbated. For example, the incarceration rate in New Orleans is twice the national average and in 2015 New Orleans came second in the top 300 American cities based on income inequality with the extremely unaffordable housing, rising rents and low wages (Robertson & Fausset, 2015). Thereby showing how poor fiscal policy responses can be detrimental if not implemented adequately. Overall, clearly Hurricane Katrina did not result in significant adverse impacts to nationwide macroeconomic variables, arguably justifying the need not to implement a monetary policy response directly to the disaster. This point accompanied with the issues raised surrounding Hurricane Katrina's fiscal policy response will be touched upon again later in the thesis.

Tohoku Earthquake and Tsunami:

The Tohoku Earthquake and Tsunami was one of the most impacting earthquakes recorded in worlds history, it resulted in devastating wide ranging impacts not only in Japan but globally (Kan, 2011). The natural disaster struck Japan at a time when the economy was gaining momentum in its recovery to previous difficulties within Japan's economy, including Japan's infamous liquidity trap, otherwise regarded as Japans 'lost decade' (Svensson, 2003). The combination of damage from the earthquake, tsunami and the resulting accident at the Fukushima nuclear power plant resulted in significant negative impacts to Japan's economy not only in the disaster stricken areas but on a national level (Shirakawa, 2011) . The disaster was estimated to cost 15 trillion yen, totalling approximately 3% of Japans GDP (N.B.,

2011). The impacts were wide ranging, including but not restrictive to, destruction of roads, ports, factories and houses. Damage also occurred to key power generating facilities, mainly in the Kanto and Tohoku regions (Shirakawa, 2011). It was estimated that industrial production for Japan in March decreased by 15% on a month to month basis, which was the most significant drop on record (Shirakawa, 2011). All these factors combined resulted in a significant negative aggregate supply shock. In turn, this had a significant negative impact on overseas exports (Shirakawa, 2011).

The shock also stemmed from the demand side. The earthquake itself and the accident at the nuclear plant caused in the short term a loss of confidence for both businesses and households, dampening aggregate demand, hence economic activity (Shirakawa, 2011). Aggregate demand was also impacted from employment, in turn wages and household consumption, particularly for luxury spending such as eating out (Shirakawa, 2011). Flow on effects were also felt for business investment levels. Furthermore aggregate demand was impacted by a fall in tourism in Japan, particularly in the short term (Shirakawa, 2011).

Japan's government dedicated a fiscal policy response to assist in the recovery of the natural disaster. As seen in Figure Eight, the Japanese Ministry of Finance on April 22nd 2011 released its outline of the Supplementary Budget for FY2011 (Ministry of Finance Japan, 2011). A few days later on April 28th 2011 the Minister of Finance, Noda, summarised the budget, stating that the expected fiscal policy would total 4,015.3 billion yen (Noda, 2011). The speech outlined that the Japanese government planned to finance these costs by firstly reducing other expenditures by just over 3,700 billion yen in areas and projects such as child allowance, pensions and road works (Noda, 2011). Additionally, the government proposed to increase government revenue by 305.1 billion yen by increasing tax payments from Expressway Holding and Debt Repayment Agency (Noda, 2011).

The Japanese government made explicit reference to the fact that the government was still striving to ensure a sustainable fiscal deficit (Shirakawa, 2011). Since the 1990's it has been argued that Japan has implemented excessive fiscal stimulus measures to stimulate the economy out of a prolonged liquidity trap (Shirakawa, 2011). Consequently, prior to the natural disaster, fiscal sustainability was a key concern for the Japanese government. In Japan there has been two consecutive decades of budget deficits, the continuous deficits through expansions and recessions highlights the problem is more structural in nature rather than cyclical. The government also acknowledged that Japans aging population continuously adds

significant cost to the economy through areas such as health costs (Shirakawa, 2011). Hence the government asserted that allowing the fiscal deficit to grow to unsustainable limits could cause greater harm to the economy (Shirakawa, 2011). Claiming that once fiscal sustainability is questioned this could negatively impact the issuing of government bonds (Shirakawa, 2011). Furthermore, if an increasing proportion of the population anticipate that the working age population will bear the cost of fiscal spending, it could lead to a negative self-reinforcing cycle where households and businesses enact an increased level of precautionary savings, hence negatively impacting aggregate demand (Shirakawa, 2011).

Therefore, with all these factors considered, the Japanese government decided to implement a fiscal policy response, predominately financed by a cut of spending elsewhere and increase in taxes rather than being debt driven. In addition, the BOJ decided to further enhance a monetary easing policy in the hope of stimulating and supporting Japans economy post the exogenous event. The BOJ made direct reference to the thought that due to the impact of the natural disaster being geographically widespread, they anticipated production to be dampened and the confidence of firms and households to decline for an extended period of time (BOJ, 2011a) . As a result of this the central bank decided to encourage the uncollateralized overnight call rate to remain at 0 to 0.1 percent (BOJ, 2011a). Further to this, the BOJ asserted its commitment to ensure there is ample funds within the financial markets to meet demand and ensure financial market stability (BOJ, 2011a). Additionally, the BOJ increased their asset purchase program, in other words quantitative easing, from 5 trillion yen to approximately 40 trillion yen (BOJ, 2011a).

In a report released by BOJ in October 2010, prior to the 2011 Earthquake and Tsunami, the BOJ made forecasts outlining how they viewed the future of Japans economy (BOJ, 2010). In summary the BOJ outlined that financial conditions in Japan have continued to show signs of easing and claimed the economy is still showing signs of a reasonable recovery. However, pace is slowing down due to decreasing recovery rates in exports and production (BOJ, 2010). The BOJ predicted that employment and household income should be expected to improve in 2011 therefore private consumption as well (BOJ, 2010). Figures 9a, 9b and 9c show BOJ forecasts made in January 2011 (prior to the earthquake and tsunami) for Real GDP, Domestic CGPI and CPI for the remainder of 2011 against the actual values of these macroeconomic variables for the period. Clearly Real GDP was significantly lower than forecasted, down 1.1 in 2011. Furthermore, CPI was lower than forecasted, down 0.3 in 2011. However Domestic CGPI, which measures the changes in supply side prices in the Japanese

economy, was higher than what was forecasted for the 2011 period, up 0.4. Overall, clearly the earthquake in Japan had significant impact at the nationwide level and caused clear deviations from forecasted figures.

Figure 10a shows the impact Tohoku Earthquake and Tsunami had on the Nikkei 225 Index closing prices. The significant drop in the Nikkei 225 was seen the first trading day after the disaster, 14th March, as the earthquake occurred in the afternoon. On the 14th March the Index closed 6.2% lower than the closing price on 11th March, the day of the earthquake and a drop of 7.8% from the day prior to the disaster on the 10th March. Furthermore, on the 15th March the stock market closed with a significant drop of 17.5% from the closing value pre the earthquake. Many claimed the nuclear explosions that occurred at the Fukushima plant contributed to the significant drop in closing prices. Arguably panic selling occurred as the nuclear catastrophe exacerbated the situation in Japan and further heightened the fear in the country (Kumar, 2011). Additionally, the adverse impact to the stock market continued to occur for a few weeks post the Tohoku earthquake and tsunami (Schnell & Weinstein, 2012). Therefore, evidentially there was a significant market correction because of the disaster and the impact to the stock market was more pronounced than what occurred post Hurricane Katrina.

Additionally, several of Japan's leading companies faced significant losses in the stock market, including Toyota was down 8% and Sony and Nissan Motor down more than 9% (Schneider, 2011). The impact was not restricted to the Japanese stock market, overseas markets also felt the repercussions, including in America, the Dow Jones industrial average was down 0.5 percent and the Nasdaq was down 0.3 percent after the disaster (CNN Money, 2011). Figure 10b represents how the financial markets reacted to the Japanese government fiscal policy response to the earthquake and tsunami. Closing values on the day of the announcement, 28th of April and the first trading day after, 2nd of May indicated a positive response from the markets. However, markets were only up 3.2% from the trading day prior to the fiscal policy announcement, hence an insignificant movement. Additionally, the subsequent two trading days showed that the positivity was short lived, and the markets remained down. In terms of the monetary policy response, Figure 10c shows that the closing figure on the 17th March compared to the 11th of March, the day before the monetary easing statement was released there was an overall decline of -12.6%. Clearly the announcement of the monetary policy did not result in any substantial significant positive improvement to the closing figures in the stock markets to counter act the adverse impacts.

The subsections under Figure 11 shows the empirical results for the Tohoku earthquake, notably the data for FDI was sourced from The World Bank which is a reliable source however had a yearly frequency. Notably a smaller sample size impacts the reliability of forecasts made and there were further concerns with the results for FDI as will be mentioned later. In addition, whilst there is greater variation in the size of the data sets compared to Hurricane Katrina, all data sets are of sufficient size to allow for accurate predictions within the two-year period. The same reasoning applies as previously mentioned that it is beneficial to use larger data sets when available. The macroeconomic variables that produced abnormal values that produced statistically significant t-test values at the 5% level was unemployment, RGDP and inflation.

Firstly, for unemployment, as apparent in Figure 11a an ARMA model of (2,10) (0,0) was chosen for the log of unemployment to produce forecasted values. The Q-stat values indicate the residuals were white noise. The abnormal returns were calculated with a t-test value of 3.401 hence statistically significant at the 5% level. The forecasted graph for unemployment shows historically there have been clear fluctuations with an overall constant increase in the unemployment rate. Prior to the exogenous shock in the beginning of 2011, the unemployment rate was trending downwards and levelling off. As evident in the graph, the forecasted values predicted a downward trend and then increasing back up to the pre dip levels. However, the actual values showed that unemployment rate for Japan continued to decrease for the two-year period post the natural disaster. Clearly the exogenous event did not have a significant adverse impact in the unemployment rate at a nationwide level, rather a favourable trend. Overall, there was a 0.9 decrease in the unemployment rate within the two years compared to levels pre the earthquake.

However, in saying this, employment was significantly adversely impacted in the main three disasters zones of Miyagi, Iwate and Fukushima. This was particularly due to an increase in emigration occurring, specifically from young people in the Fukushima region as a result of the disturbances caused at the nuclear plant and the subsequent health concerns (Higuchi et al., 2012). Additionally, whilst there was an increase in the number of jobs in the earthquake reconstruction industry and recoveries made in manufacturing production, employment suffered due to a significant mismatch between job offers and applicants (Higuchi et al., 2012). The mismatch was particularly felt in the industries of professional and technical jobs as well as management and security jobs. The mismatch resulted in applications for employment insurance benefits to rise to around 40% within the three disaster stricken

regions in the ten-month period post the disaster, compared to figures from previous years (Higuchi et al., 2012). Therefore, even though unemployment at the national level wasn't adversely impacted as a result of the earthquake, there was significant impact in the regions that were prolonged (Higuchi et al., 2012). Having workers out of work for extended periods of time can prove detrimental for several factors. Hence some argued that there was a need for greater encouragement and assistance for people to train and acquire additional skills so unemployed individuals could find new lines of work (Higuchi et al., 2012).

Notably the unfavourable impact in unemployment did not reflect in the nationwide figures for a few reasons. Firstly, when compared to OECD standards, the Japanese labour market has performed well in reaction to economic shocks. In comparison to other OECD countries, historically Japan's labour market has outperformed in restricting the increase in unemployment and fall in labour income and the same can be seen in the empirical results after the natural disasters (OECD, 2012a). Some argue this occurs due to the long-term employment system in Japan which results in companies aiming to ensure the long-term livelihoods are achieved for employees and significant seniority-based wage (Hattori & Maeda, 2000). Therefore, it is argued that such a system drives the commitment of companies to maintain employment for employees even during economic downturns (OECD, 2012a). Moreover, the earthquake struck at a time when Japan's economy was starting to recover post GFC and the unemployment rate was beginning to fall pre the disaster (Gurría, 2011). Therefore, all the reasons mentioned are contributing factors as to why there was not an adverse impact seen in the unemployment figures for Japan nationwide.

Figure 11b shows the empirical data for RGDP, the data was seasonally adjusted, the log of RGDP and an ARMA model of (2,3) (0,0) was used to produce forecasted values. The Q-stat values showed the residuals were white noise, the abnormal returns produced a statistically significant t-test value at the 5% level of 8.234. As shown by the forecasted graph in Figure 11b, RGDP for Japan was on an upward trend from a low point post the GFC and the forecasted values predicted for this upward trend to continue. However, the actual values indicated that for the first and second quarter of 2011 there was a steady downward trend in RGDP and then a recovery in RGDP value for the third and fourth quarter of 2011 and the first quarter of 2012, before another slight decline in the remaining three quarters.

Evidentially there was clear discrepancies between the forecasted and actual values, hence the positive t-test value. Clearly RGDP was adversely impacted by the earthquake, however the data values showed that recovery in RGDP in the third quarter of 2011 were at levels

above RGDP levels in the quarter prior to the earthquake. Hence whilst values were significantly less than forecasted, some recovery was made in RGDP in the two-year period after the event.

Figure 11c shows the empirical results for business confidence, the ARMA model of (3,3) (2,2) was chosen as the model of best fit. However, looking at the Q statistic values and the correlogram there is insignificant evidence to suggest the residuals were white noise. Thereby impacting the reliability of using forecasted figures to calculate abnormal returns and in turn interpret the t-test value. Therefore, instead just looking at the actual values, the graph shows historically business confidence has had clear fluctuations, there was a peak pre the Tohoku earthquake. The actual values show a dip in business confidence in the months after the March disaster until an eventual rise from September 2011 to another fluctuating dip starting February 2012. Clearly the impact to business confidence was not prolonged and short-term recoveries were made to levels near the business confidence levels, pre the earthquake.

Further to this, in a survey conducted by Bloomberg, 23 economists projected the Japanese economy would shrink by 1.9 percent (Tabuchi & Wassener, 2011). Where in reality the economy shrunk by a rate of 3.7 percent for the first quarter of 2011 (Tabuchi & Wassener, 2011). As evident in the data set, the second quarter of 2011 also had negative economic growth for Japan, clearly indicating by most commonly accepted definitions, the country entered into another recession. However, projections were made that the recession was likely to be significant but not prolonged. As notably machinery orders, a key indicator of future capital spending, increased during March which went against what was predicted and manufacturers overall predicted they would return to pre earthquake production levels earlier than expected (Tabuchi & Wassener, 2011). These projections were supported when looking at the actual data shown for investment figures in residential dwellings, which again is another valuable indicator showing future capital spending. A drop did occur in investment levels for the second quarter of 2011, but a quick recovery was made in the third quarter. In addition, when looking at business confidence levels, a drop in confidence did occur but only until September 2011, hence the impact was not prolonged and not as significant as some anticipated.

However the short term impact did prove to be significant and many economists including Frederic Neumann argued that the short-term significant impact of the earthquake proved just how weak the Japanese economy had been before the exogenous event occurred (Tabuchi &

Wassener, 2011). In addition, as previously mentioned, Japan has faced years of a deflation trap with significantly low levels of consumer spending which resulted in the country to be reliant on exports as a stimulator of growth (Tabuchi & Wassener, 2011).

Therefore, an area that caused key concerns for the whole economy in the short term, particularly in the exporting sector, was the damage to nuclear plants which caused an energy shortage. Pre the earthquake, Japans electricity sector relied on nuclear power to supply 30 percent of the nation's total electricity sector (Tabuchi & Wassener, 2011) . The supply of this electricity source was not only impacted by the disaster at the Fukushima plant and other subsequent nuclear plants that were destroyed, but also several other nuclear power plants were forced to close by governments instructions until sufficient tsunami defences were implemented (Tabuchi & Wassener, 2011).

Additionally, there was a change in household perspective, nuclear was once considered as a safe alternative to fossil fuels, however the Fukushima disaster highlighted the negative health impact that could occur (Schnell & Weinstein, 2012) . This resulted in only 3 of the 54 nuclear reactors in Japan to be operating nearly one year after the disaster and it was not until 7 months after the disaster that the first idle nuclear reactor was permitted to reopen (Schnell & Weinstein, 2012). Hence showing the magnitude and time period the electricity sector was impacted. This resulted in the Japanese government to request that households, offices and factories reduce electricity use by 15% over the summer period. This had significant flow on effects into the production sector. Specifically in the short term, as major company Toyota Motor claimed that the companies first quarter profit had fallen significantly, a total of 77 percent down from the same period last year (Tabuchi & Wassener, 2011).

In an interview regarding the disaster of September 11th in America, economist Milton Friedman, discussed the role of fiscal policy. Arguing that Japan is a perfect example of fiscal spending having very limited impact, Milton argued that the fiscal spending that has occurred for several years historically in Japan has not done any good (Institution, 2011). Milton explicitly states that fiscal spending either comes from taxes which in turn makes households disposable income decline or it comes from borrowing money which can make consumers hesitant on how the debt will be paid back, relating to ideologies of Ricardian equivalence. In other words, there is no free lunch, and people have to be paid (Institution, 2011). Therefore, Milton argues that economic stimulus should come from monetary policy and argues that tax

cuts are a more appropriate form of fiscal stimulus and keeps government spending reduced (Institution, 2011).

Japan has faced years of excessive fiscal spending and prior to the disaster Japan's public debt was already twice the size of its \$5 trillion economy (Tabuchi, 2011). The intended impact of fiscal policy to stimulate the economy had not come to fruition (Auerbach & Obstfeld, 2005). The multiplier generated from public spending was one in the 1990s and public spending increased by 15 percent from 1992 to 1993, whilst GDP only grew by 1 percent (Ishii & Wada, 1998). A key factor contributing to this problem is the structural issues within Japan. For example, central and local governments have fixed relations, resulting in some key problems, including local governments not spending all money allocated to fiscal spending, approximately 10 trillion yen less (Ishii & Wada, 1998). Therefore, due to the country's track record when it comes to fiscal policy the government had to be cautious of their economic response approach. Which some argued they did by funding recovery payments through reductions in other areas, as well as having some targeted initiatives. This included providing incentives for companies to rebuild their factories in the Tohoku region in an effort to reduce operations being moved overseas (Tabuchi, 2011).

Further to this, a key policy response that was taken in response to the earthquake was the use of monetary policy. The BOJ injected historically high and significant amounts of money into the economy in an effort to stimulate the economy and encourage spending (Tabuchi, 2011). A tool otherwise known as quantitative easing. Historically QE has been unsuccessful in Japan. Despite the money base increasing by 50 percent over two years up until 2003, no significant recovery was seen for the Japanese economy. Japan continues to be faced with deflation and subdued growth (Svensson, 2003). One paper argued that QE fails as it is the central bank establishing expectations on rate levels that gives people the confidence to invest, rather than the action of printing money (Cúrdia & Ferrero, 2013). An additional research paper supports this view and asserts that QE fails as banks do not view the rise in money base as permanent (Auerbach & Obstfeld, 2005). Resulting in banks to limit lending, hence no significant stimulus and subsequent improvements to economic factors (Auerbach & Obstfeld, 2005).

Initially there was concern that further easing from the BOJ could result in inflationary expectations which could increase interest rates in turn adversely impact Japan's debt levels, making it relatively more costly to service the pre-existing unsustainable levels of debt

(Paribas, 2011) . When looking at the empirical evidence, inflation was measured as CPI for all items besides non-food and non-energy. Figure 11d shows the empirical results for CPI, the ARMA model of (3,2) (0,1) was used to produce forecasted figures. Looking at the Q-stat values shows suggestion of acceptance of the null, however notably the confidence of residuals being white noise decreases as the lag length increases, so caution must apply to the forecasted figures. Overall, the abnormal results produced a t-test value of -3.670, significant at the 5% level. The forecasting graph shows clear fluctuations in CPI historically, since a peak in 1975 there has been a gradual decline in the CPI. The forecasted figures predicted an initial increase in CPI and then a downturn in the two-year period. The actual values showed an overall rise in CPI over the two-year period rising from -1.030 the quarter before the natural disaster to -0.484 for the last quarter of 2012. For the first quarter of 2011 there was a further decline in the CPI, hence deflation occurring, but improvement was made in the second and third quarter of 2011 and as previously mentioned improvement made to Japan's historically significant deflationary trap. Therefore, whilst inflation was lower than anticipated in 2011 compared to BOJ forecast and caution must be applied to the forecasting values clearly the actual values showed CPI improved over the two-year period greater than what was forecasted.

Inflation rose due to a combination of factors including food shortages in Japan, higher food and energy prices worldwide, depreciation of the yen, key disturbance in the domestic economy production caused from breaks in the supply chain and significant energy reductions (Paribas, 2011). Notably, the CPI indicator used in this data analysis excluded food and energy, therefore there was a rise in inflation even without the consideration of these key factors. Chief economist, Hiromichi Shirakawa at the time articulated that inflation would be pushed up by these factors previously mentioned and also expressed concern surrounding consumer spending (Paribas, 2011). Claiming all though consumer spending was expected to recover, wages had not risen, hence expressing key concern of how consumer spending would fare in the future (Paribas, 2011).

However, the data for consumer spending did not show any statistically significant adverse impact in consumer spending over the two-year period post the event. As can be seen by Figure 11e, the forecasted values expected the log of consumer spending to fluctuate with an overall general increasing path over the two-year period. The actual values showed there was a decline in consumer spending for the first quarter of 2011 and consumer spending remained

lower in the second quarter of 2011 compared to levels pre the earthquake. However, for the majority of the two-year period, consumer spending levels remained similar to what was expected under forecasted values. Thereby showing that consumer spending was not significantly adversely impacted post the disaster for a prolonged period of time.

In terms of consumer confidence, Figure 11f shows that forecasted values expected consumer confidence to gradually decline with some fluctuations, the actual values reflected similar results. The first and second quarter of 2011 experienced a decline in consumer confidence, from here there was a gradual increase heading towards but remaining below confidence levels pre the natural disaster. Therefore, clearly whilst consumer confidence declined after the event forecasted figures expected similar declines, due to the highly fluctuating nature of the consumer confidence data set and troughs tending to be prolonged in the past. Hence whilst the Japanese earthquake and follow-on events would have disturbed consumer confidence there was not a significant adverse impact that differed from historical trends.

Additionally, investment for Japan was measured as the billions of chained 2011 yen spent on private residential investment. This indicator was used, as a total investment figure could not be sourced on a quarterly basis; thus, this variable is a suitable substitute. As seen in Figure 11g whilst the ARMA model of (3,4) (0,0) produced the lowest AIC value, it was still a relatively high AIC value of 16.057 compared to the AIC values for other macroeconomic variables. Therefore, impacting the reliability of the forecasted figures and in turn the calculation of abnormal returns and the t-test value output. Hence looking at just the actual values, there was a decrease in investment levels for the second quarter of 2011 and then fluctuations leading to an eventual increase in investment levels at the end of the second year period, above investment levels prior to the natural disaster. Overall showing limited adverse impacts to investment levels after the natural disaster.

Lastly, in terms of FDI whilst the ARMA model of (4,3) (0,0) produced the smallest AIC value, the value of 47.433 is significantly large, hence impacting the validity to make any statistically significant conclusion. However, when looking at the actual figures, there was one of the most significant drops historically in FDI levels into Japan for the year of 2011, as evident in the forecast graph in Figure 11h. The drop was attributed to the devastating impact caused by the earthquake and subsequent events that impacted business operations, including safety and power supply concerns surrounding the Fukushima power plant (JETRO, 2011).

However, there was a substantial recovery made in 2012 to positive figures and this increase occurred up until 2014, showing the shock to FDI was relatively short-lived.

Many argued the quick recovery was attributed to the Japanese quick and adequate response to the disaster, showing that the nation is resilient to adverse events (JETRO, 2011).

Additionally, the resistance in a large proportion of Japan's infrastructure, for instance no deaths being associated with the shinkansen bullet train, clearly demonstrated the success of Japan's technology and infrastructure. Therefore, whilst historically FDI has been low in Japan against the country's GDP in comparison with other countries, the impact as a result of the earthquake was short lived (JETRO, 2011). With many companies continuing their investment plans into Japan despite the disaster, including global company Umicore which continued its opening of a Kobe plant in April 2011 (JETRO, 2011).

Overall, as previously mentioned, whilst the natural disaster was significant nationwide and caused some adverse impacts in the short term post the disaster, recoveries were seen to be made in the two-year period. Therefore, as previously mentioned whilst one cannot exactly pin down what recoveries were caused from the policy responses, taking a holistic analysis shows clearly recoveries were made. The economic policy response implemented after the Japanese earthquake will be discussed in further detail later in the thesis.

Christchurch Earthquake:

The city of Christchurch and the greater Canterbury region in New Zealand suffered a significant earthquake on the 4th of September 2010, the city faced many aftershocks and another significant earthquake on the 22nd February 2011 which was far more impactful than the first earthquake (Wood et al., 2016). Beyond the devastating loss of life, the earthquakes had significant economic costs not only centred around the region of Canterbury but for New Zealand on the whole. NZ Treasury estimated that the rebuild of the February natural disaster would be approximately equivalent to 10 percent of New Zealand's GDP (New Zealand Parliament, 2011). Hence when accounting for the cost of the disaster relative to the size of a country's GDP/RGDP levels, the Christchurch earthquake was more impactful than Hurricane Katrina and the Tohoku earthquake. Overall, the impacts from the earthquake were predominately felt from the supply side as seen in Hurricane Katrina, however there were components of a demand side shock for particular segments in the Christchurch region.

The RBNZ estimated the total cost of the rebuild to be \$40 billion NZD in 2015 dollars (Parker & Steenkamp, 2012). Whilst the cost of the damage from the natural disaster was significant for NZ the impact was relatively centralized to the Christchurch region. A study conducted by the RBNZ claimed that the spill over impact to other regions in New Zealand was limited (Parker & Steenkamp, 2012). In the Christchurch region the natural disaster caused nearly 170,000 properties to be damaged, equating to around three quarters of the entire Canterbury's housing stock (Wood et al., 2016). Such a substantial impact to the housing market resulted in a shortage of housing, in turn a sharp rise in house prices and rents in the Christchurch region. Furthermore, the destruction of the earthquakes caused significant damage to commercial property and public infrastructure, indicating a significant supply side shock. In addition, the earthquake resulted in significant movement of individuals, it was estimated that the population of the Canterbury region fell by nearly 12,000 people, equivalent to 2 percent of the population for the first two years post the earthquake (Wood et al., 2016). Initially after the earthquake employment in Christchurch declined by five percent, reaching a low point in June 2012. However up until 2015 employment rose by approximately 16 percent within the Christchurch region, mainly attributed to the increase in employment for the Christchurch rebuild (Wood et al., 2016).

Key areas that were specifically impacted in the Christchurch earthquake included accommodation, hospitality and retail industries. For New Zealand on the whole, confidence did decline post the February earthquake and international tourism and education decreased (Parker & Steenkamp, 2012). However, good exports and manufacturing activity remained steady nationwide post the natural disaster (Parker & Steenkamp, 2012). Therefore, clearly whilst the impacts of the Christchurch earthquake were significant in the region, the impacts did not significantly filter through to surrounding regions. However, there was a nationwide economic response taken by key policy makers in New Zealand.

It is important to mention that with the expensive price tag of the exogenous event it was extremely favourable that there were high rates and levels of insurance coverage. It was asserted that the combined insurance claims made on the Christchurch earthquake was in the top 5 of the most expensive insurance events to occur anywhere in the world (Cole, 2012). Hence a great proportion of the costs was funded by insurance, thereby costs were shared globally through reinsurance (Cole, 2012). The estimated claims made for the Christchurch earthquake was \$26 billion, funded from NZ total premium pool of \$3.5 billion (Mcleannan, 2016). In comparison the Japanese earthquake and tsunami, occurring less than a month

later, had an estimated cost of NZ \$45 billion, however Japan's annual premium is NZ \$130 billion thus significantly proportionally less (McLeannan, 2016). Therefore the coverage from insurance lessened the blow of such a costly disaster relative to New Zealand's GDP (McLeannan, 2016).

Policy makers in New Zealand used the tool of fiscal policy to respond to the earthquake. An expansionary fiscal policy was already implemented in response to the earthquake in September 2010. On Monday the 6th of September 2010 the Prime Minister of New Zealand, John Key announced that \$5.5 billion will be contributed by the government as funds for the Canterbury Earthquake Recovery Authority (Hon Bill English, 2012). After the February earthquake the government made further extensions to their original fiscal policy response. Bill English the Minister of Finance, made a speech on March 18th 2011 to the ANZ's Capital Markets Conference estimating the cost to the Crown to be \$10 billion dollars, including both direct and indirect expenses (English, 2011).

At the time Bill English clearly articulated that the government's immediate response would be to issue an increase in debt to fund the increase in fiscal spending. He argued it was an appropriate response as it allowed the government to start paying the reconstruction bills immediately to allow for recovery, whereas spending and tax programmes can delay the process (English, 2011). Additionally, Bill English made reference to the point that prior to the earthquakes, New Zealand economy was already facing a decline in economic growth due to the GFC, hence debt was more suitable than cutting operating spending or increasing taxes. In addition, the government would redistribute pre-existing capital allocation to Christchurch rather than other New Zealand regions (English, 2011).

Figures were made clear when NZ Treasury released its budget economic and fiscal update in May 2011, which outlined that the estimated cost to the Crown of the earthquakes was \$8.8 billion with a significant proportion of this cost to be incurred during the period of 2011-2015 (Treasury, 2011). Figure 12 shows the expected run down of cost and timeframe that was released by the Treasury (Treasury, 2011). It was estimated that net debt would be approximately 3% of GDP higher by the end of the forecast period than it would have been if the earthquake did not take place. As evident by Figure 12, the government spending was widely spread (Treasury, 2011) including spending to repair local infrastructure and to support lost income through programmes such as a wage subsidy (Beehive, 2011b).

Additionally, another component of fiscal policy that the New Zealand government implemented was tax relief measures (Beehive, 2011a).

Whilst the NZ government clearly communicated its commitment to use fiscal policy as a mechanism to support the recovery post the earthquake, key reservations were also articulated by the government. Bill English explicitly stated within his March 2011 speech that the government was still committed to reaching a budget surplus, however this had now been pushed out to 2015/16 with the occurrence of the earthquakes (English, 2011). English made reference to the importance to get Crown debt down to pre-earthquake levels so the NZ government could absorb future economic shocks to ensure NZ economy remains competitive and attractable to overseas investors and lenders (English, 2011).

Monetary policy was another tool used by policy makers; in March 2011 the RBNZ decided to reduce the OCR by 50 basis points from 3 to 2.5 percent. RBNZ made explicit reference to the occurrence of the Christchurch earthquake within its decision-making process.

Acknowledging that even prior to the February earthquake GDP growth was weak, caused by a range of factors including a slow down due to the GFC and household precautionary spending occurring (RBNZ, 2011). Whilst export sectors were benefiting from high prices, farmers were focused on servicing debt rather than spending, in addition a drought constrained output for farmers (RBNZ, 2011).

At the time the RBNZ acknowledged the fact that they were making a decision on limited information and they were unsure of the lasting and nationwide impacts of the earthquake (RBNZ, 2011). The RBNZ viewed the earthquake as an event that caused massive damage to property and buildings, in turn significant adverse impact to business activity, with Alan Bollard the governor of the RBNZ stating “business and consumer confidence has almost certainly deteriorated”(RBNZ, 2011, p. 2). Overall the RBNZ asserted that whilst the expansionary monetary policy action may need to be removed once rebuilding begins, Bollard claimed that “ we have acted pre-emptively in reducing the OCR to lessen the economic impact of the earthquake and guard against the risk of this impact becoming especially severe”(RBNZ, 2011, p. 2).

In a report published in December 2010, a few months prior to the February earthquake, the RBNZ made forecasts for the year ahead as seen in Figure 13a, 13b and 13c. The RBNZ summarised that economic growth has subsided and the economic outlook in regards to GDP growth had softened in the short term, but expected the prospect of higher export volumes

and earthquake repairs from the 2010 earthquakes are likely to influence underlying inflation to increase (RBNZ, 2010). Figure 13a shows that Real GDP was 0.1 less than forecasted in March 2011 quarter. Figure 13b shows for the first three quarters of 2011 CPI figures were significantly greater than what was forecasted, producing a positive value of 3.3 and 2.6 respectively. Figure 13c shows for the first three quarters of 2011 the unemployment rate was more favourable than forecasted, down 0.4, 0.4 and 0.3 respectively compared to forecasted figures.

Figure 14a shows that the NZX closed down -0.69% the day after the earthquake, thus not a significant deviation. In addition, this slight downward trend was short-lived with the markets closing with an upward value on the 23rd of February, on the third day post the earthquake the closing value of the NZX was only slightly down compared to the closing value on the 21st February. Therefore, clearly the stock markets traded relatively normally post the disaster. In terms of the economic response, Figure 14b shows that the markets closed with increasing closing values for the three days after the fiscal policy announcement. However, the increase in closing values was only 1.4%, hence no significant impact on stock market figures. Figure 14c represents the market reaction to RBNZ monetary policy response of decreasing the OCR. On the day of the announcement and for the three days post the expansionary OCR decision the markets closed with a decreased value. However, the overall decrease over the three days after was only -2.9%, therefore no significant impact. All the subsections under Figure 15 show the empirical results for the Christchurch earthquake, the discussion surrounding the choice of data previously mentioned, applies in this context as well. The macroeconomic variables that had abnormal values which produced statistically significant t-test values at the 5% level was inflation, consumer confidence, consumer spending and GDP.

Firstly, inflation was measured by CPI and shown as the percentage change from year on year, allowing for adjustment of seasonality. The ARMA model of (1,4) (0,0) was used to produce forecasted values for CPI as shown in Figure 15a. The Q-stat values indicate the residuals were white noise. The abnormal returns were calculated with a t-test of 5.332 hence statistically significant at the 5% level. The forecasted graph shows there had been clear fluctuations in the CPI rate historically. Prior to the Christchurch earthquake there was a rise in CPI and the forecasted figures predicted for this rise to continue and then a gradual decline within the two-year period. The actual values showed a rise as well, however a significantly greater decline than what was predicted within the forecasted values. Notably the second quarter of 2011, the quarter after the cut in the OCR, there was a rise in CPI from year-on-

year data, however for the remainder of the two years the OCR was held at 2.50 and there was a substantial decline in CPI.

Clearly as previously mentioned CPI outstripped what the RBNZ forecasted to occur for the few months post the Christchurch earthquake. In addition, A report published in May 2011 by New Zealand Treasury predicted that the Christchurch earthquake would produce inflation pressures for 2012 and further years higher than what would have been if the earthquake did not occur (Treasury, 2011). It was predicted that inflation would rise predominantly in areas such as construction costs and the reduction in capital stock was predicted to decrease the level of potential output, thus increase inflation for a specific level of economic activity (Treasury, 2011). In addition, the Treasury forecasted that the RBNZ would likely in the medium term have to increase interest rates to combat inflation (Treasury, 2011).

However, this was not the case, undoubtedly Christchurch experienced consumer price inflation, with household items including clothing and recreation items being more expensive as well as rent in Christchurch compared to national averages (Wood et al., 2016). However, these price differentials disappeared in the short term (Wood et al., 2016). Therefore, clearly the actual values did not reflect what was forecasted and despite the decrease in OCR, there was no significant recovery in inflation rates, rather a further decline. There was no further change in the OCR to combat the expected rise in inflation, rather the rate was held constant at 2.5 until the first quarter of 2014 (RBNZ, 2020e).

A report released by the RBNZ outlined why over the few years before 2013 New Zealand experienced low inflation. Firstly, the RBNZ attributed the low inflation to many advanced economies having slow recoveries post the GFC and advanced economies contributing to the vast majority of global demand particularly for consumer goods (Kergozou & Ranchhod, 2013). Therefore, the slow recovery resulted in dampened global trade, in turn decreasing export price inflation (Kergozou & Ranchhod, 2013). Furthermore, the strength of the New Zealand dollar further exacerbated the decline in inflation by decreasing the domestic prices of imported goods (Kergozou & Ranchhod, 2013). In line with this, the lower prices of imported goods increased competitive pressures domestically which resulted in a decrease in the inflation rate for some domestically produced goods.

Additionally, New Zealand experienced a slow recovery post the GFC hence prolonged excess capacity added to dampening prices and hence inflation, combined with greater caution from household and firms in their spending dampened inflation once again (Kergozou

& Ranchhod, 2013). Overall the RBNZ asserted that the main factors that contributed to the continued low inflation was unexpected strength in NZD driving up domestic and international competition and fall in inflation expectations combined with subdued wages (Kergozou & Ranchhod, 2013). Hence arguably Christchurch earthquake was not an exogenous shock that was noted to have significant impact to the movement in inflation rates.

Figure 15b shows the empirical results for consumer confidence, the ARMA model of (3,2) (0,0) was used to produce the forecasted values. The Q-stat values indicate the residuals are white noise. The abnormal values produced a t-test statistic value significant at the 5% level of 2.671. As shown in the forecasted graph there is clear fluctuations historically in consumer sentiment levels and the forecasted values predicted this fluctuation would continue over the two-year period. However, the actual values showed much greater dips, specifically for the first quarter of 2011. Consumer confidence significantly declined and then improvements were made for the second and third quarter of 2011, however, declines and fluctuations occurred for the remaining quarters of the two-year period.

Therefore, clearly whilst other economic factors would have been influencing consumer confidence at the time including being at the back of the GFC. Clearly the Christchurch earthquake had an impact on consumer confidence for the time period after the event and it was not just felt in the Christchurch region. Rather the loss of confidence was felt outside of the region, negatively impacting the nation-wide figures. Notably other areas where consumer confidence experienced significant drops included Wellington, Gisborne and Hawke's Bay which are all areas that had suffered significant earthquakes in the past (Weir, 2011). Senior economists in Westpac bank, Dominick Stephens noted that the fall in consumer confidence was felt by everyone, including people from a wide variety of age, sex and income groups (Vaughan, 2011). However, consumer confidence levels did improve in 2011 for the Christchurch region and nationwide so the significant initial adverse impact was not prolonged (New Zealand Parliament, 2011). In saying this, the recovery was not maintained for long and fluctuating figures occurred again over the two-year period.

Consumer spending indicated similar results as seen in consumer confidence. Figure 15c shows the ARMA model of (2,2) (0,1) was used to produce forecasting figures. The Q-stat values indicates the residuals are white noise, the abnormal returns produced a statistically significant t-test value at the 5% level of 3.707. Clearly as evident by the forecasted graph, consumer spending historically has experienced significant fluctuations, prior to the

Christchurch earthquake consumer spending was experiencing a downward trend. The forecasted values predicted an upward trend for the following two-year time frame, however this significantly differed to what the actual values showed for consumer spending. There was a decrease in consumer spending for the first quarter of 2011 and then an increase from the second quarter of 2011 through to the second quarter of 2012, where there was a decline again in consumer spending. Notably consumer spending was significantly impacted directly in the Christchurch region but impacts were felt nation-wide as well (New Zealand Parliament, 2011).

However, it is worth mentioning that real household consumption expenditure in New Zealand increased by 40 percent between 1992 to 2011, but consumption per person and per household declined in New Zealand in 2009 and 2010 (Ministry for the Environment, 2020). In addition, consumption levels in 2011 were equivalent to the same levels in 2009. This decline in 2009 and 2010 was mainly attributed to New Zealand being in an economic recession at the back of the GFC with other developed nations experiencing similar trends (Ministry for the Environment, 2020). Therefore, whilst the Christchurch earthquake impacted consumption particularly in certain industries such as tourism, within Christchurch, the decline in 2011 was also due to New Zealand's economy continuing to recover (Ministry for the Environment, 2020).

GDP was the last macroeconomic variable that had abnormal values which produced a statistically significant t-test value. Notably for the context of the Christchurch earthquake GDP was used instead of RGDP. This is because the frequency of RGDP was less frequent resulting in the data set to be significantly smaller, in turn causing concern for the validity of forecasts made. Figure 15d contains the empirical results for GDP, the ARMA model of (2,3) (0,0) was used for forecasting the log of GDP. The Q-stat values indicate the residuals are white noise. The abnormal returns were calculated with a t-test value of -15.520 hence statistically significant at the 5% level. As evident in the forecasting graph whilst there have been fluctuations, GDP has continued to steadily increase throughout time. As evident in the graph, there was a dip in GDP prior to the Christchurch earthquake and the forecasted figures predicted there would be a recovery from this and steady rise in GDP post the last quarter of 2010. The actual values showed a more significant and steady increase post the last quarter of 2010 compared to the forecasted values.

Thus whilst the earthquake had significant impact in the Canterbury region and was significantly costly in relation to New Zealand's GDP levels, the impact of the earthquake did not adversely impact GDP on a nationwide level (Treasury, 2011). Notably there were impacts to components of GDP, for instance, impacts to inventory levels and capital formation specifically in the Christchurch region (Statistics NZ, 2011). In addition, there were some disturbances made to export levels, but nothing significant to flow on to a nationwide level (Statistics NZ, 2011). The area that was impacted the most significantly as a result of the earthquake, was the exports of services, this was specifically impacted due to tourists' numbers declining into New Zealand (Statistics NZ, 2011).

Christchurch is the central hub for South Island tourism and prior to the earthquake contributed 16 per cent of nationwide tourism levels into New Zealand (Orchiston et al., 2014). Notably the continuation of aftershocks in Christchurch made the earthquake a prolonged natural disaster, further impacting tourism numbers (Orchiston et al., 2014). However, again the impact in the tourism sector did not cause a significant enough impact to effect nationwide GDP figures. Rather GDP growth outstripped what was forecasted. Likely the rebuild and other reasons previously mentioned stimulated New Zealand GDP figures. In addition, Christchurch's regional GDP increased significantly after the earthquakes due to the rebuild and only returned back to national averages some years after the crisis (Statistics NZ, 2018).

Figure 15e contains the empirical results for business confidence, whilst the ARMA model of (4,2) (1,2) produced the smallest AIC value out of the models tested, this is a relatively large AIC value in comparison to other models with a value of -12.449. In addition, the Q stat values indicate the residuals are not white noise. Therefore, this directly impacts any statistically significant conclusions being made. Hence just looking at the actual values instead, for the second- and third-month of 2011 business confidence did decline but this was short lived with figures rising again in April and May and fluctuating for the remaining two-year period.

Notably the Christchurch earthquake occurred during a time when New Zealand and economies around the world were recovering from the GFC and significant economic events were continuing to unfold including the European debt crisis. Therefore, whilst for the first quarter of 2011 clearly the Christchurch earthquake impacted recoveries in business confidence nationwide, this was short lived (New Zealand Parliament, 2011). Additionally,

whilst business confidence was notably most impacted in Christchurch, the impact was relatively short lived in Christchurch as well, with recoveries being made in late 2011 (New Zealand Parliament, 2011). This was likely attributed to the fact that there were global factors that continued to stimulate NZ businesses and prop up business confidence levels. This includes the Japanese earthquake, that occurred less than a month later and increased demand for some of New Zealand's key exports including timber and aluminium (Vaughan, 2011). Additionally, there was higher prices in other key exporting industries, including dairy and overall steady demand for NZ export products which helped stimulate the NZ economy (Vaughan, 2011).

In terms of investment, this was measured as building consents, which is the number of building permits issued for new dwellings, the reason for using this indicator was the same rationale explained under the Tohoku earthquake. The t-test value for the abnormal values for this macroeconomic variable was not statistically significant. As evident by the forecasted graph in Figure 15f, there had been distinctive fluctuations in building consent levels and the forecasted values predicted this trend to continue. The actual values showed similar fluctuations. Notably there was a decline in investment levels for the first quarter of 2011, however this was short lived with a substantial increase in the second and third quarter of 2011, showing evidence of the rebuild and distinctive fluctuations for the remainder of the two-year period. In line with this, looking at further indicators such as ready-mix concrete which is a key raw material used in several construction projects, including for roads, large scale building and houses (Statistics NZ, 2018). The volume of the ready-mix concrete produced in Canterbury significantly decreased in the March 2011 quarter and then increased for the remaining quarters in the two-year forecasting period and continued to increase beyond that time period (Statistics NZ, 2018).

Figure 15g shows the empirical results for FDI, whilst the ARMA model of (0,3) (0,0) produced the smallest AIC value it was still significantly large with a value of 44.986. Thus, resulting in no statistically significant conclusions able to be made from the abnormal results. Hence instead just looking at the actual values, showed a significant decrease in FDI in 2011, however this was short-lived with a quick recovery in 2012 to levels above 2010. Numerous academic studies have determined a link between natural disasters and FDI levels (Escaleras & Register, 2011). Investment decisions are centred around expected risk and return, therefore one would expect that significant natural disasters would negatively affect FDI levels (Escaleras & Register, 2011). Hence, in the context of the Christchurch earthquake it

was reasonable to predict that FDI levels would decline and the data shows that FDI decreased from four out of the top five countries who contribute FDI into New Zealand (Statistics NZ, 2019). Interestingly there was an increase in FDI into New Zealand by Japan from 2,469,000,000 in 2010 to 3,118,000,000 in 2011 (Statistics NZ, 2019). Hence despite both countries going through significant natural disasters in 2011, FDI continued to increase in NZ from Japan.

In addition, a decrease in the OCR would have made investments in NZ less attractable compared to overseas returns. In turn, this could have resulted in a depreciation of the NZD as investors would no longer demand NZD to invest in New Zealand, however in reality the dollar value was held relatively constant after the earthquake and as mentioned above, there was a quick recovery made in FDI levels (Stephens et al., 2011). This was likely attributed to key economic events no longer being as great of a concern, for instance in terms of the political stability in the Middle East the fear of adverse impact of oil shipments into the Western world was alleviated (Stephens et al., 2011). In addition, as previously mentioned, there was substantial insurance claims made as a result of the earthquake which generated significant inflow of NZ dollars (Stephens et al., 2011).

Lastly, for unemployment Figure 15h shows that prior to the last quarter of 2010 unemployment began to increase with fluctuations, the forecasted figures predicted this fluctuation to continue, however on a downward path over the two-year period. The actual values predicted a similar pattern hence no statistically significant t-test values for the abnormal values. Clearly Christchurch earthquake did not have a significant impact on the unemployment rate at the nation-wide level, with a slight decrease in the rate in 2011 to 6.0 and the rate staying very close to this value for the remainder of 2011. However notably there was an increase in the unemployment rate in the first quarter of 2012, to a rate of 6.3 and the rate remained relatively stable around this value for the remainder of the two-year forecasted period.

Whilst unemployment was adversely impacted in the city of Christchurch, with employment decreasing by 8 percent from year on year in the September 2011 quarter (New Zealand Parliament, 2011) this impact did not flow onto nationwide figures, partly due to thousands of people leaving Christchurch and relocating elsewhere in New Zealand and overseas (Craigie et al., 2012). Additionally, there was a transition in demand. There was a significant decrease in the need for employment in tourist and accommodation sectors as many hotels were

destroyed in the heart of the city and tourist numbers and overseas students declined in Christchurch (Craigie et al., 2012). However, there was a surge in demand for work in reconstruction sectors, including both construction and accompanied professional services. The key problem with this decline was a mismatch between workers skills and jobs available. Many of the unemployed workers from Christchurch did not have the skills required for the rebuild (Craigie et al., 2012). Hence this resulted in the sizeable impact to the Christchurch area but did not flow through to impact the nation-wide level of unemployment rates.

A report released by the RBNZ in December 2012 attributed the high unemployment rate due to the unemployment rate increasing and remaining high ever since the GFC. The report also made reference to job matching efficiency exacerbating the employment problem which was further impacted by the Christchurch earthquake (Craigie et al., 2012). Therefore, whilst there wasn't a surge in the unemployment rate post the Christchurch earthquake at the nationwide level, some argued that the exogenous event was a contributing factor for why the unemployment rate hadn't decreased significantly post the GFC, rather remained stagnant (Craigie et al., 2012). However as previously mentioned the actual values were not significantly different to the forecasted values for the two-year period.

Overall, the results for the Christchurch earthquake are similar to that of Hurricane Katrina, the impact was felt relatively locally. However, the Christchurch earthquake differed as both a monetary and fiscal policy response was implemented post the disaster. Overall assertions of the mix of policy response will be referenced later in the thesis.

Appendix: Natural Disasters

Figure Four:

Indicator	Federal Reserve Governors and Reserve Bank presidents	
	Range	Central tendency
	2005	
<i>Change, fourth quarter to fourth quarter¹</i>		
Nominal GDP	5 to 6-1/4	5-1/2 to 5-3/4
Real GDP	3 to 3-3/4	3-1/2
PCE price index excluding food and energy	1-1/2 to 2-1/4	1-3/4 to 2
<i>Average level, fourth quarter</i>		
Civilian unemployment rate	5 to 5-1/4	5
	2006	
<i>Change, fourth quarter to fourth quarter¹</i>		
Nominal GDP	5 to 6	5-1/4 to 5-1/2
Real GDP	3-1/4 to 3-3/4	3-1/4 to 3-1/2
PCE price index excluding food and energy	1-1/2 to 2-1/2	1-3/4 to 2
<i>Average level, fourth quarter</i>		
Civilian unemployment rate	5	5

1. Change from average for fourth quarter of previous year to average for fourth quarter of year indicated.

Note: Table is sourced from (The Federal Reserve Board, 2005a).

Figure Five:

	The Federal Reserve Forecast–Central tendency	Actual	Differences
2005:			
<i>Change fourth quarter to fourth quarter</i>			
Real GDP	3-1/2	3.1	Within range
PCE price index excluding food and energy	1-3/4 to 2	2.2	+0.2
<i>Average level, fourth quarter</i>			
Civilian unemployment rate	5	5.0	-
2006:			
<i>Change fourth quarter to fourth quarter</i>			
Real GDP	3-1/4 to 3-1/2	2.6	-0.65 from lower bound
PCE price index excluding food and energy	1-3/4 to 2	2.3	+0.3 from upper bound
<i>Average level, fourth quarter</i>			
Civilian unemployment rate	5	4.4	-0.6

Note: Data for the Federal Reserve Forecast is from (The Federal Reserve Board, 2005a), Data for Real GDP Actual from (FRED, 2020u), Data for PCE Actual from (FRED, 2020q), Data for Unemployment rate Actual from (FRED, 2020ad).

Figure 6a:

Date	S&P 500 Index-Close
August 26 th 2005	1205.1
August 29th 2005- Hurricane Katrina	1212.28 (up)
August 30 th 2005	1208.41 (down)
August 31 st 2005	1220.33 (up)
September 1 st 2005	1221.59 (up)

Note: Data was sourced from (IRESS, 2020f).

Figure 6b: Fiscal Policy Response:

Date	S&P 500 Index- Close
September 1 st 2005	1221.59
September 2 nd 2005- \$10.5 billion contributed to the FEMA	1218.02 (down)
September 6 th 2005	1233.39 (up)
September 7 th 2005	1236.36 (up)
September 8 th 2005	1231.67(down)

Date	S&P 500 Index- Close
September 7 th 2005	1236.36
September 8 th 2005- further \$50 billion to FEMA	1,231.67 (down)
September 9 th 2005	1,241.48 (up)
September 12 th 2005	1,240.56 (down)
September 13 th 2005	1,231.2 (down)

Date	S&P 500 Index- Close
September 20 th 2005	1221.34
September 21 st 2005- Hurricane Katrina emergency tax relief bill	1,210.2 (down)
September 22 nd 2005	1,214.62 (up)
September 23 rd 2005	1,215.29 (up)
September 26 th 2005	1,215.63 (up)

Note: Data was sourced from (IRESS, 2020f).

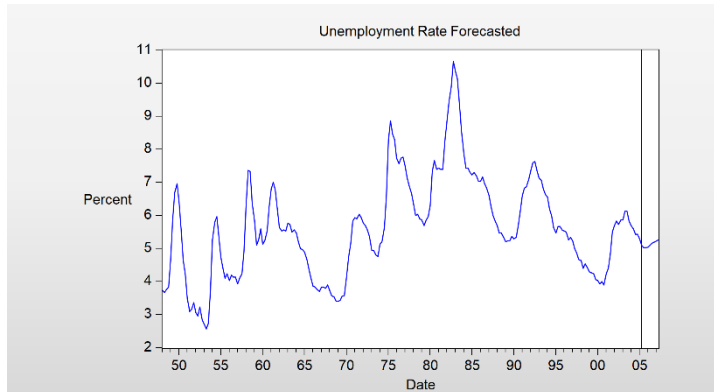
Figure 6c: Monetary Policy Response:

Date	S&P 500 Index- Close
September 19 th 2005	1231.02
September 20 th 2005- Federal Funds rate is raised by 25 basis points to 3.75%	1221.34 (down)
September 21 st 2005	1210.2 (down)
September 22 nd 2005	1214.62 (up)
September 23 rd 2005	1215.63 (up)

Note: Data was sourced from (IRESS, 2020f).

Figure 7a:

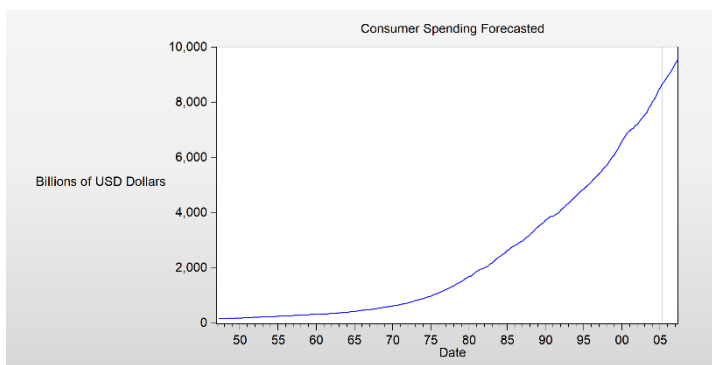
Key Metrics for Unemployment	Values
ARMA model	(3,4) (0,0)
AIC	0.332
Q-Stat value	Q4- 0.307 Q8- 4.279
T-test	4.688



Note: Data was sourced from (FRED, 2020ad).

Figure 7b:

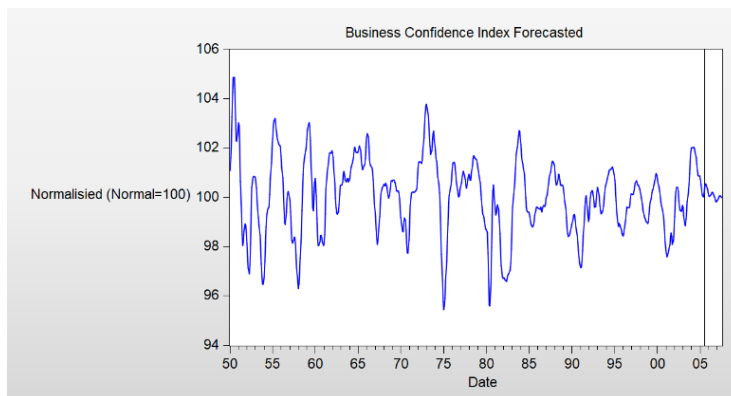
Key Metrics for Log of Consumer Spending	Values
ARMA model	(2,4) (0,0)
AIC	-6.715
Q-Stat value	Q4- 2.077 Q8- 6.298
T-test	-12.727



Note: Data was sourced from (FRED, 2020o).

Figure 7c:

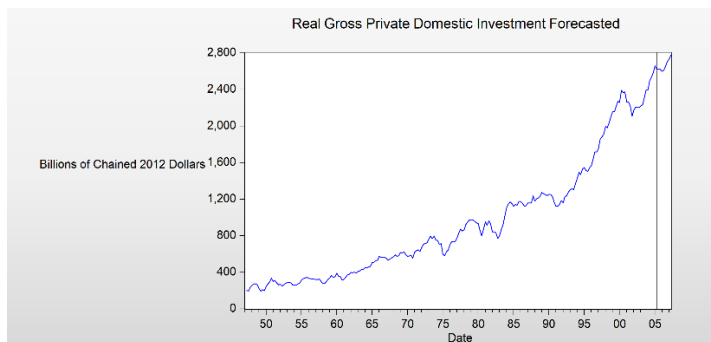
Key Metrics for Business Confidence	Values
ARMA model	(4,4) (2,2)
AIC	-1.331
Q-Stat value	M12- 16.313 M24- 48.983
T-test	-7.322



Note: Data was sourced from (OECD data, 2020).

Figure 7d:

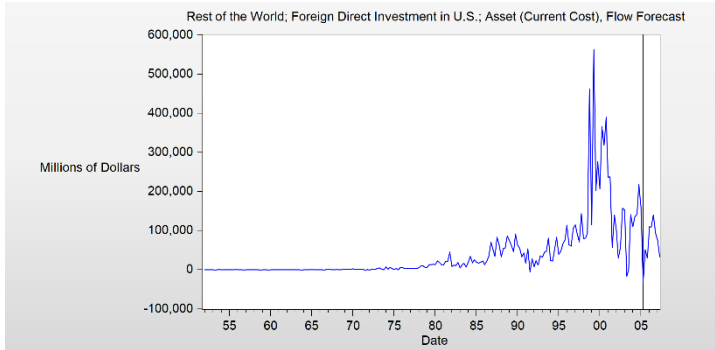
Key Metrics for Log of Investment	Values
ARMA model	(6,6) (0,0)
AIC	-3.300
Q-Stat value	Q4- 2.500 Q8- 2.865
T-test	-1.838



Note: Data was sourced from (FRED, 2020k).

Figure 7e:

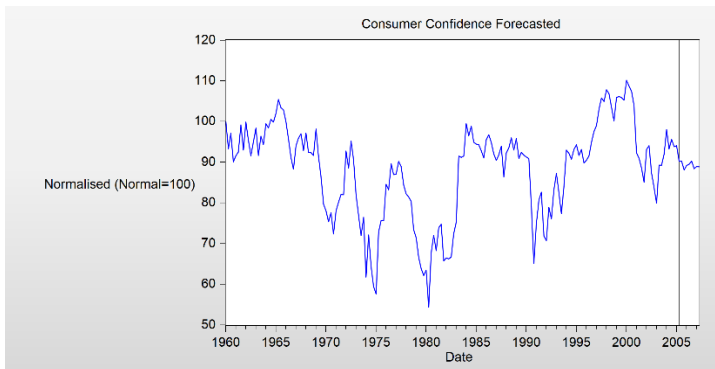
Key Metrics for FDI	Values
ARMA model	(3,4) (0,0)
AIC	24.327



Note: Data was sourced from (FRED, 2020aa).

Figure 7f:

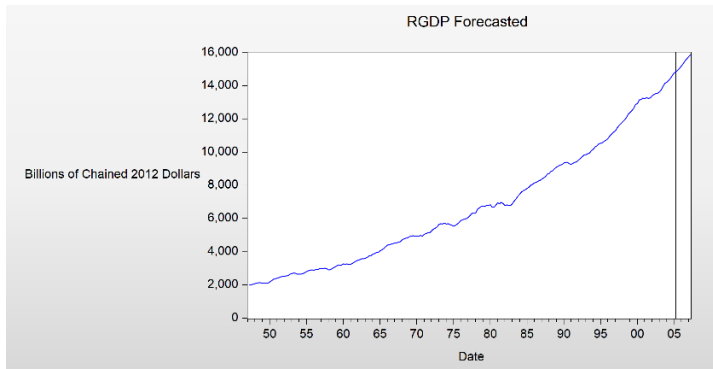
Key Metrics for Consumer Confidence	Values
ARMA model	(4,3) (0,0)
AIC	6.048
Q-Stat value	Q4-0.224 Q8- 1.784
T-test	1.357



Note: Data was sourced from (FRED, 2020ag).

Figure 7g:

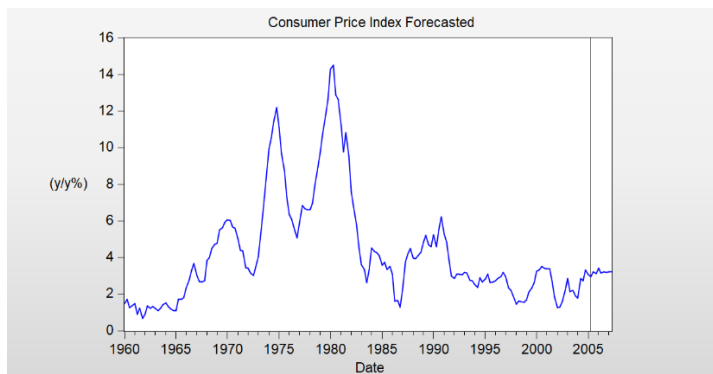
Key Metrics for log of RGDP	Values
ARMA model	(4,3) (0,0)
AIC	-6.545
Q-Stat value	Q4-1.444 Q8- 6.567
T-test	2.281



Note: Data was sourced from (FRED, 2020u).

Figure 7h:

Key Metrics for log of Inflation	Values
ARMA model	(2,4) (0,0)
AIC	-0.859
Q-Stat value	Q4-0.099 Q8- 0.770
T-test	0.060



Note: Data was sourced from (FRED, 2020g).

Figure Eight:

(Provisional Translation)

Outline of the Supplementary Budget for FY2011

- For early restoration from the Great East Japan Earthquake, the expenses which would be required within the current fiscal year is budgeted.
- To maintain confidence of the bond market, financial resource of the Supplementary Budget are secured by reallocation or reduction of predetermined expenditures, not by additional bond issuance.

(Unit: billion yen)

1. Disaster Relief	482.9
(1) Providing temporary housing etc. (Including those provided by the contingency reserve, more than 100,000 temporary housing will be constructed and rented.)	362.6
(2) Contribution of condolence money for bereaved family and consolation payment for disaster victims	48.5
(3) Disaster Assistance Loan	35.0
(4) Livelihood Welfare Fund Loan	25.7
(5) Emergency support to disaster victims (including care for elderly people and infants, medical care in devastated areas)	11.2
2. Disposal of Disaster Waste	351.9
Expenses for disposing disaster waste (debris, etc) caused by tsunami, etc.	

1

3. Public Works in Response to Disaster	1,201.9
(1) Disaster recovery public works	1,043.8
○ Public civil engineering facilities (river, coast, road, port, harbor, and sewage system)	823.5 billion yen
○ Farmlands and agricultural facilities	50.0 billion yen
○ Toll road	49.2 billion yen
○ Repair of existing public housing	46.8 billion yen
○ Airport	23.7 billion yen
○ Others (water supply, industrial water supply, and waste disposal facilities)	50.6 billion yen
(2) General public works	158.1
○ Public housing for disaster assistance	111.6 billion yen
○ Emergency repair of public civil engineering facilities to implement disaster recovery works	46.5 billion yen
4. Rebuilding of Facilities	416.0
(1) School facilities	217.1
○ Rebuilding of school facilities etc.	183.1 billion yen
○ Promotion of earthquake-resistance for school facilities	34.0 billion yen
(2) Social welfare facilities including nursing home, medical facilities, and facilities for disables	84.5
(3) Facilities for agriculture and forestry	35.5
(4) Facilities for police, fire-fighting, and disaster prevention	26.4
(5) Common facilities for SMEs cooperatives associations	19.0 etc.

5. Disaster-related Public Financing Programs	640.7
(1) Loan for rebuilding business and stabilizing management of SMEs (Of which: measures enabling to provide zero-interest loan through local bodies, etc 10.0 billion yen)	510.0
(2) Loan for rebuilding housing devastated by disaster	56.0
(3) Loan for rebuilding business and stabilizing of the Agriculture, Forestry and Fisheries industries	40.0
(4) Low-interest loan for improvement of private school facilities	22.6 etc.
6. Local Allocation Tax Grants	120.0
Increasing special local allocation tax for disaster response as financial resource that local governments can use with discretionary.	
7. Other Disaster-related Spending	801.8
(1) Spending for activities of the Self Defense Forces, fire-fighting, police, and the Coast Guard	259.3
○ Activities of the Self Defense Forces and restoration of SDF facilities etc. 188.6 billion yen	
○ Activities of the Emergency Fire Response Teams 41.4 billion yen	
○ Activities of police 16.4 billion yen	
○ Activities of the Coast Guard 13.0 billion yen	
(2) Special Measures for reduction or exemption of healthcare insurance contribution	114.2
(3) Support to payment of fishing boat insurance and fishermen's mutual aid insurance	93.9
(4) Measures for recovery of fishing grounds and aquaculture facilities	68.1

3

(5) Aid of support for rebuilding disaster victims' life	52.0
(6) Employment	51.4
○Expansion of job creation program in strategic fields 50.0 billion yen	
○Assistance for employment by Job Supporter 0.9 billion yen	
○Contribution of benefit for job change 0.5 billion yen	
(7) School attendance support for affected students	21.9
○School attendance support for affected students 11.3 billion yen	
○Reduction or exemption of tuition for university students, student loan program 7.6 billion yen	
○Sending school counselors 3.0 billion yen	
(8) Measures for electric power supply and demand of companies	17.8
○Promotion of introduction of in-house power generation facilities 10.0 billion yen	
○Measures to restrict power demand 7.7 billion yen	
(9) Measures for stable supply of fuel	13.6
○Support for cash management for gas station 5.1 billion yen	
○Support for early restoration of gas station (repair of tank, etc) 4.6 billion yen	etc.
Total	4,015.3

(Note) Figures may not add up to the totals due to rounding.

4

Note: Table is sourced from (BOJ, 2011b).

Figure 9a:

	Real GDP (y/y %)- Forecasted	Real GDP (y/y %)- Actual	Difference
2011	1.6	0.5	-1.1

Note: Data for Real GDP Forecasted from (BOJ, 2011b), Data for Real GDP Actual from (BOJ, 2020a).

Figure 9b:

	Domestic CGPI (y/y %)- Forecasted	Domestic CGPI (y/y %)- Actual	Difference
2011	1.0	1.4	+0.4

Note: Data for Domestic CGPI Forecasted is from (BOJ, 2011b), Data for Domestic CGPI Actual from (BOJ, 2020b).

Figure 9c:

	CPI (excluding fresh food) (y/y %)- Forecasted	CPI (excluding fresh food) (y/y %)- Actual	Difference
2011	0.3	0.0	-0.3

Note: Data for Domestic CPI Forecasted is from (BOJ, 2011b), Data for CPI Actual from (BOJ, 2020b).

Figure 10a:

Date	Nikkei 225 Index- Close
10 th March 2011-	10,434.38
11 th March 2011- Tohoku Earthquake and Tsunami	10,254.43 (down)
14 th March 2011-	9,620.49 (down)
15 th March 2011-	8,605.15 (down)
16 th March 2011-	9,093.72 (up)

Note: Data was sourced from (IRESS, 2020d).

Figure 10b Fiscal Policy:

Date	Nikkei 225 Index- Close
27 th April 2011	9,691.84
28 th April 2011- Minister of Finance Noda gave a speech on Japans Fiscal Policy response	9,849.74 (up)
2 nd May 2011-	10,004.24 (up)
6 th May 2011-	9,859.20 (down)
9 th May 2011-	9,794.38 (down)

Note: Data was sourced from (IRESS, 2020d).

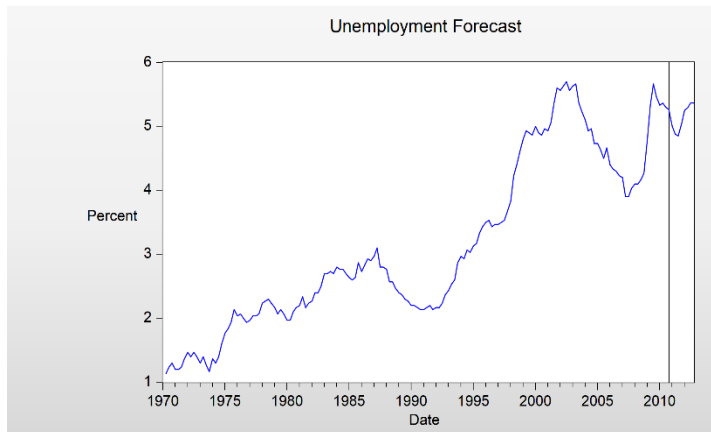
Figure 10c Monetary Policy:

Date	Nikkei 225 Index- Close
11 th March 2011-	10,254.43
14 th March 2011- BOJ Monetary Easing statement	9,620.49 (down)
15 th March 2011-	8,605.15 (down)
16 th March 2011-	9,093.72 (up)
17 th March 2011-	8,962.67 (down)

Note: Data was sourced from (IRESS, 2020d).

Figure 11a:

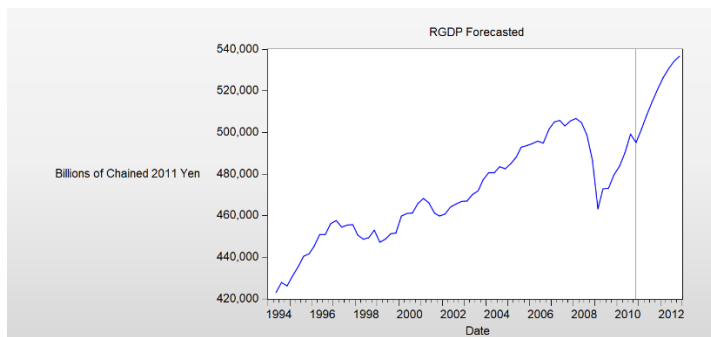
Key Metrics for log of Unemployment	Values
ARMA model	(2,10) (0,0)
AIC	-3.604
Q-Stat value	Q4-0.241 Q8- 2.404
T-test	3.401



Note: Data was sourced from (FRED, 2020ae).

Figure 11b:

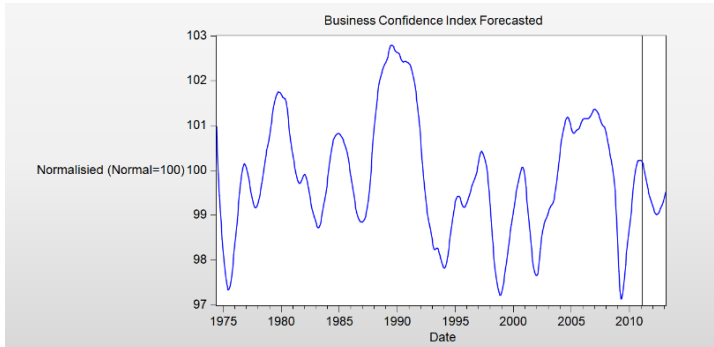
Key Metrics for log of RGDP	Values
ARMA model	(2,3) (0,0)
AIC	-6.297
Q-Stat value	Q4-0.723 Q8- 4.638
T-test	8.234



Note: Data was sourced from (FRED, 2020w).

Figure 11c:

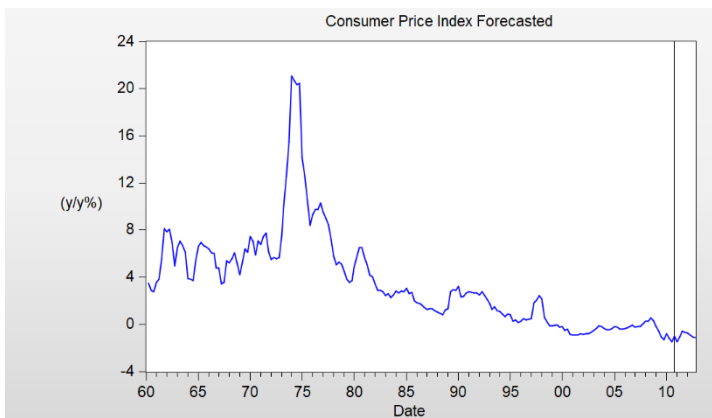
Key Metrics for Business Confidence:	Values
ARMA model	(3,3) (2,2)
AIC	-5.670
Q-Stat value	M12-5.150 M24- 44.905
T-test	-6.426



Note: Data was sourced from (OECD data, 2020).

Figure 11d:

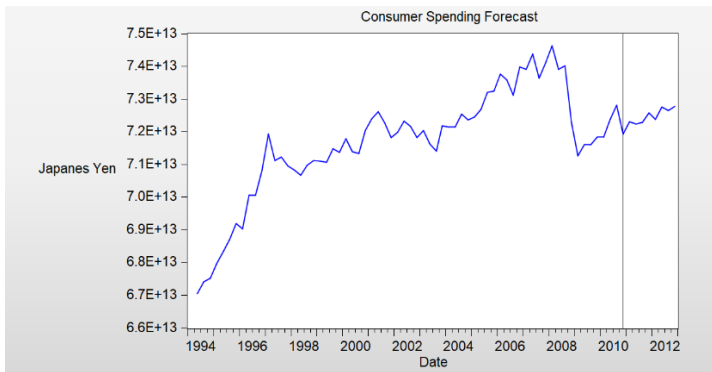
Key Metrics for Inflation	Values
ARMA model	(3,2) (0,1)
AIC	2.167
Q-Stat value	Q4-0.633 Q8- 4.778
T-test	-3.670



Note: Data was sourced from (FRED, 2020d).

Figure 11e:

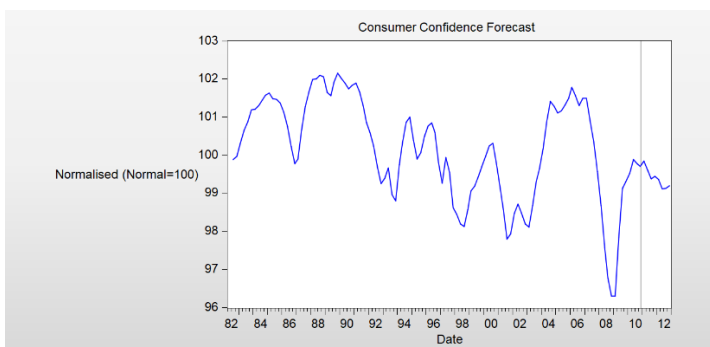
Key Metrics for log of Consumer Spending	Values
ARMA model	(2,2) (0,0)
AIC	-7.080
Q-Stat value	Q4-2.542 Q8- 3.876
T-test	1.813



Note: Data was sourced from (FRED, 2020s).

Figure 11f:

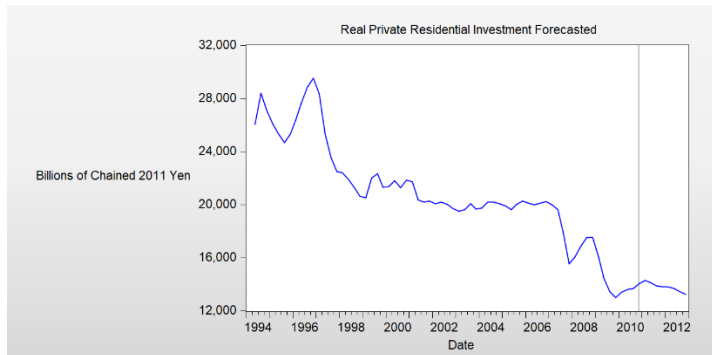
Key Metrics for Consumer Confidence	Values
ARMA model	(4,4) (0,0)
AIC	0.543
Q-Stat value	Q4-1.111 Q8- 3.405
T-test	1.477



Note: Data was sourced from (FRED, 2020b).

Figure 11g:

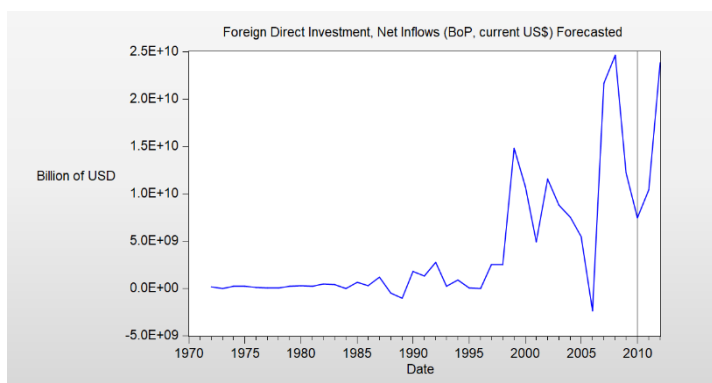
Key Metrics for Investment	Values
ARMA model	(3,4) (0,0)
AIC	16.057



Note: Data was sourced from (FRED, 2020z).

Figure 11h:

Key Metrics for FDI	Values
ARMA model	(4,3) (0,0)
AIC	47.433



Note: Data was sourced from (World Bank, 2020d).

Figure 12:**Table 2.2** – Impact on operating expenses of earthquake costs (years ended June)

Accrual expenses \$million	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	Total
Local infrastructure	789	59	78	79	79	78	1162
State-owned assets (schools etc)	25	45	15				85
Welfare support and emergency response	457	52	6	6			521
AMI Insurance contingency	427	18	18	18	19		500
Yet to be allocated	1111	1492	234	166	165	71	3239
Total Canterbury Earthquake Recovery Fund	2809	1666	351	269	263	149	5507
EQC	3050						3050
ACC	181						181
Other SOE and CE costs	40						40
Total Crown	6080	1666	351	269	263	149	8778

Figure 13a:

	Real GDP (annual average % change)- Forecasted	Real GDP (annual average % change)- Actual	Difference
Mar-11	1.7	1.6	-0.1

Note: Data for Real GDP Forecasted from (RBNZ, 2010), Data for Real GDP Actual from (RBNZ, 2020g).

Figure 13b:

	CPI (y/y%)- Forecasted	CPI (y/y%)- Actual	Difference
Mar-11	1.5	4.5	+3
Jun-11	2.3	5.3	+3
Sep-11	2.0	4.6	+2.6
Dec-11	1.9	1.8	-0.1

Note: Data for CPI Forecasted from (RBNZ, 2010), Data for CPI Actual from (RBNZ, 2020f).

Figure 13c:

	Unemployment rate (%) - Forecasted	Unemployment rate (%) - Actual	Difference
Mar-11	6.4	6.0	-0.4
Jun-11	6.4	6.0	-0.4
Sep-11	6.2	5.9	-0.3
Dec-11	5.8	6.0	+0.2

Note: Data for Unemployment rate Forecasted from (RBNZ, 2010), Data for Unemployment rate Actual from (RBNZ, 2020c).

Figure 14a:

	NZX 50 Index- Close
21 st February 2011-	3,381.932
22 nd February 2011- Christchurch Earthquake	3,358.706 (down)
23 rd February 2011	3,372.069 (up)
24 th February 2011	3,368.353 (down)
25 th February 2011	3,363.914 (down)

Note: Data was sourced from (IRESS, 2020e).

Figure 14b: Fiscal Policy Response:

	NZX 50 Index- Close
17 th March 2011-	3,329.587
18 th March 2011- Fiscal Support Announcement	3,339.509 (up)
21 st March 2011-	3,348.365 (up)
22 nd March 2011-	3,365.225 (up)
23 rd March 2011-	3,375.79 (up)

Note: Data was sourced from (IRESS, 2020e).

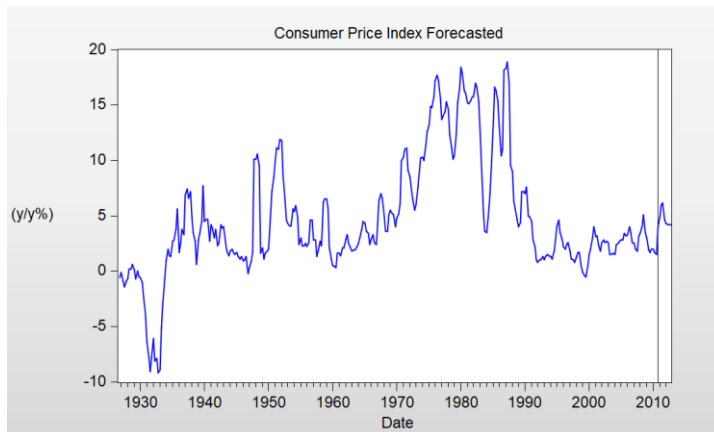
Figure 14c: Monetary Policy Response:

	NZX 50 Index- Close
9 th March 2011-	3,414.424
10 th March 2011- RBNZ OCR Announcement	3,406.235 (down)
11 th March 2011-	3,382.841 (down)
14 th March 2011-	3,361.197 (down)
15 th March 2011-	3,314.137 (down)

Note: Data was sourced from (IRESS, 2020e).

Figure 15a:

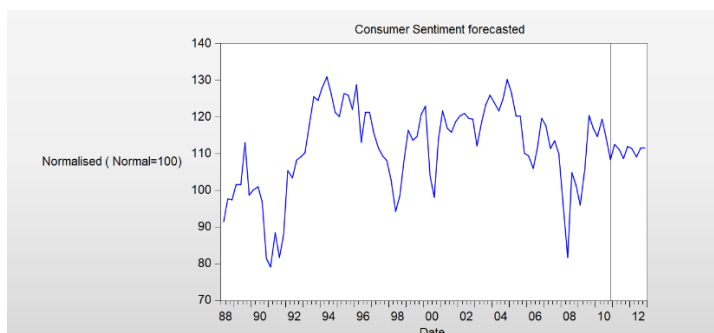
Key Metrics for Inflation	Values
ARMA model	(1,4) (0,0)
AIC	3.061
Q-Stat value	Q4- 3.902 Q8- 10.180
T-test	5.332



Note: Data was sourced from (RBNZ, 2020f).

Figure 15b:

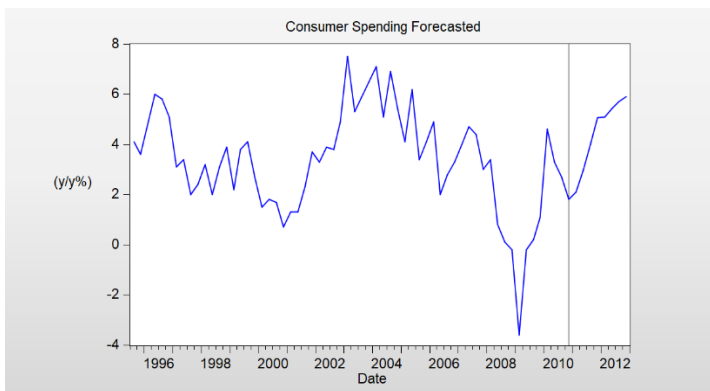
Key Metrics for Consumer Confidence	Values
ARMA model	(3,2) (0,0)
AIC	6.735
Q-Stat value	Q4- 2.186 Q8- 6.436
T-test	2.671



Note: Data was sourced from (FRED, 2020n).

Figure 15c:

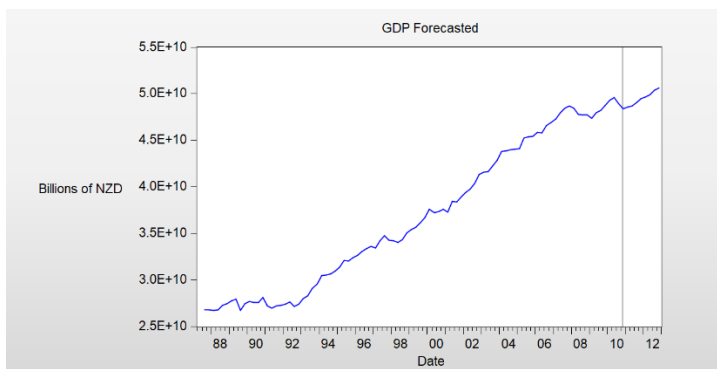
Key Metrics for Consumer Spending	Values
ARMA model	(2,2) (0,1)
AIC	3.345
Q-Stat value	Q4- 3.370 Q8-5.776
T-test	3.707



Note: Data was sourced from (RBNZ, 2020a).

Figure 15d:

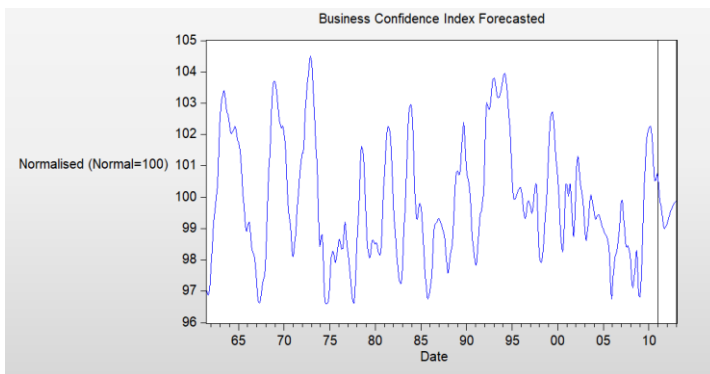
Key Metrics for log of GDP	Values
ARMA model	(2,3) (0,0)
AIC	-5.929
Q-Stat value	Q4- 3.168 Q8-6.259
T-test	-15.520



Note: Data was sourced from (FRED, 2020i).

Figure 15e:

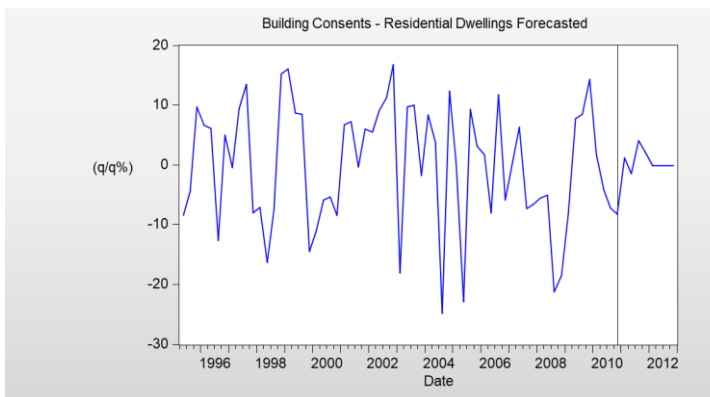
Key Metrics for log of Business Confidence	Values
ARMA model	(4,2) (1,2)
AIC	-12.449
Q-Stat value	M12-71.017 M24-101.06
T-test	-13.238



Note: Data was sourced from (OECD data, 2020).

Figure 15f:

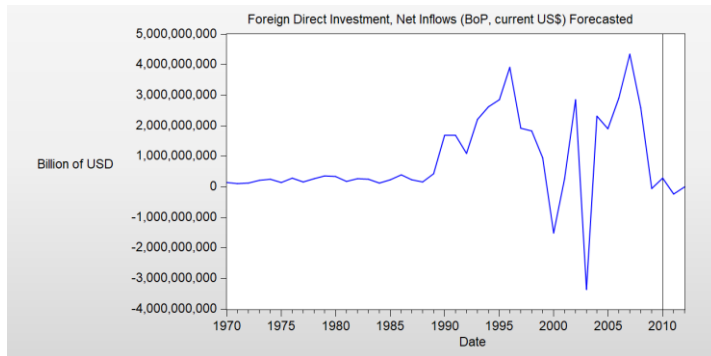
Key Metrics for Investment	Values
ARMA model	(0,4) (0,0)
AIC	7.473
Q-Stat value	Q4- 2.559 Q8-4.843
T-test	-0.823



Note: Data was sourced from (RBNZ, 2020b).

Figure 15g:

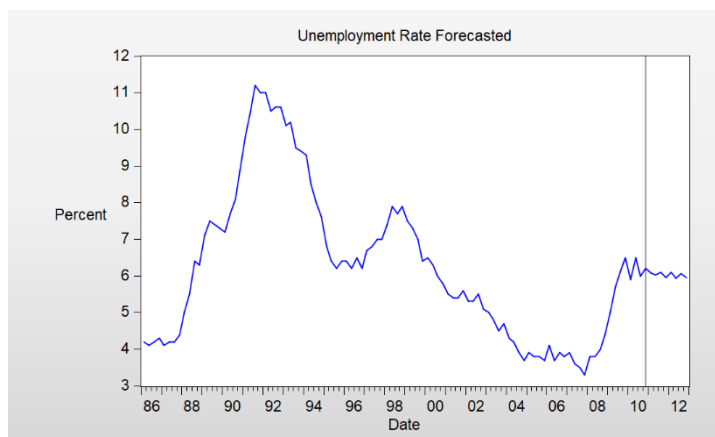
Key Metrics for FDI	Values
ARMA model	(0,3) (0,0)
AIC	44.986



Note: Data was sourced from (World Bank, 2020e).

Figure 15h:

Key Metrics for Unemployment	Values
ARMA model	(4,1) (0,0)
AIC	0.639
Q-Stat value	Q4- 0.181 Q8- 1.294
T-test	-1.557



Note: Data was sourced from (FRED, 2020af).

Chapter Four: Terrorist Attacks

This chapter will explore terrorist attacks, for each attack the context of the event will be explored to provide an understanding of the nature and scale of the event. Next, the economic policy response implemented post the event will be examined followed by the empirical results. Analysis will also be provided on other relevant economic factors at the time to provide a holistic study on the impact the exogenous event and economic policy response had on the key macroeconomic variables over the time period studied. These findings will then be referenced later in the thesis when comparing and contrasting all exogenous events and providing value assessments and recommendations on policy responses.

The table below provides a summary of the three terrorist attacks studied. The terrorist attacks chosen to be analysed had a range of impacts and targets to allow for a holistic analysis.

Event	Date of Terrorist Attack	Number of Deaths	Monetary Policy Response	Fiscal Policy Response
September 11th - America	September 11 th 2001	2,977 people	Expansionary monetary policy response.	Expansionary fiscal policy response.
Madrid Bombings- Spain	March 11 th 2004	193 people	No response taken.	No response taken.
Parris Terrorist Attacks-France	November 13 th 2015	130 people	No direct response taken.	No response taken.

Note: Information for 9/11 sourced from(CNN Editorial Research, 2019b), Information for Madrid Bombings sourced from (CNN Editorial Research, 2020), Information for Paris Terrorist Attacks sourced from (CNN Editorial Research, 2019a).

September 11th Terrorist Attacks:

America faced the most devastating terrorist attacks in the country's history on September 11th, 2001. The attack was organised by Al Qaeda leader, Osama bin Laden and targeted the World Trade Centre, Pentagon and one plane crashed into a field in Pennsylvania. The attack resulted in a significant loss of human life and had impacting economic consequences. The occurrence of September 11th changed and influenced America in many ways. Including America was at war for several years as a form of retaliation, which in itself had significant economic implications. However, as has been previously mentioned the analysis of this research is focused on the short term and direct economic responses to the disaster. Therefore, the direct economic response to 9/11 will be analysed within this research rather than the long-term secondary cost of the war as well. As will be explained 9/11 resulted in a supply side shock through its key disturbances to financial systems and air travel, as well as temporary demand side shocks, specifically to particular tourism industries including air transport and hotels (Werling & Horst, 2009).

The target of the attack was on the financial sector which added further economic complications. The financial industry suffered a significant loss of life, 74 percent of the casualties occurred within the World Trade Centre (Johnston & Nedelescu, 2006). Specifically, the loss of key personnel such as the largest interdealer broker, Cantor Fitzgerald, resulted in substantial impact to the government securities market (Johnston & Nedelescu, 2006). In addition, key trading infrastructure was destroyed, including damage to communication systems of the Bank of New York and J.P Morgan Chase which were the key banks involved in the process of clearing government securities. These key banks main operations were in close proximity to the World Trade Centres and therefore had to relocate to backup sites after the attack, which caused delays and significant economic ramifications (Johnston & Nedelescu, 2006).

Additionally, the attack resulted in large scale suspension of flights, thereby impacting the ability to clear cheques which in itself had adverse ramifications (Neely, 2002). Several financial markets closed for the remainder of the week including the New York Stock Exchange to prevent investment panic. The attacks created extensive fear for individuals, resulting in many to withdrawal their money from the bank and move their monetary assets from riskier assets like stock and bonds to less risky and more liquid assets such as checking accounts (Neely, 2002).

Fiscal policy was a tool used by the American government to respond to the terrorist attacks. Firstly, on the 18th of September America Congress introduced the \$40 billion emergency appropriation bill to fund relief efforts to the terrorist attacks ("PUBLIC LAW 107-38—SEPT. 18, 2001," 2001). This bill was funded through deficit financing and was estimated that approximately \$11.2 billion of the \$40 billion in the emergency bill was focused on the recovery in New York City (Makinen, 2002). Furthermore, on the 21st of September America Congress passed an aid package for airlines totalling \$5 billion and \$10 billion in loan guarantees (CNN, 2001). This was the direct fiscal policy response taken in the short term as a response to 9/11. However additional support programs were introduced, including prior to the crisis the American government was planning to enhance an expansionary fiscal policy as there was already the presence of an economic slowdown. Therefore on the 9th of March 2002, the Job Creation and Worker Assistance Act of 2002 was implemented (Makinen, 2002). This program introduced support including a 30% bonus depreciation for property placed in the damaged zone, the cost of this initiative estimated to total \$1.6 billion (Makinen, 2002). In addition, there was an expansion of the Work Opportunity Tax Credit for employers in New York City estimated to total \$631 million (Makinen, 2002).

The Federal Reserve also implemented an expansionary monetary policy. On the 17th of September 2001, the FOMC announced a reduction in the federal funds rate by 50 basis point to three percent (Federal Reserve, 2001). In addition, there was a reduction in the discount rate by 50 basis points to 2.5 percent (Federal Reserve, 2001). The Fed provided emergency liquidity by purchasing a significant proportion of US Treasury securities in its entirety and through repurchase agreements to restore confidence. The Federal Reserve ensured stability with foreign banks by providing swap lines with the ECB, BOE and Bank of Canada to ensure these banks could provide resources in US dollars, thereby ensuring liquidity (Neely, 2002). Furthermore, within this announcement the Federal Reserve acknowledged that the actual federal funds rate could be below its target on occasion, as the Federal Reserve plan was to continue to supply uniquely large volumes of liquidity into the financial markets to restore confidence and ensure the functionality of the markets (Federal Reserve, 2001). Within this announcement the FOMC acknowledged that such actions were necessary as even prior to the occurrence of 9/11 economic conditions signalled a down turn in key macroeconomic factors, hence the occurrence of 9/11 was only likely to dampen spending further (Federal Reserve, 2001).

Figure 16a shows the extract of the Monetary Policy Report that the Federal Reserve created and distributed to congress prior to September 11th, on February 13th 2001. Figure 16b shows the actual values for 2001. The Federal Reserve central tendency value for expected Real GDP was 2 to 2-1/2, however the actual value of RGDP from fourth quarter to fourth quarter was 0.2 in 2001. In addition, the Federal Reserve predicted the central tendency of the civilian unemployment rate to sit around 4 ½ percent, however the actual civilian unemployment rate was 5/5 percent in 2001. Notably there was not as prevalent of discrepancies between the forecasted and actual values for the personal consumption expenditure (PCE) chain type price index. The central tendency forecasted figures included the range of 1.75- 2.25 and the actual value of PCE chain type price index sat just to the left of this range, with a value of 1.7.

In response to 9/11 the stock markets were shut for the remainder of the week, Figure 17a shows over the three trading days post the attack the S&P500 dropped seven per cent compared to the closing value the day prior to the attack. Over the five trading days post the attack the S&P 500 fell by a combined 11.6% (Anonymous, 2011). Therefore whilst this was a market correction the loss was only felt in the short term, within a month the Dow Jones, S&P, Nasdaq and Russell 2000 all recovered to pre 9/11 levels (Nasdaq, 2011). Overall, arguably all the actions taken by the Federal Reserve provided calamity to the markets as on the 17th of September, the stocks experienced the largest trading volume ever to occur over one day, a total 2 billion shares were traded (Federal Reserve Bank of San Francisco Economic Education, 2012). Figure 17b and 17c shows the closing values for the S&P500 after the fiscal and monetary policy announcements. Both fiscal and monetary policy responses were implemented directly after the disaster and therefore as previously mentioned there was a decline in closing values during this period. Hence showing that the announcements did not result in any significant immediate improvement in stock market figures. All the subsections under Figure 18 shows the empirical results for September 11th, the same discussion regarding choice and use of data as previously mentioned applies in this context. The macroeconomic variables that produced abnormal values with a statistically significant t-test value at the 5% level was consumer spending, investment, unemployment and inflation.

Consumer spending produced abnormal values with a statistically significant t-test value. As shown in Figure 18a an ARMA model of (4,2) (2,2) was used for the log values of consumer spending to produce forecasted figures. The Q-stat values indicate the residuals are white

noise. The abnormal returns were calculated with a t-test value of 5.056 hence statistically significant at the 5% level. As seen by the forecasted graph, consumer spending has continued to increase historically with an exponentially increasing curve. The forecasted values predicted this trend to continue. However, the actual values showed that whilst consumer spending did increase throughout the two-year period, it did so at a smaller rate than what was predicted in the forecasted values. Evidentially clearly the occurrence of September 11th did not result in any substantive decrease in consumer spending nationwide after the attack, however there is suggestion there was a slowdown in nationwide consumption compared to expected figures over the two-year period.

Figure 18b shows the empirical results for investment. The ARMA model of (3,3) (0,2) was used to forecast the log of investment. The Q-stat values indicate the residuals are white noise. The abnormal returns were calculated producing a t-test value of 5.481 hence statistically significant at the 5% level. As seen in the graph investment had clear fluctuations, but the trend historically shows an exponentially increasing trend particularly from 1980-2000. Prior to the third quarter of 2001 there was a decline in investment. As shown in the graph, forecasted values predicted this decline to continue and an eventual rise and return to pre dipped figures to occur within the two-year period. Contrastingly the actual values showed that investment levels declined more substantially than predicted for the third and fourth quarter of 2001. Additionally, the overall increase in investment figures for the remainder of the two-year period was significantly less than forecasted and did not reach to equivalent investment levels seen before the attack. Therefore, clearly investment levels were impacted directly after the attack and slow recoveries were made.

Figure 18c shows the data for unemployment, the ARMA model of (4,4) (0,0) was used to forecast the unemployment figures. The Q-stat values indicate the residuals are white noise. The abnormal returns were calculated producing a t-test value of -9.583 hence statistically significant at the 5% level. The forecasted graph shows clear fluctuations in the unemployment figures historically, with peaks shortly followed by dips. Prior to September 11th the unemployment rate was on a downward trend with beginning stages of an upward movement and the forecasted values predicted this upward movement would continue with a levelling off period occurring in the later quarters of the two-year forecasting period. However, the actual figures showed a substantial increase in unemployment rates for the quarter during September 11th and the last quarter of 2001. For the remainder of the two-year

period there was an overall gradual incline in the unemployment rate at levels higher than what was forecasted and levels above unemployment figures before the attack.

The empirical results for inflation are shown in Figure 18d, the ARMA model of (2,4) (0,0) was used to produce the forecasted values for the log of inflation. The Q-stat values indicate the residuals are white noise. The abnormal returns were calculated with a t-test value of 6.869 hence statistically significant at the 5% level. The forecasted graph predicted CPI to have a slight increase and then level off over the two-year period. However, the actual values showed that instead there was a steady decline in CPI until the second quarter of 2002 where a slight increase and fluctuation occurred for the remainder of the 2-year period. However, inflation levels never reached to equivalent inflation level pre the terrorist attack. Clearly even despite the reduction in the federal rate, there was still a significant impact on CPI during the two-year period with a sizeable drop occurring in the quarter that the terrorist attack took place.

Figure 18e contains the empirical results for FDI. Whilst the ARMA model of (4,4) (0,0) had the lowest AIC value compared to all other ARMA models tested, it produced a value of 23.925. This is a relatively large AIC value compared to other models hence impacting the validity of statistically significant conclusions being made from the abnormal returns.

Therefore, just looking at the actual values there was a significant drop in FDI into America the quarter that September 11th occurred, however there was quick recoveries made in the last quarter of 2001. Yet this recovery was short-lived with a decline in FDI occurring over the first two quarters of 2002.

Consumer confidence abnormal values did not produce a statistically significant t-test value. As seen in Figure 18f, consumer confidence had significantly fluctuated historically and prior to September 11th consumer confidence was on a downward trend. The forecasted figures predicted this downward trend in consumer confidence to continue and then predicted a recovery in confidence rates within the two-year period. The actual values showed a similar trend, there was a significant decline in consumer confidence for the quarter during the September 11th attack, dropping to 88.6 and this decline continued through to the last quarter of 2001. However, there was a quick recovery in the beginning half of 2002, with confidence levels being 93.1 in the first quarter of 2002, higher than confidence levels prior to the attack, there was fluctuating trends thereafter. Therefore, whilst consumer confidence dropped

around the time of September 11th, there was not a significant difference from what was expected in forecasted figures when not accounting for the occurrence of September 11th.

Figure 18g shows the empirical results for RGDP, the AMRA model of (4,3) (0,0) was chosen as best fit. However, looking at the Q statistic values and the correlogram there is insignificant evidence to suggest the residuals are white noise. Thereby impacting the reliability of using forecasted figures to calculate abnormal returns and in turn interpret the t-test value. Therefore, instead just looking at the actual values, the graph shows historically RGDP has steadily increased. The actual values showed there was a decline in RGDP for the third quarter of 2001 and then a gradual increase to RGDP levels greater than values before the attack. Clearly the terrorist attack had some impact on the growth of RGDP in the quarter of the event and whilst recoveries were made, growth was slowed. Notably other key factors at the time such as the economic downturn pre-existing in America prior to September 11th would have also impacted RGDP levels.

The empirical results for business confidence can be seen in Figure 18h, the ARMA model of (4,2) (2,2) was chosen as best fit. However, looking at the Q statistic values and the correlogram there is insignificant evidence to suggest the residuals are white noise. Thereby impacting the reliability of using forecasted figures to calculate abnormal returns and in turn interpret the t-test value. Therefore, instead just looking at the actual values, the graph shows that there had been clear fluctuations around the 100 mark historically. Evidentially prior to September 11th there was a substantial fall in business confidence and the beginnings of a gradual increase. Business confidence declined in September and October 2001, then there was significant fluctuation in confidence levels over the remaining two-year period. Notably business confidence levels did reach to higher levels than values pre the attack, however clearly there was an impact to business confidence levels after September 11th and there was uncertainty within the two-year period.

Notably the empirical results show an adverse impact occurred directly after the attacks to the majority of the macroeconomic variables. Furthermore, for some of the macroeconomic variables the empirical evidence suggests the adverse impacts remained prolonged over the two-year period. Therefore, as previously mentioned whilst one cannot directly pinpoint the precise impact policy played on the macroeconomic variables, analysis can be made at the holistic level. Firstly, it is important to note, that September 11th occurred when America was already in a recession, therefore there was adverse impacts already occurring to the

macroeconomic variables analysed (Makinen, 2002). In addition, some of the fiscal policies implemented in response to 9/11 were extended to include the wider economy, to address the negative impacts occurring as a result of the recession. Specifically seen with unemployment benefits, initially legislation was introduced to help those directly impacted by 9/11, however the time frame and for those who it was applicable to, extended to those unemployed in highly unemployed states as well (Makinen, 2002). Overall, many argued at the time the response to September 11th showed the benefits of implementing a monetary policy over fiscal policy, as there were clear lags with September 11th fiscal policy response (Makinen, 2002).

Whilst the emergency expenditures were deployed quickly, the stimulus bill for September 11th was not signed into law until March 9th 2002 and the amount of the stimulus was significantly less than what either party intended it to be (Makinen, 2002). The inefficiencies in Americas government, specifically with congresses ability to restrict President's emergency budgetary requests has key impacts on the effectiveness of fiscal policy. Overall, whilst there was evidence of adverse impacts to key macroeconomic variables within the empirical analysis, many claimed that the economy rebounded quickly to the attack given the fact that the economy was facing an economic recession at the time (Makinen, 2002). It has been argued that any attack on the US economy totalling USD \$10 trillion at the time would only have a significant prolonged effect to the nation-wide economy if there were significant indirect effects (Makinen, 2002). However, as previously discussed, confidence levels remained/ recovered in the two-year period, thus whilst there was undoubtedly a confidence shock nationwide in the immediate aftermath of the attack, normality in some areas and to some degree was resumed. Arguably normality could have been resumed quicker if the inefficiencies in the economic policy responses was not present, further discussions regarding this subject will be made later in the thesis.

Paris 2015 Terrorist Attacks:

The November 2015 Paris terrorist attack was claimed responsibility by ISIS. The terrorist attacked six locations across Paris with the use of assault rifles and explosives. The attack occurred during an already struggling Eurozone. The attack did not result in any significant supply side shock as seen under September 11th attacks in America. However, many predicted that the attack would have a significant impact on confidence, consumer spending and tourism within France thereby resulting in a demand side shock (Ewing, 2015). Tourism

makes up a significant proportion of the French economy, eight percent, and Paris is the hub of tourism in France (Jolly et al., 2015). Therefore, there was the fear at the time that if additional attacks occurred it could prolong recovery and keep international tourists away for longer, making households reluctant to spend. In turn, impacting the thousands of jobs in the tourism industry and the subsequent adverse economic consequences that come as a result of these job losses (Jolly et al., 2015). The ECB itself specifically acknowledged that the attack could dampen consumer spending which was already a significant factor prolonging economic recovery for the Eurozone (Ewing, 2015).

Additionally, many feared that the nature of the attack targeting an everyday location could add to the psychological fear that no one feels safe anywhere, hence exacerbating consumer confidence and in turn consumer spending levels (Jolly et al., 2015). The ECB chief economist stated at the time that policy makers would carefully watch consumer confidence figures post the Paris attack (Ewing, 2015). Peter Praet, former chief economist and board member at the ECB stated that, “Usually these sorts of events have a transitory effect on the economy so this is not a priori a reason to change the way we see the evolution of the European economy. It’s also true on the other hand that we have a fragile cyclical recovery, fragile with downside risk, and it’s clear these sorts of events do not help restoring confidence in the recovery, so this is something we will watch” (Ewing, 2015, p. 1).

Therefore many believed that the occurrence of the attacks in Paris would lead to the ECB to enhance their monetary policy easing approach (The Guardian, 2015). This is because the day before the Paris attack the head of the ECB Mario Draghi, flirted with the idea that the ECB may continue to buy bonds beyond late 2016. In addition he suggested the idea of increasing the number of bond purchases per month and expanding the list of bonds the ECB would buy (Pisani, 2015). Additionally, economists Chris Scicluna and Mantas Vanagas at Daiwa Capital Markets stated, “Friday evening’s events in Paris we suspect that the ECB will now want to pull out all the stops in its easing, with a rate cut and extra QE now more likely to be on the cards” (Ewing, 2015, p. 2). After the event Mario Draghi explicitly stated that in short, the ECB does not know what impact the Paris attacks would have on the Eurozone economy, stating that, “The future is full of geopolitical risks. That is why there is confidence, but there is no complacency” (ECB, 2015a).

On the 3rd of December 2015, the ECB announced the following steps in pursuit of achieving monetary and economic objectives. This included lowering the interest rate on deposit facility

by 10 basis points to -0.3% (ECB, 2015b). In addition, extension was made to the asset purchasing programme (APP) with the monthly purchases of €60 billion extended to occur until at least the end of March 2017 (ECB, 2015b). In line with this, the ECB announced plans of reinvesting the principal payments on the securities purchased under the APP as they mature for as long as is deemed necessary (ECB, 2015b). Therefore, whilst the ECB did not take any direct monetary policy reaction to the Paris attacks, it was arguably a contributing factor to their decision to further advance expansionary monetary policy response. However, many argued that it was not enough and the APP easing should have been increased in monetary value as well (Ewing, 2015).

The French government did not implement any significant fiscal policy package in response to the attack. There was direct support given to victims impacted by the attacks, including financial and health support to name a few (Agence France Trésor's, 2015). In addition, on the 23rd of November the prime minister, foreign minister and minister for foreign trade with representatives from tourist sectors met to develop an action plan (Agence France Trésor's, 2015). Spending was distributed to ensure the safety for French citizens and tourists to restore confidence and financial support was given to key sectors in the tourism industry, including hotel owners (Agence France Trésor's, 2015).

Figure 19a shows extracts from the Banque de France (BDF), economic projections for 2015 and 2016 and subsequent economic projections in later years shows the actual value of economic projections for these years. Both the years of 2015 and 2016 were analysed as the terrorist attack occurred mid-way through November, hence inclusion of both years allows for greater analysis of the initial impact of the exogenous event. Figure 19b shows the differences between forecasted and actual values, for 2015 several key indicators showed no difference between forecasted and actual values. Values that had slight differences included Harmonised Index of Consumer Prices (HICP) which was forecasted to be 0.3 and the actual value was 0.1, additionally total investment was forecasted for 0.7 and actual figures showed 0.9, lastly the actual value for unemployment rate was slightly higher, 0.1 greater than what was forecasted. The year 2016 held greater differences between forecasted and actual values, however notably greater weight is placed on the 2015 year as the aim is to measure the short-term impact of the event. In 2016 both HICP and HICP excluding energy and food was at least half the value less than what was forecasted. In addition, Real GDP had a forecasted value of 1.8 but an actual value of 1.1 in 2016. Contrastingly private consumption, total

investment and real household disposable income, all had greater actual values than what was forecasted with the unemployment rate remaining the same.

Figure 20a depicts how the CAC40, reacted after the attacks in Paris. A notable mention is that the Paris attack took place in the evening, hence after the markets closed. The first day after the attack the market was only down 1% from the closing value on the day prior to the attack. Moreover, on the second day post the attack, the markets closed on an upward figure and on the third day the markets closed down again but was above the closing value on the day before the terrorist attacks. Therefore, there was no significant impact on the French stock market after the terrorist attacks. However, there were specific industries that took a noticeable hit, including Air France-KLM was down six percent and French company AccorHotel's stock was down nearly five percent on the Monday after the attack (Jolly et al., 2015). Figure 20b shows how the market reacted to the ECB monetary policy announcement which occurred shortly after the terrorist attack, similar behaviours were repeated. Overall, the markets were down 4.6 percent from the closing value on the day prior to the announcement, therefore no significant adverse impact.

Overall, the markets did not react significantly to the Paris attacks. Many argue this occurred because stocks were oversold at the time, with a predominant proportion of Europe and America already down three percent at the time of the attacks (Pisani, 2015). Furthermore, knowledge from previous terrorist attacks show that consumer spending is more postponed rather than abandoned, hence the impact is short lived and investors take this into consideration (Pisani, 2015). In addition, President of Heritage Capital stated that, "Markets continue to price in future terrorist attacks at an increasing rate since 9/11, and that's not to say the markets are complacent, but they're adjusting and adapting to the new reality of being at constant war against an unconventional enemy" (Benjamin, 2015, p. 1) Therefore, arguably as terrorist attacks continue to occur, investors and individuals are getting used to the occurrence of such events, hence limiting the economic impact of these exogenous shocks (Benjamin, 2015).

All the subsections under Figure 21 shows the empirical results for the 2015 Paris Attacks. The macroeconomic variable that produced abnormal values that produced statistically significant t-test values at the 5% level was consumer confidence. Figure 21a shows the empirical results for consumer confidence, the ARMA model of (4, 4) (0,0) was used to produce forecasted values for the log of consumer confidence. The Q-stat values indicate the

residuals are white noise. The abnormal returns were calculated and produced a t-test value of -4.827 which is statistically significant at the 5% level. As evident in the forecasted graph, there has been clear fluctuations in consumer confidence around the 100 mark, and historically a peak has been followed by a dip. Prior to November 2015, consumer confidence was on an upward trend and the forecasted values predicted that consumer confidence would decline in the forecasted two-year period. However, the actual values saw a contradiction to this, there was an increase in confidence levels for the last quarter of 2015, the quarter the attack took place. There was a slight decline in consumer confidence levels for the first two quarters of 2016, then a gradual increase in consumer confidence levels. Therefore, clearly the Paris attack did not have a significant adverse impact on consumer confidence levels, with actual values outstripping forecasted values.

Notably in 2016 when consumer confidence declined, terrorist attacks were continuing to occur across the Eurozone, including the Brussels bombings, thus this could be a contributing factor to the decline (Bremmer, 2015). Arguably the attacks further heightened travel fears across Europe. Additionally, as previously mentioned the randomness of the attacks added to the fear caused by the terrorist attacks, in turn impacting consumer confidence levels (Bremmer, 2015). Earlier in 2015 France suffered with the Charlie Hebdo attacks which had a clear political message behind the attack (Bremmer, 2015). However, the randomness of the November attacks and subsequent attacks throughout Europe clearly portrayed that no one is safe anywhere, regardless of your background or political ideologies (Bremmer, 2015). However, on the other hand, as showed within the data, Frances consumer sentiment remained stable after the 2015 attack which many argue is attributed to the increased frequency of such attacks. Senior economist at HIS Global Insight, Diego Iscaro, argues “Unfortunately, France has suffered several terrorist incidents since the start of 2015 and, the more frequent they become, the weaker the impact of each attack is likely to be” (Schulze, 2016).

Business confidence empirical results are shown in Figure 21b. The chosen model was an ARMA model of (4,4) (1,1). However, notably the AIC value for this model is -11.973 which is relatively large compared to other models. In addition, looking at the Q-stat value, whilst there is evidence to suggest the residuals are white noise this confidence declines with an increase in lags. Hence these two factors combined creates concerns surrounding the validity of forecasts made. Instead, just looking at the actual results, the graph shows business confidence has had clear fluctuations around the 100 mark historically within France. Prior to

the November Paris attacks, there was an upward fluctuating trend in business confidence. The actual figures showed no significant decline in business confidence after the attacks, rather a gradual incline until February 2016 where a fluctuating trend began thereafter. Overall, over the two-year period business confidence was back to levels pre the Paris attack. Therefore, clearly the attack did not have a significant adverse impact on business confidence levels.

The empirical results for consumer spending are shown in Figure 21c. Whilst the ARMA model of (2,0) (1,1) produced the smallest AIC value out of all the ARMA models, it was still significantly large with a value of 44.624. Therefore, impacting the reliability of statistically significant conclusions being made from the abnormal returns and in turn t-test results. Hence just looking at the actual values, there was a decline in consumer spending for the last quarter of 2015 when the attack took place. From here there was a gradual increase for the remaining two-year period to levels above consumer spending levels pre the attack, clearly showing recoveries being made after the attack.

Notably leisurely and tourism spending was particularly impacted, in the week after the attack's cafes, bars and brasseries suffered a 44 per cent drop compared to previous year figures and hotels experienced a 57 percent decrease in business (Thomson, 2015). In addition, in the tourism sector the low-cost airline company easyJet recorded the demand for flights to Paris declined in the short term after the attack (Thomson, 2015). Additionally, when looking at the data a year on after the event, hotel occupancy in Paris continued to be down 11 per cent compared to 2015 figures (Vora, 2016). Therefore, whilst impact was prolonged in the tourism sector particularly in the Paris region recoveries were made in consumer spending as consumers continued to spend on durable goods (Schulze, 2016). Hence, there was no significantly adverse impact nationwide to consumer spending and some recoveries were made in Paris.

Figure 21d shows the empirical results for investment. Whilst the ARMA model of (1,2) (0,0) produced the smallest AIC value out of all the ARMA models tested, it was still significantly larger with a value of 43.705. Therefore, impacting the reliability of any statistically significant conclusions being able to be made from the abnormal returns and in turn t-test results. Hence just looking at the actual values, prior to the Paris 2015 attacks, capital formation had been relatively stagnant but for the two-year period post the attack there was

an upward trend in investment levels. Thereby showing no apparent adverse impact on investment levels after the attack from merely looking at the actual values.

Figure 21e shows the results for FDI. Whilst the ARMA model of (4,2) (0,0) produced the smallest AIC value out of all the ARMA models tests it was still significantly larger with a value of 49.380. Therefore, impacting the reliability of statistically significant conclusions being made from the abnormal returns and in turn t-test results. Hence just looking at the actual values there was a rise in FDI within the two-year period post the attack. Therefore, merely looking at the actual values shows no evidence that the occurrence of the Paris attacks had a significant adverse impact on FDI coming into France, rather it increased for the country. In terms of inflation seen in Figure 21f, there was a downward trend in inflation prior to the Paris attacks and the forecasted figures expected the CPI to remain relatively constant over the two-year period. The actual values indicated a similar trend, hence the insignificant t-test value.

Figure 21g shows the empirical results for RGDP. Whilst the ARMA model of (3,2) (0,0) produced the smallest AIC value out of all the ARMA models tests it was still significantly larger relative to AIC values for other models with a value of 17.548. Therefore, impacting the reliability of statistically significant conclusions being made from the abnormal returns and in turn t-test results. Hence, just looking at the actual values there was a steady increase in RGDP over the two-year period. Consequently, a lack of evidence that RGDP was significantly adversely impacted after the Paris attacks. Lastly, for the unemployment rate the forecasted graph within Figure 21h showed that prior to the Paris attacks, the unemployment rate was on a fluctuating upward trend. The predicted values forecasted a change in trend and rather a decline in the unemployment rate to occur during the two-year forecasting period, the actual values showed a similar trend.

Overall, the empirical results showed there was limited prolonged impact to the French economy because of the 2015 Paris terrorist attacks. Paris did experience some short-term transitory effects to key industries such as the tourism industry, however on the whole, arguably it was justified that the exogenous events did not receive a direct economic response which will be discussed in further depth later in the thesis.

Madrid 2004 Bombings:

The 2004 Madrid train bombings was a devastating attack resulting in a significant loss of life and was recorded as the deadliest terrorist attack for Spain. The attacks were carried out by a group associated with Al Qaeda, ten bombs in bags exploded on four commuter trains (History.com Editors, 2010). However, at the time there was minimal impact on the Spanish and wider European economy, hence limited supply and demand side shocks (Johnston & Nedelescu, 2006). Furthermore, there was limited impact on the Spanish and global financial markets. Within the Euro area the Dow Jones EURO STOXX 50 decreased by around three percent on March 11th and continued to decline for the following days, however the decline was not prolonged, with a near full recovery occurring by the end of the month (Johnston & Nedelescu, 2006). Notably, the ECB did acknowledge the impact of the Madrid attacks in terms of having a temporary impact on stock market volatility in the euro area, but again no impact was deemed significant enough to render a significant economic response to the terrorist attack (ECB, 2004a). In line with this, the attacks in Spain have been argued to have little economic impact, as the attacks were viewed as only having a regional impact. Furthermore unlike the attacks in America on September 11th 2001 which occurred during a pre-existing economic downturn, the terrorist attacks in Madrid occurred during a time when economic growth was growing steadily (Johnston & Nedelescu, 2006).

Therefore, on April 1st 2004 the ECB whilst acknowledging the tragedies of the terrorist attack, decided that the main intervention rates were to remain unchanged (ECB, 2004b). The ECB concluded that on the basis of their regular economic and monetary analysis there was no significant change to the economic climate to warrant a change in the ECB interest rates and the low interest rates would continue to provide support to the recovery within the euro area (ECB, 2004b). Furthermore, in terms of fiscal policy, no fiscal stimulus, tax breaks, or any other significant fiscal measures were deemed necessary to be taken in direct relation to the Madrid terrorist attacks, other than providing aid to victims and families directly impacted by the attack (Johnston & Nedelescu, 2006).

Figure 22 shows data from the IMF World Economic Outlook publications, this data was used as the central bank of Spain, Banco de España, did not have economic projections dated as far back as 2004, the time of the Madrid attacks. There were slight differences between the forecasted and actual values for each of the economic indicators. Firstly, for RGDP the actual value was 2.7, slightly less than the forecasted value of 2.8. In addition, the actual

unemployment rate was 10.8, again slightly lower than the forecasted value of 11.0. Whereas the actual value for consumer prices was 3.1, higher than the forecasted figure of 2.7. Overall, clearly there was no significant deviations between forecasted and actual values, further supporting previous claims that the terrorist attacks did not result in a significant adverse impact to the Spanish economy.

Figure 23a shows how the key stock market index for Spain, IBEX 25, reacted to the Madrid bombings. On the day of the attack and for the two days following the terrorist attack the markets closed with decreasing closing values, an overall decline of seven percent. However, on the third day after the terrorist attacks the markets closed with an upward value, therefore whilst there was a noticeable dip, the decline was short-lived. All the subsections under Figure 24 shows the empirical results for the Madrid 2004 terrorist attacks. The macroeconomic variables that produced abnormal values, which in turn produced statistically significant t-test values at the 5% level, was unemployment, inflation and consumer confidence. However, the empirical results show very limited adverse impact to the macroeconomic variables.

The unemployment empirical results can be seen in Figure 24a, the ARMA model of (1,0) (1,0) was used to forecast the values for the unemployment rate. The Q-stat values indicate the residuals are white noise. The abnormal returns produced a t-test value of 2.713 hence statistically significant at the 5% level. As seen by the forecasted graph historically unemployment has been on a steady decline, however prior to the Madrid attacks there had been a rise in the unemployment rate. The forecasted values predicted this trend would not continue and rather a decline in unemployment within the two-year forecasting period. However, the actual values showed a more significant drop in the unemployment rate than what was forecasted. Hence there was no significant adverse impact on the unemployment rate directly after and in the short term after the Madrid attacks.

The empirical evidence for inflation can be seen in Figure 24b, the ARMA model of (1,3) (0,0) was used to forecast the log values of inflation. The Q-stat values indicate the residuals are white noise. The abnormal returns produced a t-test value of -7.790 hence statistically significant at the 5% level. The forecasted graph showed that there had been a steady decline in the CPI value historically and the forecasted values predicted the CPI to essentially flatline with a slight decline over the two-year forecasting period. However, the actual values showed

that CPI did not decline as much as what was predicted in the forecasted values. Therefore overall, there was not a significant adverse impact on inflation post the terrorist attacks.

The model chosen to forecast for consumer confidence was an ARIMA model of (4,1) (0,0) as shown in Figure 24c. The Q-stat values indicate the residuals are white noise. The abnormal returns produced a t-test value of -13.600 hence statistically significant at the 5% level. The forecasted graph showed there had been clear fluctuations in consumer confidence levels around the 100 mark historically. Prior to the 2004 attacks consumer confidence was on an upward recovery trend, the forecasted figures predicted there would be a shift and consumer confidence would be on a downward trend in the two-year forecasting period. However, the actual values for consumer confidence shows that consumer confidence did not decline as substantially as it was predicted in the forecasted values. Notably consumer confidence increased in the first quarter of 2004, the quarter that the Madrid attacks took place and then fluctuated with an overall decline in the remaining two-year period.

In addition, in terms of business confidence Figure 24d shows the empirical results. Whilst the ARMA model of (4,4) (0,2) produced the smallest AIC value out of all the ARMA model's tests, it was still a higher value compared to other ARMA models, with a value of -11.990. In addition, the correlogram showed some concerns of the confidence level of the residuals being white noise. Therefore, together both these factors impact the reliability of statistically significant conclusions being made from the abnormal returns and the t-test results. Hence just looking at the actual values, historically business confidence has fluctuated around the 100 mark and prior to the Madrid attacks, business confidence was on an upward trend. However, over the two-year period the actual values showed that business confidence steadily declined. Notably business confidence rose in the month that the Madrid attacks took place and for the following three months and only began to substantially fall from the second month of 2005. Therefore, for both confidence indicators there was no significant short-term adverse impact as a result of the terrorist attacks (European Commission, 2005). Whilst both indicators actual values did decline in the two-year period, this is likely attributed to other economic factors occurring at the time, including a strong fall in sentiment in the UK which had flow on impacts to the wider Eurozone area (European Commission, 2005).

Investment was measured as the total production of investment goods for manufacturing. This indicator was used because an aggregate investment figure could not be sourced on a

quarterly basis and this variable has close correlations to overall investment levels, hence is a suitable substitute. The data was not seasonally adjusted, therefore the ARMA model of (3,3) (0,2) was used as seen in Figure 24e. However, looking at the Q-stat values shows one cannot confidently conclude the residuals are white noise hence impacting the reliability of forecasts and in turn conclusions being made from the abnormal and t-test results. Therefore, looking at just the actual values, the graph shows that the data set for investment is very volatile but historically investment levels for manufacturing goods had been on an upward trend. Notably, there was a decline in investment the quarter that the Madrid attacks took place, but the second quarter reached investment levels higher than levels prior to the attack and there were clear fluctuations for the remaining two-year period. As has been previously mentioned, the terrorist attacks resulted in little impact to the Spanish economy and wider European area, hence likely the reduction in investment levels attributed to other economic and social factors.

In terms of consumer spending, Figure 24f shows that the ARMA model of (1,2) (0,0) was used to forecast the values of personal consumption expenditure. The Q-stat values indicate the residuals are white noise. The forecasted graph shows that PCE has been trending upwards historically and the forecasted values predicted this trend to continue within the two-year forecasted period. The actual values showed similar movements with a more substantial upward movement in the two-year forecasting period, hence the negative t-test value, however this was not statistically significant. Clearly the Madrid attacks did not have any significant impact on consumer spending within the two-year period and rather consumption levels continued to rise.

Figure 24g shows the empirical results for RGDP. Whilst the ARMA model of (4,1) (0,1) produced the smallest AIC value, it was still relatively large with a value of 14.902. Therefore, impacting the reliability of any statistically significant conclusions being made from the abnormal returns and in turn t-test results. Hence just looking at the actual values, historically RGDP figures had been on an upward trend and the actual figures showed this trend continued over the two-year period. Hence, notably there was no significant decline in RGDP as a result of the terrorist attacks.

Figure 24h shows the results for FDI. Whilst the ARMA model of (2,2) (0,0) produced the smallest AIC value, it was still significantly large with a value of 47.311. Therefore, no statistically significant conclusions are able to be made from the abnormal returns and in turn

t-test results. Hence, just looking at the actual values showed a significant decline in FDI into Spain in 2004, however this decline was short lived and recovery was made in 2005. In 2004 there was a general decline in FDI into developed countries totalling \$321 billion flows, down from \$380 billion the year prior (United Nations, 2005). Therefore, the decline was not just felt in Spain rather other countries across the Eurozone as well, however some countries did experience an increase. Notably, Spain experienced a decline for several factors including high levels of liquidation on previous investments by foreign companies (OECD, 2005). Additionally, due to a growing number of special purpose entities, increasing the record of inflow and outflows, in turn having limited impact to the Spanish corporate sector (OECD, 2005). Therefore, whilst one cannot rule out the attacks having an impact on FDI levels into Spain, clearly there were other factors at play and on the whole, there were very limited economic impacts from the attack itself on the Spanish economy. Overall, the empirical results showed there was limited impact to the Spanish economy as a result of the Madrid terrorist attacks. Therefore, as will be discussed later in the thesis arguably it is justified that there was no significant economic policy response implemented post the attacks.

Appendix Terrorist Attacks:

Figure 16a:

Economic projections for 2001

Percent

Indicator	Memo: 2000 actual	Federal Reserve governors and Reserve Bank presidents	
		Range	Central tendency
<i>Change, fourth quarter to fourth quarter¹</i>			
Nominal GDP	5.9	3-3/4 to 5-1/4	4 to 5
Real GDP ²	3.5	2 to 2-3/4	2 to 2-1/2
PCE chain-type price index	2.4	1-3/4 to 2-1/2	1-3/4 to 2-1/4
<i>Average level, fourth quarter</i>			
Civilian unemployment rate	4.0	4-1/2 to 5	About 4-1/2

1. Change from average for fourth quarter of 2000 to average for fourth quarter of 2001.
2. Chain-weighted.

Note: Data for Figure 16a is sourced from (The Federal Reserve Board, 2001).

Figure 16b:

Indicator	Actual 2001 Change, fourth quarter to fourth quarter value
Real GDP	0.2
PCE chain type price index	1.7
	Average level, fourth
Civilian Unemployment Rate	5.5

Note: Data for Real GDP from (FRED, 2020t), data for PCE chain type rice index from (FRED, 2020p), data for civilian unemployment rate from (FRED, 2020ad).

Figure 17a:

Date	S&P 500 Index- Close
September 10 th 2001	1,092.54
September 11 th 2001- Terrorist attack	
September 17 th 2001	1,038.77 (down)
September 18 th 2001	1,032.74 (down)
September 19 th 2001	1,016.1 (down)

Note: Data was sourced from (IRESS, 2020f).

Figure 17b Fiscal Policy:

Date	S&P 500 Index- Close
September 17 th 2001	1,038.77
September 18 th 2001- America Congress introduced the \$40 billion emergency appropriation bill	1,032.74 (down)
September 19 th 2001	1,016.1 (down)
September 20 th 2001	984.54 (down)
September 21 st 2001	965.8 (down)

Date	S&P 500 Index- Close
September 20th 2001	984.54
September 21 st 2001- America congress passed aid package for airlines	965.8 (down)
September 24 th 2001	1,003.45 (up)
September 25 th 2001	1,012.27 (up)
September 26th 2001	1,007.04 (down)

Note: Data was sourced from (IRESS, 2020f).

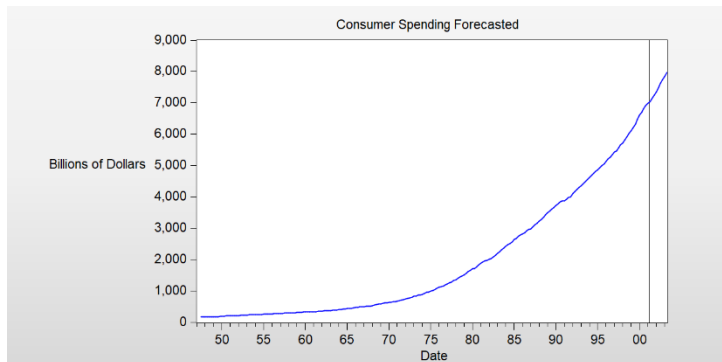
Figure 17c Monetary Policy:

Date	S&P 500 Index- Close
September 10 th 2001	1,092.54
September 17 th - Reduction in Federal rate by 50 basis points	1,038.77 (down)
September 18 th 2001	1,032.74 (down)
September 19 th 2001	1,016.1 (down)
September 20 th 2001	984.54 (down)

Note: Data was sourced from (IRESS, 2020f).

Figure 18a:

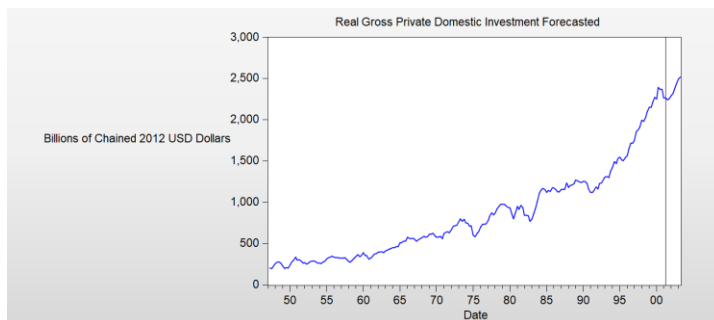
Key Metrics for log of Consumer Spending	Values
ARMA model	(4,2) (2,2)
AIC	-6.677
Q-Stat value	Q4- 1.968 Q8- 6.654
T-test	5.056



Note: Data was sourced from (FRED, 2020o).

Figure 18b:

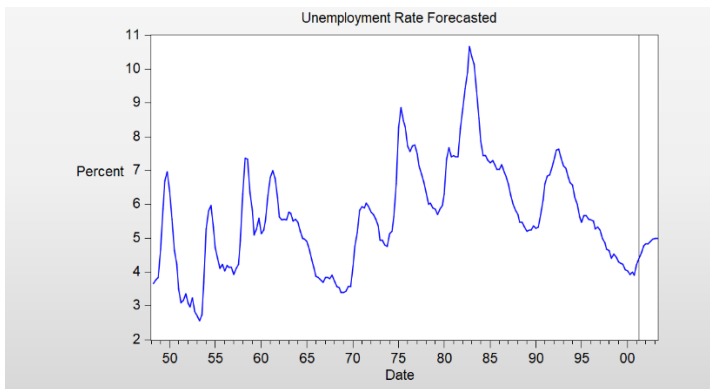
Key Metrics for log of Investment	Values
ARMA model	(3,3) (0,2)
AIC	-3.251
Q-Stat value	Q4- 1.968 Q8- 6.654
T-test	5.481



Note: Data was sourced from (FRED, 2020y).

Figure 18c:

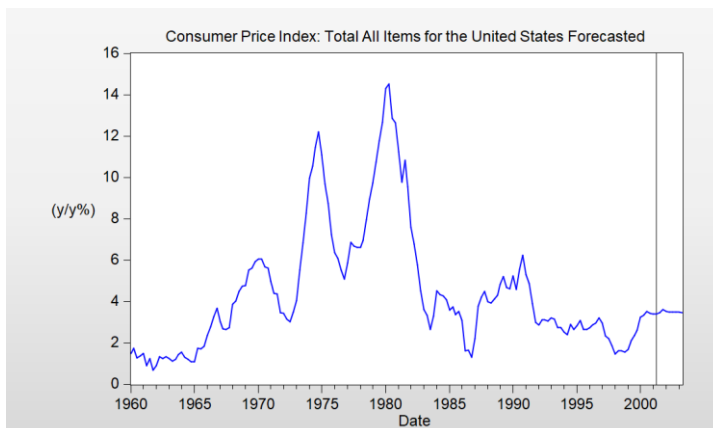
Key Metrics for Unemployment	Values
ARMA model	(4,4) (0,0)
AIC	0.393
Q-Stat value	Q4- 0.3305 Q8-2.662
T-test	-9.583



Note: Data was sourced from (FRED, 2020ad).

Figure 18d:

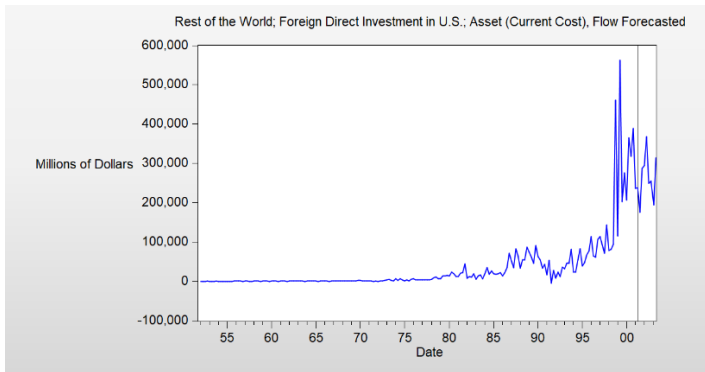
Key Metrics for log of Inflation	Values
ARMA model	(2,4) (0,0)
AIC	-0.909
Q-Stat value	Q4- 0.138 Q8-1.556
T-test	6.869



Note: Data was sourced from (FRED, 2020g).

Figure 18e:

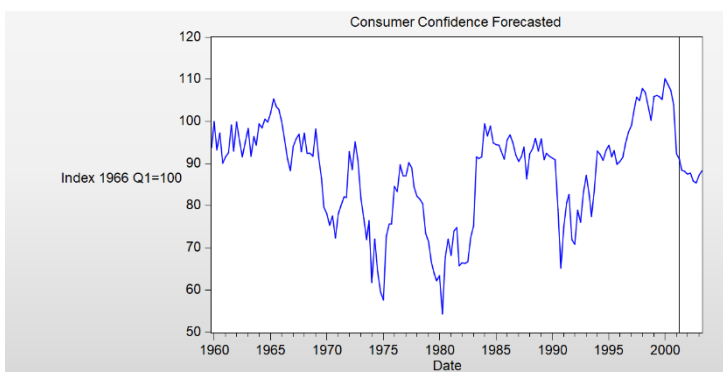
Key Metrics for FDI	Values
ARMA model	(4,4) (0,0)
AIC	23.925



Note: Data was sourced from (FRED, 2020ab).

Figure 18f:

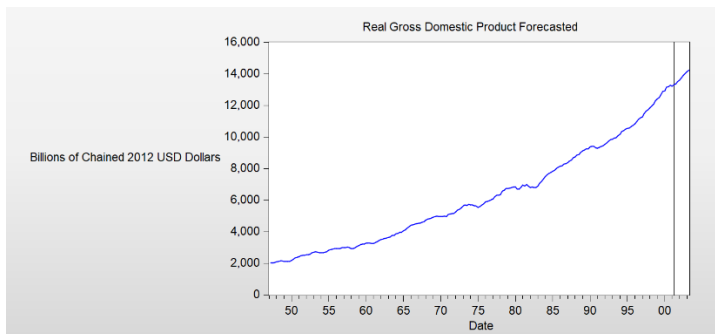
Key Metrics for Consumer Confidence	Values
ARMA model	(3,2) (0,1)
AIC	6.056
Q-Stat value	Q4- 0.677 Q8-5.387
T-test	-0.213



Note: Data was sourced from (FRED, 2020ag).

Figure 18g:

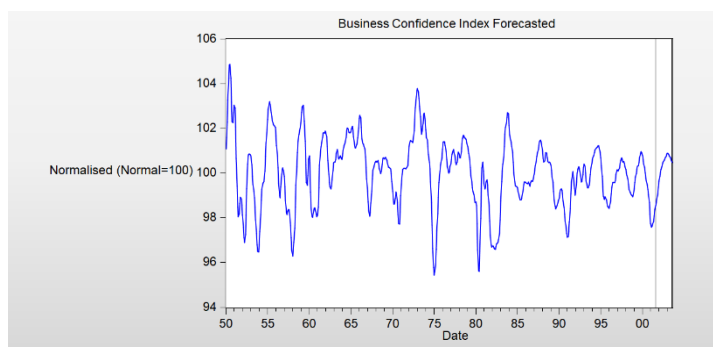
Key Metrics for log of RGDP	Values
ARMA model	(4,3) (0,0)
AIC	-6.486
Q-Stat value	Q4- 5.514 Q8-11.398
T-test	6.478



Note: Data was sourced from (FRED, 2020t).

Figure 18h:

Key Metrics for Business Confidence	Values
ARMA model	(4,2) (2,2)
AIC	-1.357
Q-Stat value	M12-14.12 M24-57.878
T-test	6.192



Note: Data was sourced from (OECD data, 2020).

Figure 19a:

KEY PROJECTIONS FOR FRANCE

	2013	2014	2015	2016	2017
HICP	1.0	0.6	0.3	1.4	1.7
HICP excluding energy and food	0.7	1.0	0.6	1.2	1.6
GDP deflator	0.8	0.6	1.0	1.0	1.2
Real GDP	0.7	0.2	1.2	1.8	1.9
Contributions to GDP growth (in percentage points):					
<i>Domestic demand (excluding changes in inventories)</i>	0.6	0.5	1.1	1.6	1.9
<i>Net exports</i>	0.0	-0.5	-0.4	0.2	0.0
<i>Changes in inventories</i>	0.2	0.2	0.5	0.0	0.0
Private consumption	0.5	0.6	1.7	1.5	1.6
Government consumption	1.7	1.5	1.4	0.9	0.9
Total investment	-0.4	-1.2	-0.7	2.5	3.5
Public investment	0.2	-6.9	-2.0	-0.4	0.0
Household investment	-1.5	-5.3	-4.2	-0.3	4.2
Business investment (NFCs-FCs-IEs)	-0.2	2.2	1.1	4.4	4.2
Exports	1.8	2.4	5.4	5.8	5.7
Imports	1.8	3.9	6.3	5.0	5.4
Real household gross disposable income (GDI)	-0.1	1.1	1.6	1.3	1.6
Household saving ratio (% of GDI)	14.7	15.1	15.1	14.9	14.9
Unemployment rate (ILO, France and overseas territories, % of labour force)	10.3	10.2	10.3	10.1	9.6

Annual rate of growth except where indicated otherwise.

Sources: Insee data for 2013 and 2014; the blue-shaded columns show Banque de France projections.

KEY PROJECTIONS FOR FRANCE

	2015	2016	2017	2018	2019
HICP	0.1	0.3	1.2	1.4	1.5
HICP excluding energy and food	0.6	0.6	0.8	1.1	1.3
GDP deflator	0.6	0.8	0.9	1.2	1.3
Real GDP	1.2	1.3	1.3	1.4	1.5
Contributions to GDP growth (in percentage points): ^{a)}					
<i>Domestic demand (excluding changes in inventories)</i>	1.4	1.8	1.3	1.5	1.6
<i>Net exports</i>	-0.3	-0.6	0.0	-0.1	-0.1
<i>Changes in inventories</i>	0.1	0.1	-0.1	0.0	0.0
Private consumption	1.5	1.5	1.2	1.5	1.6
Government consumption	1.4	1.5	1.1	0.9	1.1
Total investment	0.9	2.8	1.8	1.9	1.9
<i>Government investment</i>	-3.9	2.6	1.4	1.9	1.8
<i>Household investment</i>	-0.8	1.5	1.9	0.5	0.0
<i>Business investment (NFCs-FCs-IEs)</i>	2.9	3.3	1.8	2.4	2.7
Exports	6.0	1.2	4.3	3.8	3.9
Imports	6.4	3.0	4.1	3.9	3.9
Real household disposable income (RHDI)	1.6	1.8	1.2	1.3	1.5
ILO unemployment rate (France and overseas territories, % of labour force)	10.4	10.0	9.9	9.7	9.5

Sources: Insee data for 2015 and the first three quarters of 2016, publication of 28 October 2016. Blue-shaded columns show Banque de France projections.

Annual percentage change except where otherwise indicated.

a) The sum of individual contributions may not add up to GDP growth as figures have been rounded.

KEY PROJECTIONS FOR FRANCE

	2016	2017	2018	2019	2020	2021
HICP	0.3	1.2	2.1	1.6	1.7	1.7
HICP excluding energy and food	0.6	0.6	0.9	1.3	1.4	1.6
GDP deflator	0.2	0.7	1.0	1.3	1.5	1.6
Real GDP	1.1	2.3	1.5	1.5	1.6	1.4
Contributions to GDP growth (in percentage points): ^{a)}						
<i>Domestic demand (excluding changes in inventories)</i>	2.0	2.0	1.5	1.6	1.5	1.4
<i>Net exports</i>	-0.5	0.1	0.5	0.0	0.0	0.0
<i>Changes in inventories</i>	-0.4	0.2	-0.4	-0.2	0.0	0.0
Household consumption (52%) ^{b)}	2.0	1.1	1.0	1.4	1.3	1.3
Government consumption (24%)	1.4	1.4	1.0	1.1	1.4	1.4
Total investment (23%)	2.7	4.7	3.1	2.9	2.2	1.7
<i>Government investment (3%)</i>	0.1	1.6	2.5	2.1	1.4	0.6
<i>Household investment (5%)</i>	2.8	5.6	1.5	-0.6	0.5	1.5
<i>Business investment (NFCs-FCs-IEs) (14%)</i>	3.4	5.2	3.9	4.3	2.9	2.0
Exports (31%)	1.5	4.7	3.2	3.6	3.9	3.5
Imports (32%)	3.1	4.1	1.6	3.4	3.8	3.4
Real household gross disposable income	1.8	1.4	1.4	1.7	1.3	1.0
Net job creations (thousands)	197	331	236	118	174	148
ILO unemployment rate (France and overseas departments, % of labour force)	10.1	9.4	9.1	8.9	8.5	8.2

Sources: Insee data for 2016 and 2017. Blue-shaded columns show Banque de France projections.

Figures are adjusted for the number of working days.

a) Individual contributions may not add up to GDP growth as figures have been rounded.

b) Percentages in brackets refer to each item's share of GDP in 2017.

Figure 19b:

Key Indicators	Forecasted Values for 2015	Actual Values for 2015	Forecasted Values for 2016	Actual Values for 2016
HICP	0.3	0.1	1.4	0.3
HICP excluding energy and food	0.6	0.6	1.2	0.6
Real GDP	1.2	1.2	1.8	1.1
Private consumption	1.7	1.5	1.5	2.0
Total investment	-0.7	0.9	2.5	2.7
Real household disposable income	1.6	1.6	1.3	1.8
ILO unemployment rate	10.3	10.4	10.1	10.1

Note: Data for projected 2015 and 2016 values from (BDF, 2015), data for actual 2015 values from (BDF, 2016) and data for actual 2016 values from (BDF, 2018).

Figure 20a:

Date	CAC40 Index-Close
November 12 th 2015	4,856.65
November 13 th 2015- Paris Attacks	4,807.95 (down)
November 16 th 2015	4,804.31 (down)
November 17 th 2015	4,937.31 (up)
November 18 th 2015	4,906.72 (down)

Note: Data was sourced from (IRESS, 2020a).

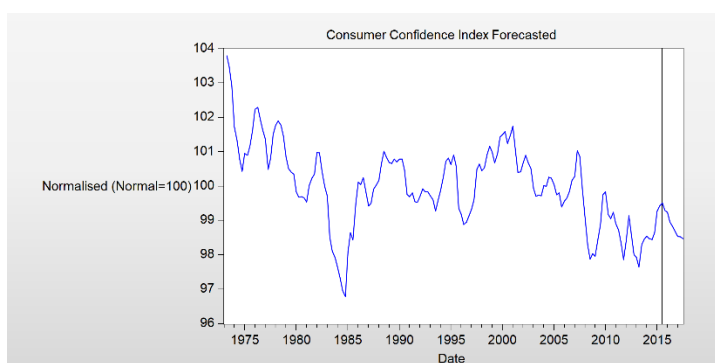
Figure 20b Monetary Policy:

Date	CAC40 Index- Close
December 2 nd 2015	4,905.76
December 3 rd 2015- ECB monetary policy announcement	4,730.21 (down)
December 4 th 2015	4,714.79 (down)
December 7 th 2015	4,756.41 (up)
December 8 th 2015	4,681.86 (down)

Note: Data was sourced from (IRESS, 2020a).

Figure 21a:

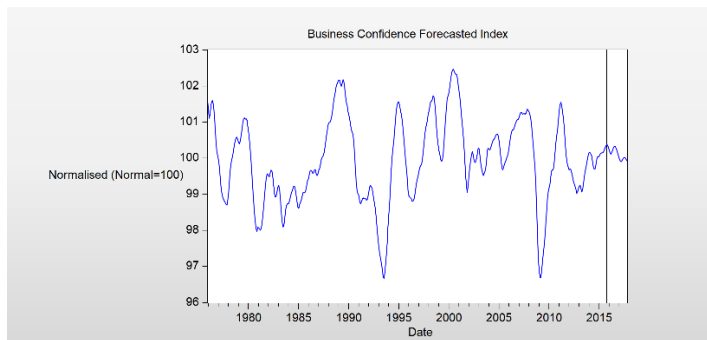
Key Metrics for log of Consumer Confidence	Values
ARMA model	(4,4) (0,0)
AIC	-8.366
Q-Stat value	Q4- 0.067 Q8- 5.520
T-test	-4.827



Note: Data was sourced from (FRED, 2020a).

Figure 21b:

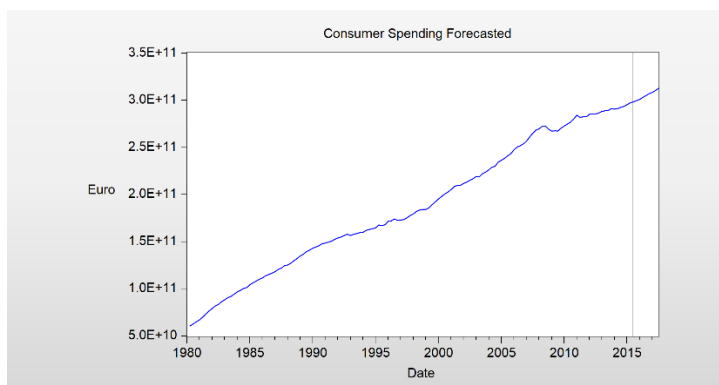
Key Metrics for log of Business Confidence	Values
ARMA model	(4,4) (1,1)
AIC	-11.973
Q-Stat value	M12- 4.779 M24-31.199
T-test	-5.356



Note: Data was sourced from (OECD data, 2020).

Figure 21c:

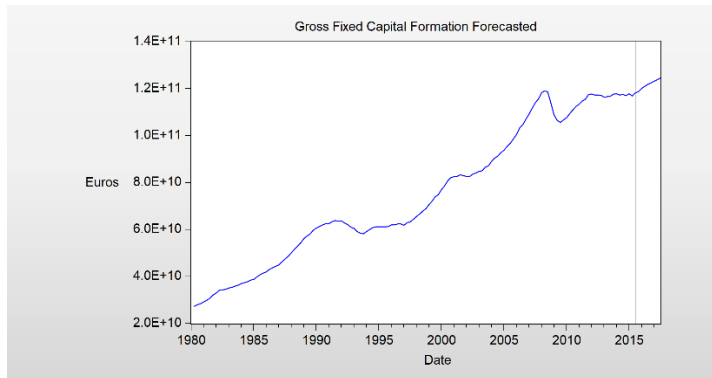
Key Metrics for Consumer Spending	Values
ARMA model	(2,0) (1,1)
AIC	44.624



Note: Data for Figure 21c was sourced from (FRED, 2020r).

Figure 21d:

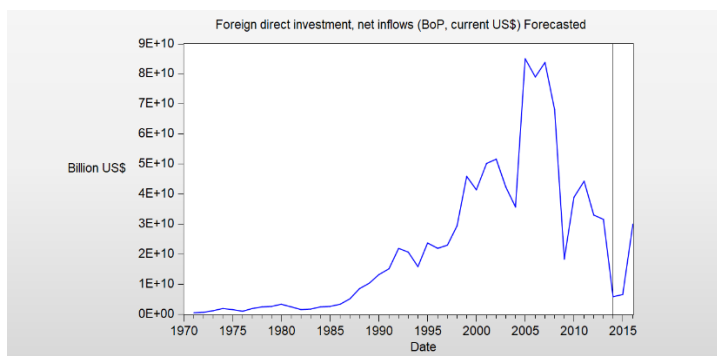
Key Metrics for Investment	Values
ARMA model	(1,2) (0,0)
AIC	43.705



Note: Data was sourced from (FRED, 2020j).

Figure 21e:

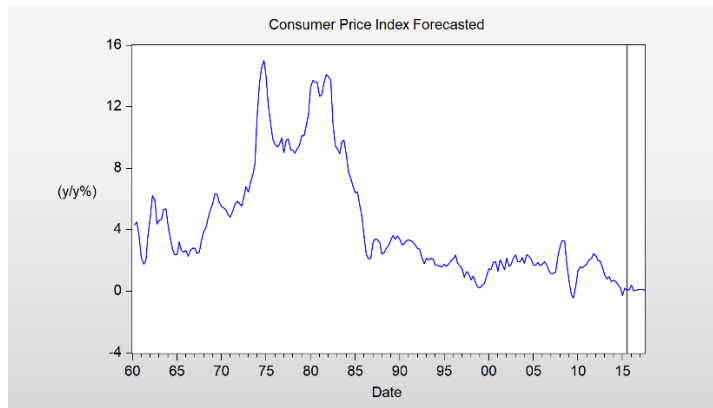
Key Metrics for FDI	Values
ARMA model	(4,2) (0,0)
AIC	49.380



Note: Data was sourced from (World Bank, 2020b).

Figure 21f:

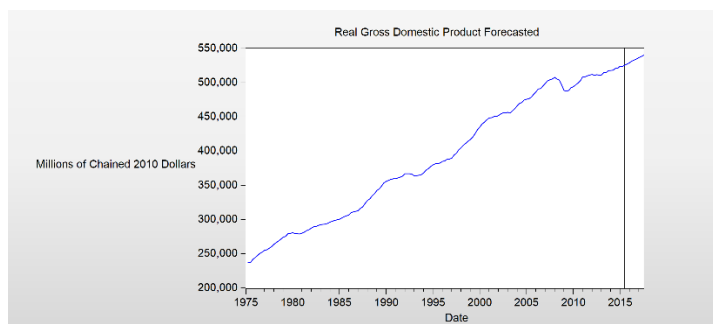
Key Metrics for Inflation	Values
ARMA model	(1,2) (0,1)
AIC	1.336
Q-Stat value	Q4- 5.228 Q8-11.247
T-test	-1.872



Note: Data was sourced from (FRED, 2020f)

Figure 21g:

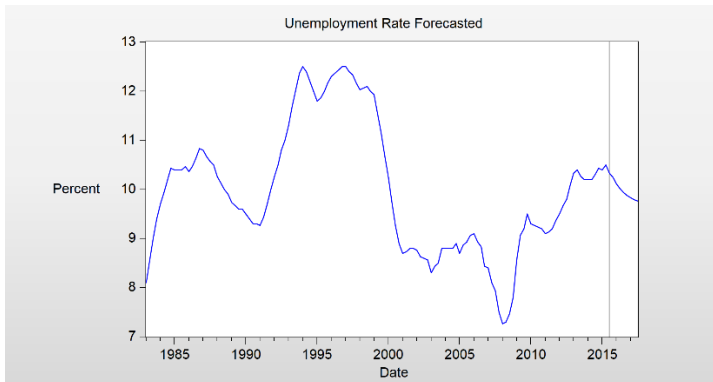
Key Metrics for RGDP	Values
ARMA model	(3,2) (0,0)
AIC	17.548



Note: Data for Figure 21g was sourced from (FRED, 2020v).

Figure 21h:

Key Metrics for Unemployment	Values
ARMA model	(2,2) (0,0)
AIC	-1.014
Q-Stat value	Q4- 0.317 Q8-4.440
T-test	1.128



Note: Data was sourced from (FRED, 2020l).

Figure 22:

Key Indicator	Forecasted values for 2004	Actual values for 2004
RGDP -annual percent change	2.8	2.7
Consumer Prices - annual percent change	2.7	3.1
Unemployment - percent of labour force	11.0	10.8

Note: Data for forecasted values of 2004 from (IMF, 2003) and data for actual values for 2004 from (IMF, 2005).

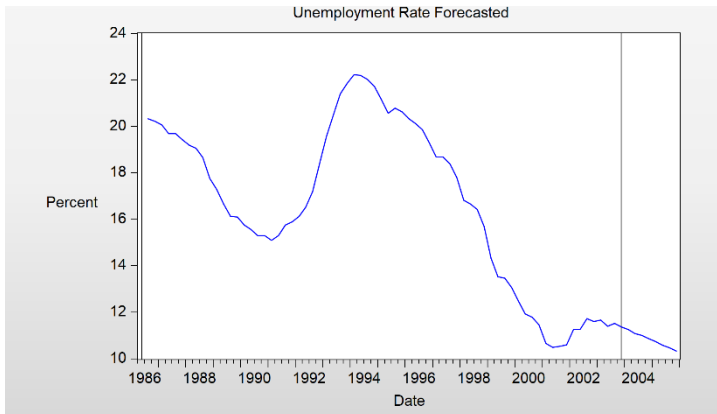
Figure 23a:

Date	IBEX 35 Index-Close
March 10 th 2004-	8,292.90
March 11th 2004- Madrid Bombings	8,112.40 (down)
March 12 th 2004-	8,032.60 (down)
March 15 th 2004-	7,699.10 (down)
March 16 th 2004-	7,810.70 (up)

Note: Data sourced from (IRESS, 2020c).

Figure 24a:

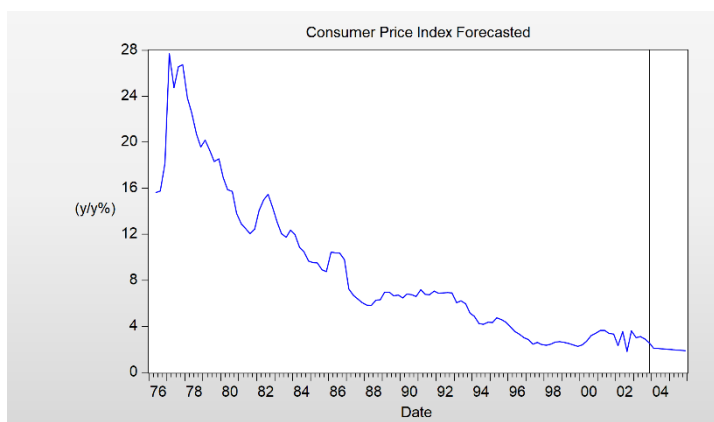
Key Metrics for Unemployment	Values
ARMA model	(1,0) (1,0)
AIC	0.692
Q-Stat value	Q4- 5.999 Q8- 8.753
T-test	2.713



Note: Data was sourced from (FRED, 2020m).

Figure 24b:

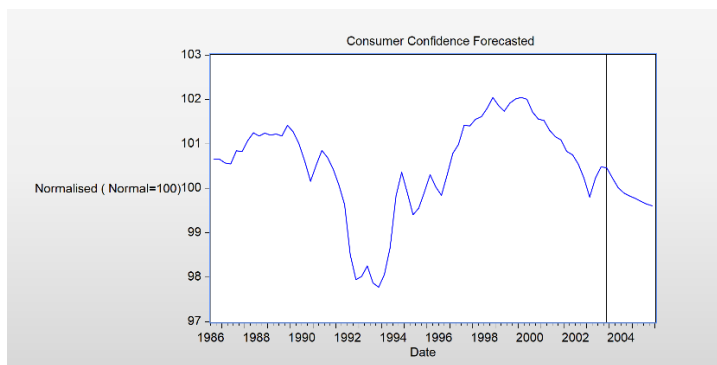
Key Metrics for log of Inflation	Values
ARMA model	(1,3) (0,0)
AIC	-1.495
Q-Stat value	Q4- 1.559 Q8-2.381
T-test	-7.790



Note: Data was sourced from (FRED, 2020e).

Figure 24c:

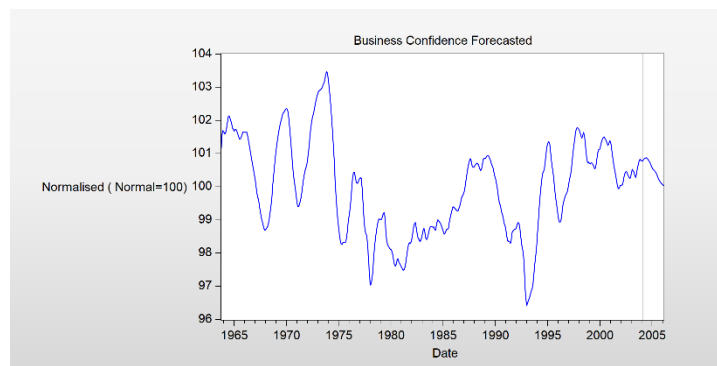
Key Metrics for log of Consumer Confidence	Values
ARMA model	(4,1) (0,0)
AIC	-8.829
Q-Stat value	Q4- 0.093 Q8-3.159
T-test	-13.600



Note: Data was sourced from (FRED, 2020c).

Figure 24d:

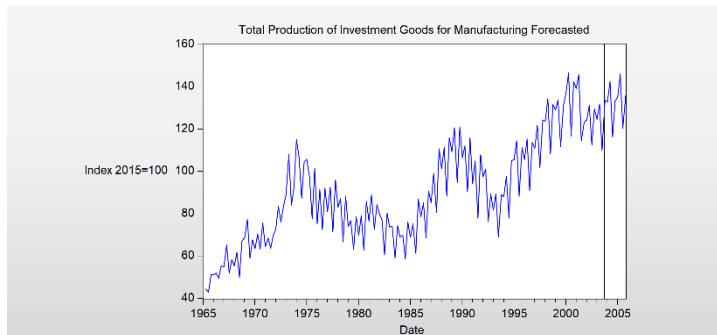
Key Metrics for log of Business Confidence	Values
ARMA model	(4,4) (0,2)
AIC	-11.990
Q-Stat value	M12- 15.584 M24- 32.313
T-test	2.261



Note: Data was sourced from (OECD data, 2020).

Figure 24e:

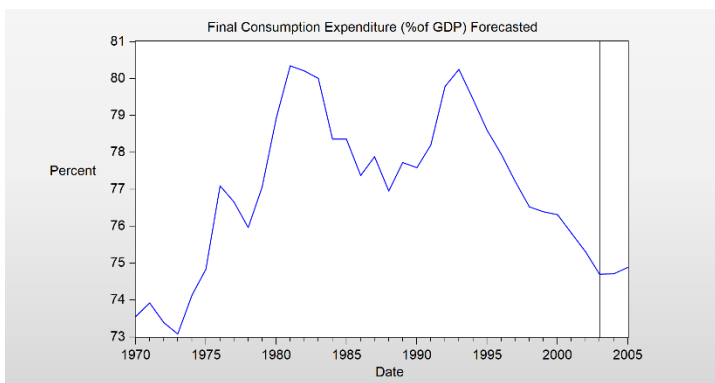
Key Metrics for Investment	Values
ARMA model	(3,3) (0,2)
AIC	6.414
Q-Stat value	Q4- 10.867 Q8- 52.924
T-test	4.976



Note: Data was sourced from (FRED, 2020ac).

Figure 24f:

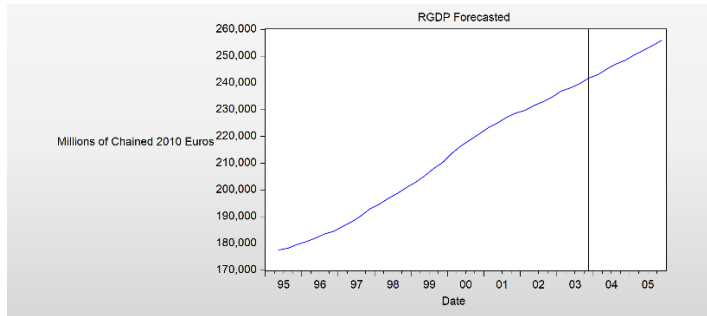
Key Metrics for Consumer Spending	Values
ARMA model	(1,2) (0,0)
AIC	2.760
Q-Stat value	Y1- 0.072
T-test	-7.044



Note: Data was sourced from (World Bank, 2020a).

Figure 24g:

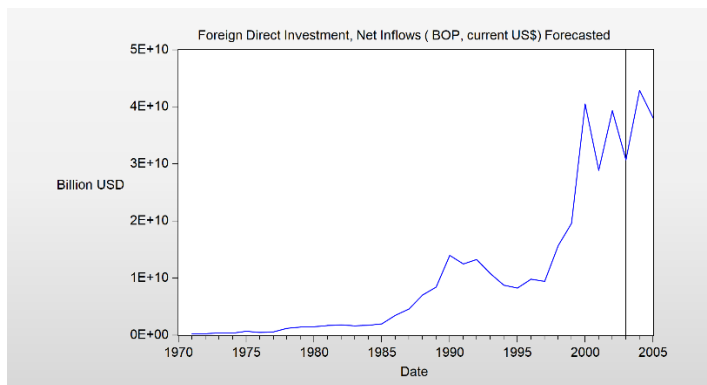
Key Metrics for RGDP	Values
ARMA model	(4,1) (0,1)
AIC	14.902



Note: Data was sourced from (FRED, 2020x).

Figure 24h:

Key Metrics for FDI	Values
ARMA model	(2,2) (0,0)
AIC	47.311



Note: Data was sourced from (FRED, 2020h).

Chapter Five: Pandemics:

This chapter will firstly explore the context of the 2003 SARS pandemic in Hong Kong to provide understanding of the nature and scale of the event. Next, the economic policy response implemented post the disaster will be explored followed by the empirical results. Analysis will also be provided on other relevant economic factors at the time to make an overall conclusion on the impact the exogenous event and economic policy response had on the key macroeconomic variables. In addition, this chapter makes reference to the current COVID-19 crisis to allow for analysis of the current pandemic to be made later in the thesis. This is done to allow the historical analysis of this thesis to be linked to the present-day crisis our world faces, to overall add to the understandings and conclusions of effective policy responses for future exogenous events.

SARS coronavirus was first identified in 2003. Whilst still uncertain, The World Health Organization (WHO) believes the virus came from an animal, predicted to be bats that spread into other animals, civet cats (WHO, 2003a). In turn, infecting humans in the Guangdong province of southern China in 2003. The outbreak impacted 26 countries resulting in more than 8,000 cases in 2003 (WHO, 2003a). The transmission of the disease occurred from person to person and symptoms were influenza-like. The incubation period of the disease was found to be between 2 to 7 days with an average of 5 days, however there was cases found with incubation periods of 10 days. Therefore individuals could have been spreading the disease for up to 10 days before displaying any symptoms. (WHO, 2003a). Mainland China suffered the largest number of cases, totalling 5,327 with 349 deaths (WHO, 2003e). Hong Kong was second to China with 1,755 cases and 300 deaths (WHO, 2003e).

SARS was first imported into Hong Kong on the 21st February 2003 by an infected physician (WHO, 2003b). On the 12th of March 2003 the Hong Kong government notified WHO of an outbreak of SARS in Hong Kong (WHO, 2003b). Beginning with 20 health care workers developing influenza like symptoms, infection numbers began to rise rapidly, on the 15th March 100 cases had been hospitalised (WHO, 2003b). Hong Kong remained on WHO's list of areas with recent local transmission until the 23rd June 2003, 20 days after the last reported case (Chan & Schloenhardt, 2004).

The Hong Kong government introduced a range of measurements and restrictions to curtail the spread of the virus. Firstly governments began to carry out medical examinations on individuals and body temperature checks for the purposes of tracking the disease and ability

to quarantine infected individuals landing in Hong Kong, up until a period where they were no longer infected (Chan & Schloenhardt, 2004). Border controls were also used to prevent the departure of anyone who had a history of contact with SARS, hence the government was not just concerned with local spread but also between other areas of China and international spread (Chan & Schloenhardt, 2004).

Furthermore the government introduced extensive contact tracing mechanisms, educated the public about the severity of the disease, the travel restrictions and correct procedures to follow to limit the spread of SARS (Chan & Schloenhardt, 2004). In addition, there were restrictions placed on household contacts of confirmed SARS patients who had to confine themselves in their homes or holiday camps for 10 days (WHO, 2003c). Furthermore, the government placed restrictions on gatherings including schools and kindergartens (WHO, 2003d).

This resulted in a supply side shock, restrictions directly stopped workers from doing their jobs. In addition, there was the presence of a demand side shock, where consumers ability and/or willingness to purchase goods and services was impacted (Australian Government: The Treasury, 2003). Specifically, in some instance's consumers could simply not consume their regular consumption patterns, particularly as the SARS pandemic occurred during the pre-online era (Australian Government: The Treasury, 2003). In addition, specific areas such as tourism experienced a significant adverse demand shock (Chan & Schloenhardt, 2004).

The Hong Kong government implemented an expansionary fiscal policy in response to the outbreak. On the 23rd of April, 2003 the government introduced a \$11.8 billion economic relief package. The brunt of the cost fell on the government, it was estimated that \$5.3 billion was lost in government revenue. Through various reductions including waiver in rates payments and a salaries tax rebate of 50% for the 2001/02 financial tax year, to a cap of \$3,000 per tax payer (The Government of the Hong Kong Special Administrative Region, 2003).

The remaining was spent on expenditures including programs such as job creation and training. Training was provided for 8,000 to 10,000 unemployed workers who were previously employed in catering, retail and tourism sectors to improve workers skills in these industries (The Government of the Hong Kong Special Administrative Region, 2003). In addition, approximately 2,500 jobs of temporary environmental hygiene workers were created and 2,000 jobs for maintenance services. These jobs were developed for 3 months to

provide free cleaning and maintenance services to the homes of those in need, specifically for the elderly and single parents (The Government of the Hong Kong Special Administrative Region, 2003). There were additional jobs created for street cleaning to clean up Hong Kong. In addition, the government implemented a loan guarantee scheme of \$1.5 billion to provide support to businesses to avoid business closures and layoffs. Expenditure was also kept to provide assistance directly related to the outbreak of SARS, including \$1.5 billion to enhance further disease control measures (The Government of the Hong Kong Special Administrative Region, 2003).

Hong Kong effectively outsources its monetary policy to the Federal Reserve. Hong Kong's primary monetary policy objective is to maintain currency stability (HKMA, 2003b). This is measured by the stability of the Hong Kong dollar exchange value in the foreign exchange market against the US dollar, with the aim of HK\$7.80 to US\$1 (HKMA, 2003b). The Hong Kong Monetary Authority (HKMA) did not take any immediate monetary policy response as a result of SARS. This is because the impact on the economy and the public finances did not call into question the exchange rate system and the interest rate differential between Hong Kong dollar and the US dollar remained minimal (HKMA, 2003a). Notably, there was significant adverse impact to market sentiment during the SARS pandemic, however there was no significant change to the Hong Kong dollar exchange rate until September 2003 (HKMA, 2003b). The dollar appreciated due to US dollar weakness and enhanced pressures for a renminbi appreciation hence for reasons other than the SARS pandemic (HKMA, 2003b).

The annual report for 2002 produced by the HKMA summarized the outlook for the economy in 2003. It was predicted that recovery of consumer spending would continue to be adversely impacted by high unemployment, slow wage growth and weak asset prices (HKMA, 2002). In addition, the monetary authority stipulated that a significant proportion of Hong Kong's growth was dependent on movements in the global economy. Key considerations included Middle East geopolitical tension and terrorism risk at the back of 9/11, impacting consumer and business confidence (HKMA, 2002). Furthermore, it was forecasted that consumer prices would continue to decline in 2003 at a modest pace due to an increase in aggregate demand and a weaker US dollar (HKMA, 2002).

The actual results for Hong Kong showed some deviations from what was forecasted. Firstly, as will be explained later, there was a decline in GDP for various reasons with a few factors

being linked to the pandemic. Consumer spending declined as expected and overall consumer prices decreased as anticipated. Notably actual values of unemployment differed to forecasted, the unemployment rate steadily decreased over the two-year period which will be explained in further detail later. Overall, as will be discussed, the SARS pandemic did have an impact to components of macroeconomic variables, however it did not result in wide ranging extensive deviances than what was anticipated to occur by the Monetary Authority in 2003.

Figure 25a represents the Hang Seng Index reaction to the SARS outbreak. Due to the disease being an ongoing event, the date that was used to mark the outbreak was the date Hong Kong notified WHO of an outbreak, the 12th of March. There was no significant impact to the stock market, with a slight fall of 1% the day after the announcement was made to WHO, the next few days showed no further significant movements. Figure 25b displays how the stock market reacted to the introduction of the fiscal policy response and again there was no significant impact. There was merely a drop of 1.9% in closing values from the day prior to the announcement to the closing figure two days after the announcement.

The subsections under Figure 26 shows the empirical results, compared to previous exogenous events analysed, the data for Hong Kong had greater variety. Data was sourced from Hong Kong's national data base and The World Bank. There was a range of frequencies used including yearly, quarterly and monthly. As previously mentioned, the rationale for having these discrepancies, rather than for example, converting monthly to quarterly data is to allow for the greatest amount of data to be used for each forecast, as a larger sample size increases forecasting strength. Overall, the sizes of all data sets were of sufficient size to allow for accurate predictions within the two-year period. Notably there was no suitable and sufficient data available to conduct empirical analysis on business and consumer confidence. However, as previously discussed, the HKMA concluded that market sentiment was adversely impacted as a result of the pandemic. Overall, only one macroeconomic variable, unemployment, produced abnormal values which had a statistically significant t-test value at the 5% level.

Figure 26a contains the empirical results for unemployment, the ARIMA model of (4,2) (2,0) was used which resulted in abnormal values which produced a t-test value of 2.528 that is statistically significant at the 5% level. Notably the Q-stat values showed confidence in the residuals being white noise, however there was a decline in confidence as lag values

increased, suggesting caution with the forecasted figures. However, the forecasted values produced from the ARMA model followed in line with HKMA predictions with the unemployment rate. The forecasted graph shows that historically there had been clear fluctuations in the unemployment rate. However, since the early 2000's there has been a substantial increase in unemployment levels in Hong Kong and the forecasted values anticipated this steady increase to continue over the two-year period. Contrastingly, the actual values showed that the unemployment rate steadily declined over the two-year period, hence the statistically significant t-test value. Notably unemployment rose in March and April of 2003 to a peak of 8.5 percent but from here, there was a decreasing trend. Therefore, showing the SARS pandemic did not have a significant prolonged adverse impact on unemployment. Hence as previously mentioned, the Hong Kong's government initiative of re training and job creation, for those who became unemployed in the industries most impacted by the pandemic would have assisted in mitigating any significant adverse impact to employment rates.

The empirical results for GDP can be seen in Figure 26b, the ARMA model of (4,4) (0,0) was chosen as the most suitable model, with the lowest AIC value of 19.555. However, this is a relative high AIC value compared to other ARIMA models analysed. Therefore, this raises concerns regarding the strength of the ARIMA model to produce forecasts and in turn the calculation of abnormal results. Instead, just looking at the actual values showed fluctuating values over the two-year period. Specifically, in the first quarter of 2003 there was a significant drop which continued into the second quarter. It was not until the last quarter of 2004 that Hong Kong's GDP levels reached levels equal to or higher than GDP figures prior to the SARS outbreak.

To overcome these hesitations of forecasted figures, a more in-depth analysis of the movement in GDP will be explained. Whilst some components of Hong Kong's GDP did improve in 2003, several components fell resulting in overall GDP figures to fall for the beginning quarters of 2003 (Government of Hong Kong, 2004b). For example, there was a decline in wholesale and retail trades and a decline of sales in restaurants and hotels as a result of the pandemic (Government of Hong Kong, 2004b) . In addition, there was a decline in transport, storage and communication sectors (Government of Hong Kong, 2004b). Furthermore, there was weak performance in domestic exports attributed to a large rise in import prices compared to export prices, hence the value of imports grew at a faster pace than total exports for Hong Kong in 2003 (Government of Hong Kong, 2004b). This in turn, contributed to net output in the local manufacturing sector to decline on average by 10.2

percent in the first three quarters in 2003 (Government of Hong Kong, 2004b). A further decline that occurred was within the construction sector which suffered a drop of 4.3 per cent on average over the first three quarters, mainly due to closure of railway projects that occurred earlier in the year and an underlying lack of building activity (Government of Hong Kong, 2004b). Therefore, GDP did partly fall due to factors surrounding the SARS pandemic as well as wider economic issues.

In 2004 Hong Kong's GDP increased on average by 8.1%, resulting in a growth performance that was second best since 1987 (Government of Hong Kong, 2004b). One contributing factor to this was the growth being measured against a low base, due to the significant drop in GDP in 2003. In addition, merchandise exports had significant growth bolstered by steady demand in overseas markets, particularly from East Asia, US and the European Union (Government of Hong Kong, 2004b). Furthermore, the weakness of the US dollar allowed for further boosts to Hong Kong exports and tourism made a quick recovery post the SARS pandemic, with the number of incoming visitors hitting new highs towards the end of 2004 (Government of Hong Kong, 2004b). Subsequently by looking at just actual data it is clear that key recoveries were made in GDP, particularly in areas most impacted by the pandemic, for example, tourism. Arguably quick recoveries were able to be made as the spread of the disease became under control and the economic response insured the economy continued to be stimulated throughout the pandemic, so there was no significant long-term adverse impact (Government of Hong Kong, 2004b).

FDI was another macroeconomic studied, the ARMA model chosen was (2,0) (0,0) with an AIC value of 49.123 as seen in Figure 26c. Thus, this is a significantly high AIC value compared to other ARMA analysis; therefore, it calls into question the reliability of the forecasts and in turn the abnormal results and subsequent t-test. Therefore, no significant conclusions can be made from the t-test result. Rather looking at purely the actual data value figures show that despite Hong Kong being the second worst hit nation by the SARS pandemic FDI values increased. The event was not severely damaging to overseas perception of investment returns into Hong Kong and rather Hong Kong was the second largest destination for FDI in Asia in 2003, with flows into Hong Kong reaching US \$13.6 billion (Government of Hong Kong, 2004a).

Figure 26d displays the empirical results for inflation, as seen in the forecasted graph, historically CPI has had a high degree of fluctuation and the forecasted values predicted an

increase in CPI levels initially and then a downward trend over the two-year period. The actual values showed similar movements, therefore despite SARS being impactful in Hong Kong, there was no significant deviance in CPI levels compared to what was forecasted without the consideration of the SARS pandemic.

Additionally, for investment, measured as gross capital formation as percentage of GDP, Figure 26e shows the empirical results. The forecasted graph shows that capital formation levels was expected to stay relatively stagnant in the beginning of the two-year period and then increase over the later parts of the forecasted period. The actual values reflected similar trends, in 2003, there was a decline in gross capital formation levels and a further small decline in 2004, but again nothing significantly different than what was expected without inclusion of the SARS pandemic.

Similar analysis applies to consumer spending, measured as final consumption expenditure as percentage of GDP, the empirical results of consumer spending is shown in Figure 26f. The forecasted graph shows prior to 2003, consumer spending was declining and the forecasted values anticipated this trend would continue in 2003 and into 2004. The actual values showed similar results with consumer spending declining in 2003, with slight improvements being made in 2004. However, as evident by the insignificant t-test value it was not a substantial deviance away from what was forecasted without the inclusion of the SARS pandemic.

Therefore whilst capital formation and consumer spending did decline in the beginning half of 2003 when business and consumer confidence took a hit as a result of the uncertainty surrounding the virus, it was not a statistically significant shock (Government of Hong Kong, 2003). Additionally, the decreases did not gather momentum, rather improvements started to be seen in consumer spending levels in the latter parts of 2003 and into 2004. There are further notable mentions surrounding the fall in consumer spending in the short term that will be referenced later in the thesis. In addition, there was slight improvements in investment levels made in the later part of 2003. Whilst in 2004 investment levels stayed relatively similar to 2003 with a slight decline overall, the decline was not as significant as the 4.3 per cent decrease in capital formation levels seen in 2002 in Hong Kong (Government of Hong Kong, 2003).

Therefore, clearly whilst the pandemic did not result in significant deviations to occur to a range of macroeconomic variables in the direct short term there was evidential impacts. Furthermore, as previously mentioned whilst the empirical results cannot specifically pin

down the influence policy had on the key macroeconomic variables. The results is in line with opinions that economic impact was mitigated due to the relatively quick reaction by the Hong Kong government to curtail the virus within 103 days and the economic stimulus provided whilst restrictions were in place (Government of Hong Kong, 2003). Later in the thesis the policy response to the 2003 SARS pandemic will be explained in further depth.

The COVID-19 pandemic is an unprecedented six sigma event that has and continues to have far greater impacts worldwide than the SARS 2003 pandemic. Whilst there are similarities in the origins of the two pandemics the COVID-19 pandemic has had far greater physical contagion (WHO, 2020) and contagion across economic markets. Notably COVID-19 is an ever-evolving exogenous event that is continuing to impact societies at the time of this analysis, therefore continuous improvements will be able to be made to commentary regarding COVID-19. Brief analysis will be provided of the response by four countries to the pandemic and reference to this will be made when evaluating all exogenous events at the aggregate. The four countries include China, America, New Zealand and Sweden which have all had a variety of responses.

Firstly, New Zealand has seen some of the strictest lockdown measurements being introduced severely impacting individuals' everyday life in an effort to pursue an elimination strategy (IMF, 2020). Whereas Sweden's response has been unique, the country initially went for a herd immunity strategy and compared to international standards have implemented relax restrictions on citizens (Bjorklund & Ewing, 2020) . China was the epicentre of this pandemic and is an example of a country that also implemented strict lockdown procedures whereas America has had a mismatch of responses between states resulting in no nationwide cohesion effort against the virus (IMF, 2020) . The results have been deadly with America continuously experiencing world record case numbers (The New York Times, 2020).

All four countries have implemented a mix of expansionary conventional and unconventional monetary and fiscal policy in response to the disaster, much like the rest of the world. Some countries have implemented new policy tools for the first time, for instance New Zealand Reserve Bank introduced QE as a way to respond to the crisis (IMF, 2020). Whilst the same analysis done for previous exogenous events cannot be applied to the current COVID-19 crisis, key analysis in the empirical data already seen during COVID-19 will be touched upon to provide further light into effective policy responses post exogenous events.

Appendix Pandemics:

Figure 25a:

Date	HSI -close
March 11 th 2003-	8,859.93
March 12th 2003- Hong Kong notifies WHO about SARS outbreak in Hong Kong.	8,874.99 (up)
March 13 th 2003-	8,787.45 (down)
March 14 th 2003-	8,956.17 (up)
March 17 th 2003-	8,804.16 (down)

Note: Data sourced from (IRESS, 2020b).

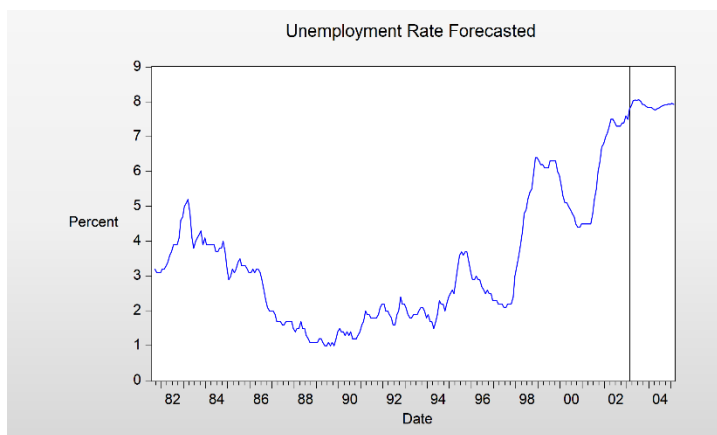
Figure 25b:

Date	HSI- close
April 22 nd 2003-	8,571.91
April 23rd 2003- Hong Kong government announce fiscal policy response	8,519.6 (down)
April 24 th 2003-	8,442.11 (down)
April 25 th 2003-	8,409.01 (down)
April 26 th 2003-	8,435.04 (up)

Note: Data sourced from (IRESS, 2020b).

Figure 26a:

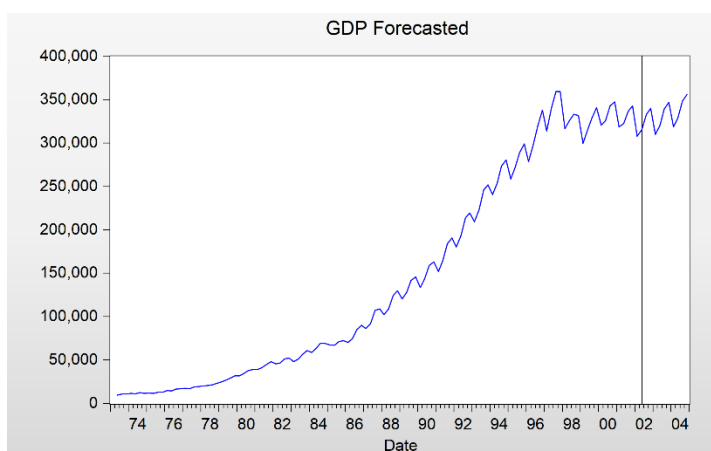
Key Metrics for Unemployment	Values
ARMA model	(4,2) (2,0)
AIC	-0.845
Q-Stat value	M12- 7.927 M24- 26.690
T-test	2.528



Note: Data sourced from (Hong Kong Government Data, 2020c).

Figure 26b:

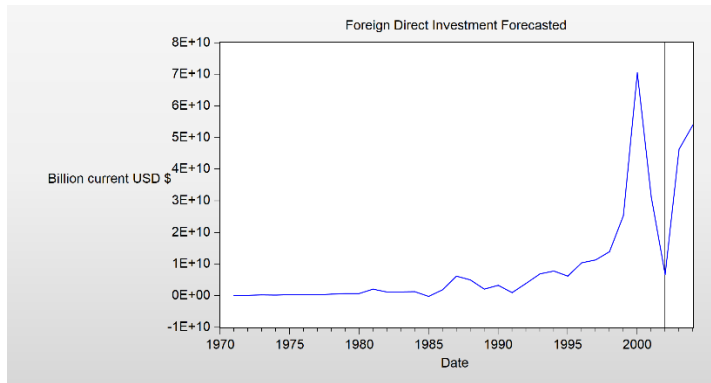
Key Metrics for GDP	Values
ARMA model	(4,4) (0,0)
AIC	19.555



Note: Data was sourced from (Hong Kong Government Data, 2020b).

Figure 26c:

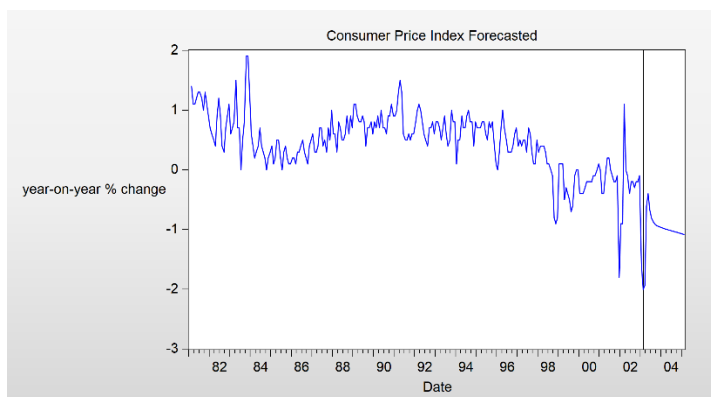
Key Metrics for FDI	Values
ARMA model	(2,0) (0,0)
AIC	49.123



Note: Data was sourced from (World Bank, 2020c).

Figure 26d:

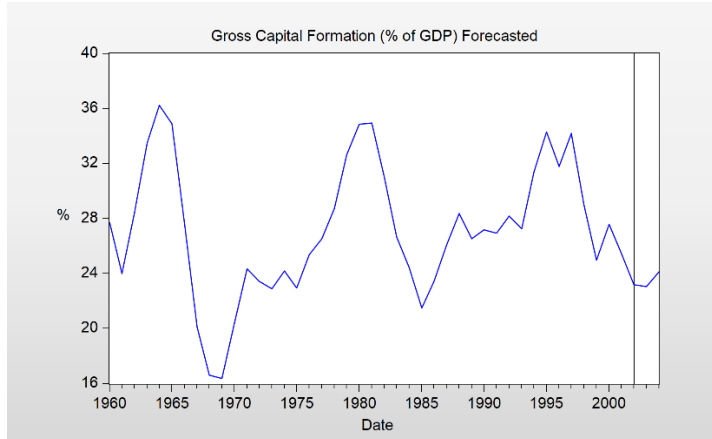
Key Metrics for Inflation	Values
ARMA model	(1,4) (0,0)
AIC	0.084
Q-Stat value	M12- 8.420 M24-16.026
T-test	-0.288



Note: Data was sourced from (Hong Kong Government Data, 2020a).

Figure 26e:

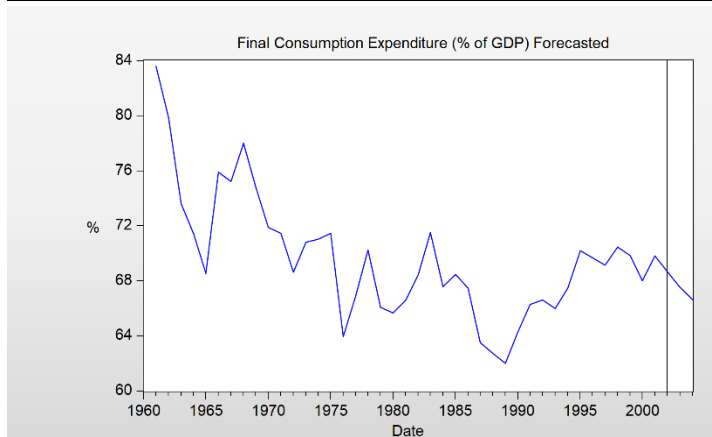
Key Metrics for log of Investment	Values
ARMA model	(2,0) (0,0)
AIC	-1.677
Q-Stat value	Y1- 0.011
T-test	2.220



Note: Data was sourced from (World Bank, 2020f).

Figure 26f:

Key Metrics for Consumer Spending	Values
ARMA model	(1,1) (0,0)
AIC	5.060
Q-Stat value	Y1- 0.225
T-test	-2.552



Note: Data was sourced from (The World Bank, 2020).

Chapter Six: Precautionary Savings:

This chapter will explore how precautionary savings has been impacted post each exogenous event. The rationale for exploring precautionary savings is to also provide analysis at the microeconomic level. Additionally, the uniqueness of exogenous events is that in many circumstances it is unpredictable, creating uncertainty, this accompanied with subsequent economic policy responses can impact household's precautionary savings. If precautionary savings increases significantly it can impact the policy objectives of monetary and fiscal policy. Therefore, this chapter will outline why precautionary savings is a key area that policy makers must be wary of and provide recommendations for adequate policy responses when precautionary savings is present to maximise efficiency and effectiveness.

Leland first explored precautionary savings, establishing that when consumers are faced with uncertainty, specifically in the labour market, consumers will increase their savings (Leland, 1978). Additional research has shown that precautionary savings can increase when there is uncertainty around interest rates, another factor impacting wealth (Sandmo, 1970). James Rickards argues that lower interest rates could increase precautionary savings as households try to compensate for the lower level of interest they earn on their deposits (Rickards, 2014). Further empirical research indicates if governments can implement policy responses that reduce uncertainty, this can reduce the precautionary motive, in turn, stimulate aggregate demand (Kazarosian, 1997).

However, if not accounted for when designing policy responses, precautionary savings can result in offsetting behaviours, which can counter act economic policy. In line with this, the theory of Ricardian equivalence presents the idea that households are forward looking and internalize the government budget constraint when making consumption decisions (Seater, 1993). Therefore, if a government is undertaking fiscal policy at a level deemed unsustainable by households, it could result in little change in consumer spending. Perhaps, a government may choose to run a deficit in response to a disaster aiming to stimulate the economy, but consumers may start saving as they realize there could be tax increases in the future, to pay off current expenditures (Seater, 1993). These offsetting behaviours would contradict the objectives of expansionary fiscal and monetary policy.

Economic theory extensively explores the idea that monetary and fiscal policy can be used to stimulate the economy, however there is conflicting views regarding consumers reactions to such policy. Hence the importance of carrying out this statistical analysis is to study the

empirical evidence to analyse how consumers saving levels have reacted to uncertainty in past events, to determine whether fiscal and monetary policy have been successful in stimulating the economy. If policy responses do not stimulate the economy, prolonged recessions can prove detrimental for numerous reasons.

The data used for this analysis was gross savings as a percentage of GDP, gross savings is measured as gross national income plus net transfers less total consumption (World Bank, 2020g). The data was sourced from the World Bank as it is a reputable source that had extensive data for countries worldwide which is needed for synthetic controls. Time periods chosen for the data sets for each exogenous event is shown in Figure 27 and was determined by available data from The World Bank, the data was filtered to ensure a quality and balanced panel data set. In addition, Figure 27 details the number of donors for each synthetic control, RMSPE and placebo p-value to (2.d.p). Notably whilst all synthetic controls and actual values had similar movements, there was some clear differences. Hence further analysis could improve the synthetic controls, for example, selection testing amongst frequency of pre intervention outcome variables used.

Figure 28 shows the synthetic control graphs for all exogenous events as a holistic visual comparison between the events. Beginning with Hurricane Katrina, Figure 29 shows post treatment the synthetic control figures are higher than actual figures. Hurricane Katrina was the only exogenous event in the short-term post treatment, to experience an increase in savings. Likely attributed to a contractionary monetary policy implemented shortly after the disaster, the disaster occurred during an economically stable time and impacts were constrained relatively locally. The in-space placebo test for Hurricane Katrina showed that 202 times out of 378 a pseudo-treated country had an apparent impact of the placebo that exceeded the impact experienced by America. A probability of 0.54 hence not statistically significant.

Next, Figure 30 shows the results for the Japanese earthquake, the graph shows post treatment synthetic control savings levels is above actual saving values for Japan. In the short term after treatment, savings decline before gradually increasing. The in-space placebo test produced a p-value of 0.82 hence not statistically significant. The Christchurch earthquake synthetic control is shown in Figure 31, post treatment synthetic control savings levels is above actual levels. In the short-term post treatment, the actual saving rates for New Zealand levels off with a gradual decline, whereas the synthetic control levels off with a gradual

incline before both the synthetic and actual values increase. The in-space placebo test produced a p-value of 0.80 hence not statistically significant.

Next, Figure 32 shows the September 11th, 2001 terrorist attack results, post treatment, the synthetic control values are above the actual values and in the short-term, actual values show a decrease in the saving rate before beginning to rise, whilst the synthetic control increases throughout the short term. The in-space placebo test produced a p-value of 0.73 therefore not statistically significant. Furthermore, the Madrid 2004 train bombings synthetic control can be seen in Figure 33, the synthetic control was above actual values and in late 2004 the actual saving rate for Spain was declining, whilst the synthetic control was rising. This trend continued for several years post treatment. The in-space placebo test produced a p-value of 0.84 hence not statistically significant.

The 2015 Paris terrorist attack synthetic control can be seen in Figure 34, there is significant differences between the actual and synthetic control values in late 1990's and early 2000's, however for the remaining pretreatment time the synthetic and actual values are similar, hence improving the reliability of the synthetic control. Post treatment the savings rate for France fell in the direct short term before beginning to rise again, similarly for the synthetic control there was a levelling off after treatment before a rise. Noticeably however, the actual savings level for France is above the synthetic control. The in-space placebo test produced a p-value of 0.44 hence not statistically significant.

Lastly for the 2003 Hong Kong SARS pandemic, Figure 35a shows the synthetic control and actual values for Hong Kong are closely related until just before treatment when the synthetic control decreases and the actual saving values for Hong Kong increases. Post treatment actual saving levels is above the synthetic control and in the short term the savings rates for Hong Kong decreases, however there is a recovery and actual savings rate increases for Hong Kong. The in-space placebo test produced a p-value of 0.29 thus not statistically significant.

For the five exogenous events where savings levels were below the synthetic control post treatment, the in-space placebo tests did not produce a significant p-value. Therefore, there was no evidence to suggest savings levels were elevated more than what would be expected post these exogenous events, if the exogenous events did not take place. Further to this point, the insignificant p-values show that a significant proportion of the time one could expect just as large or larger differences to occur in the pseudo treated country compared to the treated country. Since each exogenous event had varying shock levels and various policy or lack of

policy responses, there could be a few justifications for these results. For exogenous events like the Tohoku earthquake in Japan that had a nationwide impact and there were extensive economic policy responses taken, the policy stimuluses could have worked. In the sense that whilst policy makers want to ensure long term savings for economic propensity, in the short term post these exogenous events, policy makers want to ensure sufficient aggregate demand levels to stimulate the economy. Thus, want to limit precautionary saving levels. Opposingly for exogenous events like the Madrid attack that had limited nationwide economic impact and no policy response, the statistically insignificant differences could be attributed to the exogenous shock simply not having a substantial impact on savings.

Two exogenous events had savings levels higher than the synthetic control, hence representing the possibility of precautionary savings being presented. Yet both synthetic controls produced statistically insignificant p-values. However, it is important to note that France is a member of a shared monetary union. It is part of an open and interconnected European banking and trade system. Therefore, for any valuable conclusions to be made, it would be beneficial for further research to look at the savings rates of the entire Eurozone at the time.

Lastly, for the SARS pandemic notably in the year Hong Kong dealt with the pandemic, 2003, the in-space placebo test showed that 0 times out of 34 did a pseudo-treated country experience an apparent impact from the placebo that exceeded the difference in savings experienced by Hong Kong. Compared to other exogenous events, the pandemic had significant restrictions on individuals' movements, the Hong Kong government enforced quarantine, travel restrictions, restrictions on gatherings and so on (Chan & Schloenhardt, 2004). This all occurred when e-commerce consumption was still in its infancy, therefore if people were staying at home, they simply could not spend their money like they could pre the pandemic, arguably this could drive up savings rates. However, on the other hand, increase savings could also have been attributed to greater uncertainty occurring during the pandemic, compared to other exogenous events, therefore the presence of precautionary savings. During the pandemic people did not know how long restrictions would be in place for, unlike earthquakes or terrorist attacks where a significant proportion of the shock can be analysed immediately. Hence despite Hong Kong's government implementing an expansionary fiscal policy in pursuit of stimulating the economy, precautionary motives could have dominated, resulting in savings to increase.

Consumer spending and savings rates are intertwined, if a consumer does not choose to spend, they can choose to save for future consumption. Notably, as has been previously discussed in the empirical analysis of the pandemic, consumer spending declined in Hong Kong during 2003 and slight improvements were made in 2004. However, overall results did not statistically significantly differ from what was forecasted in the ARIMA models. In addition, as discussed earlier within the HKMA forecasts, it was anticipated that there would be a decrease in consumer spending in 2003 due to three factors; high unemployment, slow wage growth and weak asset prices. However, interestingly the unemployment rate in Hong Kong declined. Therefore, whilst consumer spending trends followed forecast, unemployment was lower than forecast and savings were above synthetic control levels.

Overall, the insignificant p-values shows this analysis produced no significant evidence of precautionary savings being present post the exogenous events studied. However, the data from Hong Kong shows potential for precautionary savings to be present in the context of pandemics. Consequently, since COVID-19 is a recent and ongoing crisis, a similar empirical study cannot be produced, however valuable analysis can be seen by looking at how personal savings figures have changed for countries worldwide in 2020.

For the United States, in April 2020 personal savings rate hit a record high of 33.7 percent, whilst the savings rate did decline from this elevated point throughout the year, savings rates have continued to be high when compared to saving figures for the same time in previous years (Singletary, 2020). The savings rate was 13.6 percent as of October 2020, higher than any peak in savings level in any previous recession and nearly at twice the savings level pre the recession (Smith, 2020). Similar patterns have been evident in China, for the first three quarters of 2020 the personal savings rate as a portion of disposable income totaled 37.2% compared to 32.2% during the same periods in the previous three years (Trivedi, 2020). In addition, in New Zealand a report from the government treasury outlined that for 2020 there was an increase in annual percentage change in deposits showing evidence of the potential of precautionary savings (New Zealand Treasury, 2020). Furthermore, there was a sharp and significant reduction in electronic card spending durables in the month of April (when New Zealand was in level 4 and level 3 lockdowns), overall total retail sales fell by \$2.6 billion equivalent drop of 47% (Stats NZ, 2020).

Several surveys have been conducted to gain an understanding on what has driven the increase in savings rates worldwide. One survey by Gallup and Franklin Templeton found

that 54 percent of Americans are deciding to save, at the very least a little money, until there's a vaccine (Singletary, 2020). In addition, the survey discovered a trend that many are deciding to take less risk and keep their money in liquid safe assets (Singletary, 2020). In China, one of the government's plan to stimulate the economy has been focused on extending each yuan of household income (Trivedi, 2020). However, many have argued the key factors driving the lower consumption levels in China is a decline in households' disposable incomes and a rise in household savings (Trivedi, 2020). Hence arguably the problem will not be solved until household's disposable income increases or households begin to feel more financially secure (Trivedi, 2020).

Furthermore, whilst in comparison to the SARS pandemic the COVID-19 pandemic has occurred when online shopping is more prevalent and the online sales have seen a substantial increase versus retail spending worldwide during the crisis (Evans, 2020). Clearly the savings empirical results still show evidence of the prospect of precautionary savings being present. Therefore, as many governments worldwide have and continue to implement significant lockdowns and restrictions to curtail the virus, the presence of online activity has not stopped consumption being impacted. Retailers and many online retailers operating in non-essential industries have simply not been able to go to work in many countries during lockdowns. Therefore, the same question as previously raised applies once again. Were people saving/continue to save as a precautionary motive or simply because they could/cannot spend, or to fuel future spending once the pandemic ends?

A study examined the current trend in savings rate of America in greater detail. The study asserted that historically it has been established that savings rates can increase through one of two mechanisms, either consumption falls relative to income or income rises relative to consumption (Smith, 2020). However, arguably the linkages are more complicated than this. For instance, since an individual's consumption is another person's income, if there is an increase in the savings rate as well as a drop in aggregate consumption, then this can lead to a decrease in aggregate income thus dampening future spending, meaning, savings has not led to an increase in future spending (Smith, 2020). Therefore, there is argument that the COVID-19 pandemic could have initiated this precautionary behaviour, however on the other hand, it is possible that the high levels of government transfers can drive both savings rates and future consumption higher (Smith, 2020). If transfer income has been saved during lockdowns and restrictions and is eventually spent, then savings rate could normalize and possibly there can be higher future consumption and income which could stimulate aggregate

demand (Smith, 2020). Therefore, this is a key concern for policy makers currently, they need to examine the motives behind the saving rates to determine what future consumption is likely to be, in turn the impact on growth.

The study conducted a statistical analysis to historically examine the relationship between government transfers, savings rate and consumption. It found transfer induced increases in the savings rate has led to an increase in consumption (Smith, 2020). However, it was also determined that an increase in the savings rate driven by precautionary motives have led to persistent declines in consumption (Smith, 2020). Hence suggesting that precautionary savings can result in a negative correlation between current savings rate and future spending (Smith, 2020). The study concluded that the current increase in savings rate in America during COVID-19 has been driven by precautionary motives (Smith, 2020). Hence based on previous findings from the analysis it would suggest that a significant proportion of the increase in savings currently happening is unlikely to be spent in the near future.

The study recognized that historically savings rates have failed to predict future consumption, reinforcing the idea that a higher savings rate does not necessarily drive higher future spending (Smith, 2020). However, the current COVID-19 crisis is unprecedented in nature thus there could be differentiation from historical trends (Smith, 2020). On the one hand, the previously unimaginable income uncertainty may result in households to continue to save to protect against potential future income losses (Smith, 2020). On the other hand, the magnitude and unprecedented size of government transfers could support spending once the pandemic ends. Notably the crisis has resulted in significant discrepancies in impacts across the economy (Smith, 2020). Hence whilst households may want to increase savings, those on lower wages in the hardest hit sectors may not be able to achieve these desires. In turn, those who are able to save if they do save, this will further exacerbate the income of the lower earners, worsening future consumption (Smith, 2020).

Interestingly, when looking at the context of Sweden, there is a slightly different story. The empirical results published in November by Eurostat shows that the European Union recorded its highest year over year increase in savings since the time series began, with an increase of 10.8 percent (Eurostat, 2020). With the main contributing factor behind this trend being a 17.3% year on year decline in household final consumption expenditure (Eurostat, 2020). However, Sweden was the only member state who experienced a decline in the savings rate in the second quarter of 2020 compared to the second quarter of 2019, a decline

of -0.6 percentage points (Eurostat, 2020). However, notably other studies earlier in 2020 established that there had not been a significant difference in consumption rates between Sweden and its neighboring countries. For instance, researchers at the University of Copenhagen discovered that consumer spending fell only 4 percent less in Sweden than in neighboring Denmark, a fall of 25% versus 29% (Schwartzkopff, 2020).

Looking at just the saving rate decline for Sweden once again shows, there could be a combination of reasoning for the results. It could have been the fact that citizens in Sweden were still able to go to work and live a quasi-normal life that gave citizens confidence to continue regular consumption habits and not accumulate precautionary savings levels. Or the mere ability of being able to spend increased spending, or likely, a combination between the two. Again, surveys can provide some indication for the answers, but possibilities of combinations remain.

Notably in New Zealand, a country that implemented strict lockdown measurements and presently reaping the benefits comparatively on the international scale, quick recoveries were seen in consumption levels and decline in savings when lockdown restrictions were lifted (Stats NZ, 2020). In actual terms, spending on durables in New Zealand experienced the greatest increase, up 20 percent equivalent to 259 million compared with July 2019 (Stats NZ, 2020). Again, there can be a combination for these results, it could simply be consumers being able to spend and spend the money saved during lockdown. Or getting out of lockdown gave people greater reassurance and confidence, limiting their need for precautionary savings, in turn stimulating aggregate demand, or a combination of these factors.

Overall, all the results discussed show that for exogenous events that on the demand side cause a great deal of uncertainty and significant restrictive measures as seen with SARS 2003 and COVID-19 pandemic, there is a noticeable impact on savings rates. Compared to the empirical results for other exogenous events such as natural disasters. Therefore, this adds complexities to policy makers decision making, as has explained earlier, there is many unknowns as to whether an increase in savings will lead to higher future consumption. Further to this, even if higher savings does lead to higher future consumption, at a time of a crisis, particularly with COVID-19 that is prolonged, immediate stimulus is vital to soften the economic downturn. Thus, clearly too high of saving rates contradicts the aims of expansionary fiscal and monetary policy. Highlighting the key flaws of predominantly monetary policy where for all intents and purposes monetary policy represents the common

metaphor that you can lead a horse to water, but you cannot make it drink. Foreshadowing in this context that monetary policy can create an environment that supports and encourages spending, but due to the indirect transmission mechanisms, cannot make consumers spend. Therefore, central bankers' carrot and stick mentality only influences behaviours to a certain extent in some contexts.

Arguably the same problem can occur with quasi-indirect targeted fiscal policy responses, seen implemented by many countries in response to COVID-19. For example, New Zealand's wage subsidy and America's fiscal stimulus cheques with no strict restrictions on how the stimulus had to be used. This once again allows for the potential opportunity for precautionary savings. This form of fiscal policy can provide consumers with the favourable ability to spend, but not actually force one to spend. Compared to a targeted fiscal policy, for example the building of infrastructure or in the context of COVID-19 issuing travelling vouchers for higher earners, limiting the opportunity for precautionary savings to transpire. Consequently, the indirect nature of monetary policy is not as effective in stimulating aggregate demand when precautionary savings is present. Rather fiscal policy, when targeted with precision, can be more effective which will be further discussed in the next chapter.

Appendix: Precautionary Savings:

Figure 27:

<u>Exogenous Event</u>	<u>Date of Event</u>	<u>Sample Period</u>	<u>Number of Donors</u>	<u>RMSPE</u>	<u>Placebo p-value</u>
Hurricane Katrina, America	29 th August 2005	1990-2018	28	1.043969	0.54
Tohoku Earthquake, Japan	11 th March 2011	1996-2018	39	1.676356	0.82
Christchurch Earthquake, New Zealand	22 nd February 2011	2000-2018	33	1.366955	0.80
September 11th Terrorist Attack, America	11 th September 2001	1990-2018	28	1.222736	0.73
Madrid Train Bombing Terrorist Attacks, Spain	11 th March 2004	1995-2018	35	0.6723856	0.84
Paris Terrorist Attack, France	13 th November 2015	1995-2018	35	0.8808496	0.44
SARS Pandemic, Hong Kong	12 th March 2003	1998-2018	35	0.0789561	0.29

Figure 28:



Figure 29:

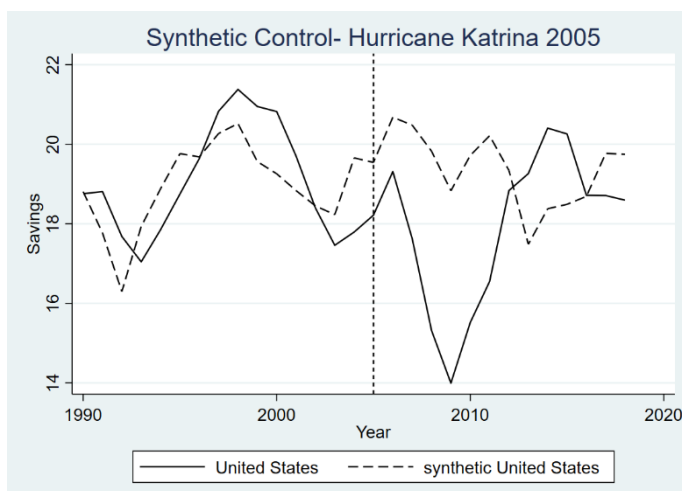


Figure 30:

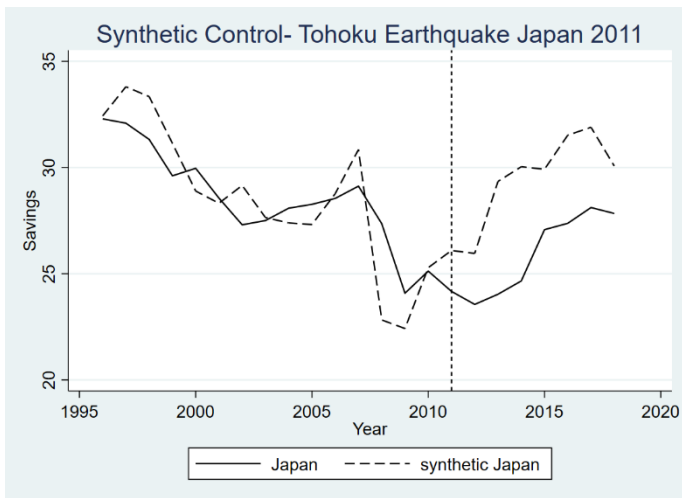


Figure 31:

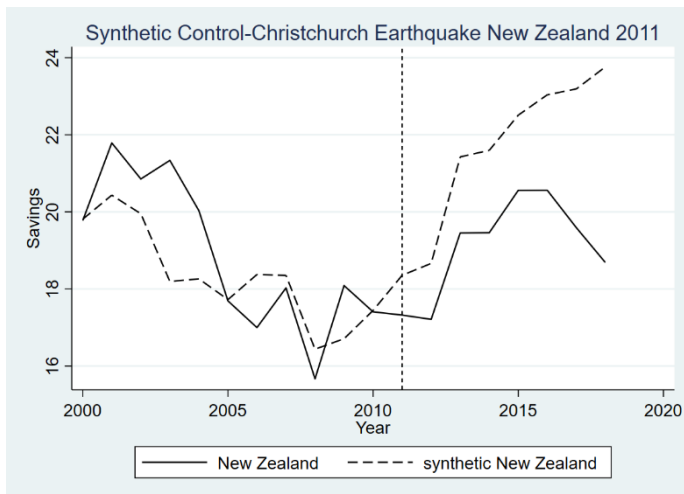


Figure 32:

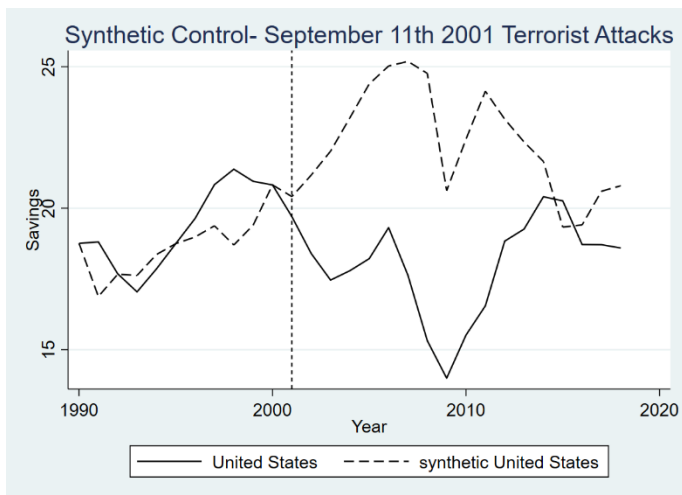


Figure 33:

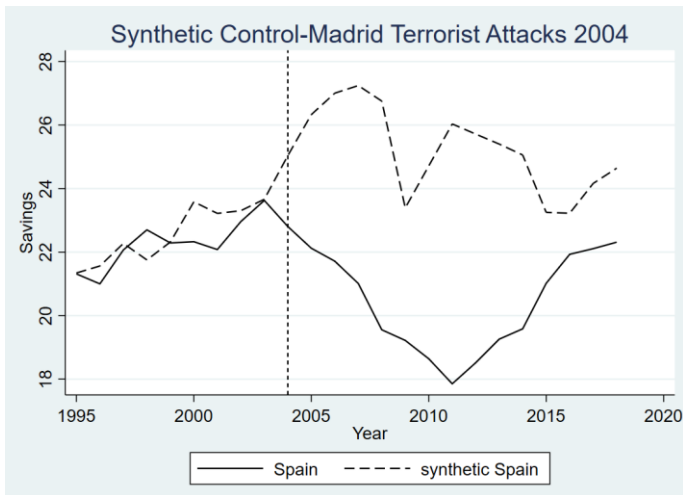


Figure 34:

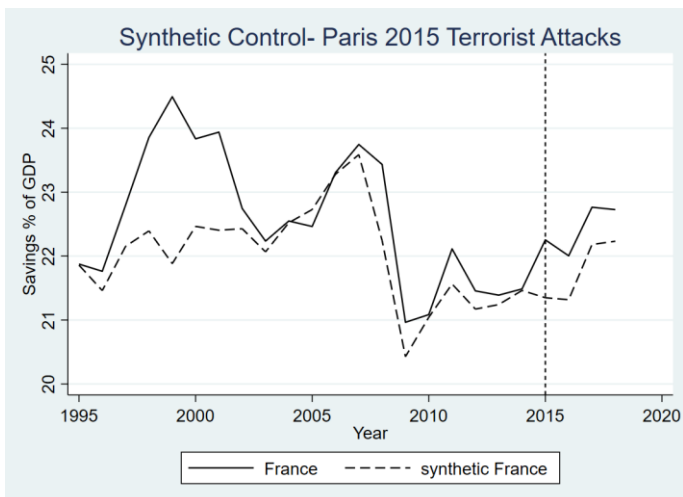
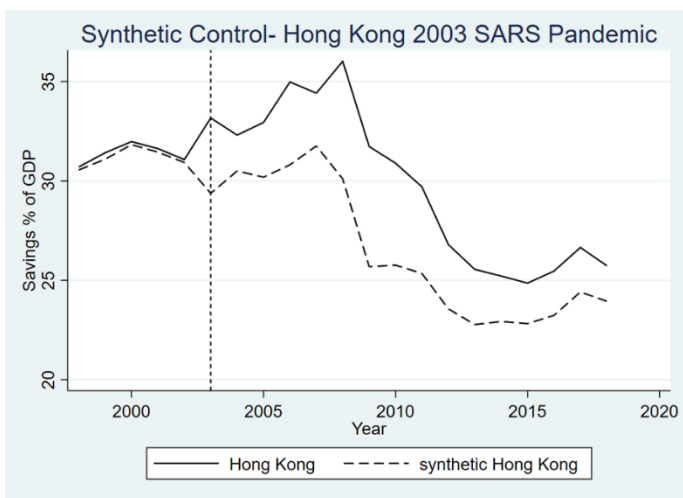


Figure 35:



Chapter Seven: Discussion of Results at the Aggregate and Economic Policy

The aim of this chapter is to use the economic theory and empirical analysis previously discussed to compare and contrast the exogenous events studied and subsequent economic policy response or lack of economic response, overall impact to the country's economy. In order to provide understanding to the key research questions and overall derive a value assessment in regard to suitable economic policies in response to exogenous events. This chapter begins by touching on findings from the stock market and its use as an indicator for policy responses. Next, value assessments are made regarding the role of monetary policy to respond to exogenous events, following on, assessment is made to the role of fiscal policy. The chapter concludes with providing an overall recommendation on how best to respond to exogenous events in the future.

Firstly, analysing the stock market results through the lenses of the efficient market hypothesis, there were two exogenous events that resulted in a market correction. However, there was no significant adverse movement or recoveries seen in the stock market after economic policy responses were made public for any of the exogenous events. The Tohoku earthquake and tsunami had a market correction of 17.5% within the first few trading days after the disaster. Compared to the other two natural disasters studied, the impact for Japan was felt predominately nationwide and as previously mentioned, the subsequent Fukushima disaster further exacerbated uncertainty. In addition, the September 11th terrorist attacks experienced a market correction of 11.6% over the first five trading days post the attack. Compared to the other two terrorist attacks September 11th resulted in a significantly greater loss of life and economic damage. Furthermore as previously acclaimed since 9/11 markets continually price with the mind frame that the world is in a constant threat of being at war with a common enemy, terrorist attacks (Benjamin, 2015).

Furthermore, the Hong Kong SARS pandemic showed no significant shock in the markets. However, the current COVID-19 pandemic has resulted in significant reaction in financial markets worldwide. The S&P 500 was down 20% in the first quarter of 2020, recording its worst quarter since the last quarter of 2008 (CNN Business, 2020). Stock markets have displayed extreme volatility throughout 2020, as economies have been worsening, the stock markets have appeared to improve (Phillips, 2020). Resulting in many to question the strength of linkage between the markets and the economy. David Rosenberg articulated his

view as to why the discrepancies exist between the stock market and the economy in an interview with CNBC. He stipulated that the situation the world finds itself in right now is an extension of an old story (Rosenberg, 2020). Claiming that between 2010-2019 economies experienced the most powerful bull market accompanied by consistent low GDP levels, arguing that a great illusion of significant earnings was created (Rosenberg, 2020). Furthermore, he argued that there are several factors that increase equity including liquidity, sentiment and momentum (Rosenberg, 2020). Therefore, currently the stock market is increasing due to the price earning multiple which is being influenced by the liquidity in the market (Rosenberg, 2020).

Moreover, when looking at the difference between the movement of the S&P 500 value versus the S&P 500 in 2020 other key points come to light (S&P Dow Jones Indices, 2020). Arguably the companies in the stock market are the companies that have been able to operate throughout the crisis and benefited from the pandemic. Particularly seen through key technology companies such as Microsoft, Apple and Google (Braithwaite, 2020). Moreover, a further influential factor that has been prevalent during COVID-19 is the presence of Robin Hood traders (Griffith, 2020). There has been opposing views to the influence such traders have on the market, however arguably one could claim that the increase of Robin Hood traders has made irrational decisions become the new rational as there are many irrational people making irrational decisions.

Overall, when looking at the COVID-19 context, the economy can be viewed as the master and the stock market as the dog. The dog hasn't and doesn't necessarily go in a straight line but does follow the master and currently during COVID-19, we have seen the leash get longer. Therefore, in comparison to previous exogenous events there has been greater fluctuations in the stock markets during COVID-19. However, this is not a signal to discredit the theories mentioned and the use of using the stock market as an indicator. Whilst greater caution may be needed with events that have high levels of uncertainty, seen with COVID-19, clearly stock market data can be one valuable tool to equip policy makers with information in a timely manner to determine adequate economic responses.

Monetary Policy:

Looking at monetary policy, out of the seven exogenous events studied, three events resulted in central banks to take direct monetary policy responses. Beginning with the Christchurch earthquake, the RBNZ decreased the OCR by 50 basis points from 3 to 2.5 percent, in its commentary the RBNZ clearly stipulated this decision was made with limited information (RBNZ, 2011). The actual results versus the forecasted results from the RBNZ showed no significant immediate deviations for RGDP and unemployment at the nationwide level after the earthquake. In addition, the empirical results from the statistical study of the key macroeconomic variables only showed significant adverse deviations from what was forecasted for consumer confidence and consumer spending. However, recoveries were made within the two years post the earthquake and overall RGDP increased greater than what was forecasted. Therefore, whilst one has the benefit of hindsight, there are key points to consider with the economic policy responses taken for the Christchurch earthquake.

Firstly, when making decisions arguably greater focus should be placed on where interest rates currently sit on the spectrum. If a nation is placed higher on the spectrum, for instance sitting at seven percent, there is greater room and ability to respond to exogenous events like the Christchurch earthquake. However, as interest rates were sitting lower on the scale, three percent, when the earthquake occurred, policy makers had to ask themselves is this move effective and necessary and weigh up whether it is needed now or better saved for a rainier day. For instance, it is likely many central bankers worldwide would have preferred to be at a higher point on the interest rate spectrum when a catastrophic event like COVID-19 began.

Arguably for a small open economy like New Zealand, the exogenous event that is most important to respond to with monetary policy is an exogenous event that has also impacted key players like the United States. For example, due to the nature of the USD being the key reserve currency when the United States is decreasing the Federal Funds Rate that is when New Zealand should be looking to decrease the OCR in order to remain competitive in a zero-sum currency dynamic. Consequently, when one is dealing with an event with small localized impacts, seen with the Christchurch earthquake, arguably a fiscal policy response should be the first point of call and sufficient.

Notably at the time the Christchurch earthquake hit, central bankers around the world were fixated about deflation at the back of the GFC, hence one could argue that a fall in the OCR was likely to occur regardless of the Christchurch earthquake. In addition, the empirical

values suggested no evidence of the expansionary fiscal and monetary policies overcompensating and resulting in significant unsustainable increases in macroeconomic variables. Given the climate at the time, improvement in key variables such as GDP compared to forecasted was welcomed. However, whilst the data is not available so a decisive conclusion cannot be made, arguably it could have been beneficial if the Reserve Bank delayed the cut in the OCR, for example for a few quarters, when inflation continued to fall over the two-year period post the earthquake.

This would have meant the expansionary monetary policy response would have been in reaction to the key factors driving the low inflation rate at the time, as previously mentioned, the strong NZD, lower inflation expectations and subdued wages (Kergozou & Ranchhod, 2013). Rather than the Christchurch earthquake which whilst was a piece to the puzzle did not result in the nationwide impact some predicted (Kergozou & Ranchhod, 2013). Hence once again reinforcing the idea that for economies like New Zealand in the post GFC low interest rate environment, it is beneficial to save monetary policy and rather employ fiscal policy in response to localized exogenous events when a nation is operating at the lower end of the interest rate spectrum.

Looking at the context of Hurricane Katrina as previously explained, the Federal Reserve took no direct monetary policy response to the disaster. Rather the Federal Funds Rate increased after the hurricane to address rising inflation pressures which was further impacted by the hurricane. The empirical results showed no significant adverse impact to the nationwide macroeconomic variables as a result of such policy responses. Hence supporting what has previously been discussed, in regards to limiting the use of monetary policy for exogenous events that result in relatively localized impacts and rather rely on fiscal policy.

The scope of this analysis did not allow for an in-depth study on whether the wealth effect was present post the exogenous events analysed. As has already been discussed in the empirical results, a few exogenous events resulted in statistically significant differences in consumer spending levels however recoveries were seen to varying degrees. Hence whilst there is evidence of consumer spending recovering post the exogenous events studied it is not determined how much of the increase was driven by the wealth effect.

As previously mentioned, whilst central banks try to influence consumers behaviour to spend through a carrot and stick mentality and hope the wealth effect is at play to some extent, to stimulate overall aggregate demand, a key issue can arise. This can be seen with the COVID-

19 crisis, the wealth effect can drive inequality, causing economic and societal issues. Many have argued that the extensive conventional and unconventional monetary policies implemented by central banks around the world has resulted in many economies to experience a 'K' recovery (Powell, 2020). Arguably the essence of why this shape of recovery has and continues to occur is due to low wage households being the most impacted from the pandemic whilst asset values have soared, widening the gap between the haves and the have nots (Powell, 2020). Further to this, many companies have prioritized shareholders over staff, exacerbating the problem (Atwater, 2020). Seen with numerous examples, including BP, giving investors a pay-out for the first quarter of 2020 but planning to cut 10,000 jobs by the end of 2020 (Horowitz, 2020).

A predominant factor resulting in the widening of the gap is the significant gains realised in the stock markets due to the cash injected by central banks. To this point, studies have found that after the dot-com crash in the early 2000's middle class families exited the stock market. In turn, the financial hardship many middle-class families have faced in recent times prevented them from re-entering the stock market (Horowitz, 2020). The wealthiest one percent of Americans now account for approximately half the total value of equities owned by US households (Wigglesworth, 2020). Highlighting the fact that the massive gains experienced in the S&P 500 this year has disproportionately flowed to the rich.

In addition, arguably expansionary monetary policy has resulted in some economies to experience an overheated housing market. Particularly seen within New Zealand, many have argued that the extensive expansionary monetary policy introduced by the RBNZ including a cut in the OCR, quantitative easing, lowering of loan to value ratios and hinting of negative interest rates is a predominant factor driving housing prices up resulting in increased inequality (Brockett, 2020). The average house price in New Zealand rose by an annual 8% in October, the fastest gain experienced in three years with overall volume of sales increasing by 25% from the same time in the previous year (Brockett, 2020). Notably whilst New Zealand's housing market is also suffering from other key issues, for instance a supply shortage, many are arguing and it's becoming a political debate that the expansionary monetary policy is a predominate factor causing the highly inflated housing market (Brockett, 2020). This is not just a New Zealand phenomenon; significant house price rises have also been seen in other countries such as Australia throughout this year (Heath, 2020).

Governor of RBNZ, Adrian Orr has defended the actions taken by the Reserve Bank stipulating on November 11th in a news conference that “All I ever read about with monetary policy is house prices, yet that’s not our mandate, our mandate is consumer-price inflation and employment”(Brockett, 2020). Orr went on to further explain that “We have seen a marked acceleration in higher risk loans, particularly to investors in the property market,” in reaction the Reserve Bank has decided to raise the loan to value ratios again in March 2021 (Brockett, 2020). However, Dominick Stephens chief economist at Westpac Banking Corp expects such a movement will not have a significant impact rather anticipates that house prices will continue to accelerate to 15% by June 2021 (Brockett, 2020).

Therefore, clearly whilst house prices are not in the RBNZ official mandate they do have a major role to play in ensuring financial stability of the wider New Zealand economy (Brockett, 2020). In addition, as previously discussed, whilst consumer spending in New Zealand experienced a rebound post lockdown (Stats NZ, 2020) providing evidence in support of the wealth effect being active to some extent. The key question is whether other economic responses would have resulted in the same increase in consumption whilst avoiding the substantial rise in inequality.

Further to this, Gita Gopinath has clearly articulated that she believes that monetary and fiscal policy have responded adequately to what was needed for the COVID-19 crisis (Sandbu, 2020). Arguing that if such actions were not taken and the situation worsened, the problems would begin to be solvency issues rather than liquidity issues, which is something monetary policy is not well placed to handle (Sandbu, 2020). When asked about inequality, whilst acknowledging other factors, Gita attributes the problem predominately to automation (Sandbu, 2020). Arguing that when it comes to access to opportunities around the world, in regards to healthcare and education there has been little progress (Sandbu, 2020). Looking at statistics from Microsoft as a result of COVID-19, Satya Nadella asserted in April 2020 that 2 years of digital transformation has occurred in 2 months, highlighting the discrepancies of equal opportunities (Spataro, 2020). Additionally Gita acknowledged that the current crisis seen with COVID-19 is increasing the level of automation occurring which has further exacerbated inequality (Sandbu, 2020). Hence she argued policies need to be developed that identify the specific problems that have arisen and will continue to appear because of this crisis, for instance labour market policies that help reskill workers and relocate workers to where jobs are available (Sandbu, 2020).

Therefore, whilst there could be argument for central bankers to widen their mandate to consider greater economic factors, another argument can be for central bankers to return to their previous omnipotent ways. Such behaviour was seen during the period of great moderation, when Alan Greenspan was the Chair of the Federal Reserve. However, there was a significant shift in central banker's behaviour post the GFC, with significant jawboning and forward guidance occurring in the economy. One example of such behaviour can be seen through Mario Draghi's 2012, "Whatever it takes" speech. For a long time now, central bankers have been predominant first responders to economic shocks, however history shows there has been some key issues arise with central banks. In particular using the Federal Reserve as an example, James Rickards argues that the Fed has poorly performed as a lender of last resort the two times it has been urgently called upon (Rickards, 2012). Firstly, during 1929-1933 when liquidity should have been provided and it was not and in 2007-2009 when insolvent banks should have been closed but instead was provided liquidity (Rickards, 2012). In addition, the GFC highlighted the weaknesses of central banks oversight. With the benefit of hindsight, it is clear that central banks took an overly relaxed approach to the regulation of financial activities (El-Erian, 2017). The lack of prior understanding of the failure within the banking system was shared by many, including Nobel prize winning economist Paul Krugman who stated during an interview he had "no idea of the fragility of the banking system" (El-Erian, 2017) . Therefore, just as the magnitude of the GFC was a surprise to economists and central bankers, many exogenous events result in central banker's decision making to have components of uncertainty. Thus, despite the political polarization facing many key western democracies, governments need to take the lead in providing economic stimulus.

Moreover, post GFC, central bankers have extended their use of monetary policy to further unconventional means. For example, one of the three arrows of abenomics, quantitative easing, was used on an unprecedented scale as a direct response to the Japanese natural disaster. In addition, whilst not used in direct response to the Paris 2015 terrorist attacks, QE was implemented soon after the exogenous event. There are some key potential consequences with quantitative easing. For instance, some argue that QE erodes one of the key advantages of central banks, that being their independence from political pressure. Additionally, credibility that arises with the transparency in their decision-making process (Carlin & Soskice, 2014). Having these two factors creates the power of central banks' ability to communicate and keep inflation expectations grounded at inflation target levels (Carlin &

Soskice, 2014). Arguably people may begin to view central banks in a new light when they start to take unprecedented unconventional actions which can have an impact on the central banks' ability for future inflation targeting (Carlin & Soskice, 2014).

In addition, QE may result in higher future inflation with the increase in money supply, however what really needs to be changed is higher expected future inflation. In order to stimulate the economy and get consumers and businesses spending, expected inflation must rise to avoid a deflation trap (Carlin & Soskice, 2014). However, extremely low interest rates can distort the allocation of resources and keep inefficient companies operating (Carlin & Soskice, 2014). Furthermore, QE can result in asset bubbles, as wealthy individuals own these assets, wealth discrepancies can increase. Additionally, low interest rates reduce yield returns on fixed income securities hurting income seeking investors. In turn, an unintended consequence of this is pushing investors further out the risk curve in search of yield (Carlin & Soskice, 2014). This is in line with the disadvantages of conventional monetary policy previously asserted. Predominately such policies help those who are already in an advantageous situation hence does not help those who need it the most (Friedman, 1982).

Lastly using America as an example, it shows the downfalls of the continuous use of quantitative easing. The first round of QE introduced by the Federal Reserve is largely seen as a success where as QE2 and QE3, not to mention operation twist, have seen to be less effective due to diminishing returns (Palley, 2011). When bond interest rates are already extremely low, there is diminishing effect further bond buying has on stimulating the economy. Ultimately, when QE is used to provide liquidity in emergencies, it is useful but with diminishing effects, arguably its indefinite use is not effective (Palley, 2011).

Therefore, rather than further widening central banks mandates or having central bankers continuously develop unconventional monetary policies, arguably it can be beneficial to revert back to their previous omnipotent ways, with long term strategic targeted engagement. Also accompanied with a greater focus in targeted fiscal policy responses from elected governmental policy makers.

Fiscal Policy:

Therefore, as James Rickard acclaims, "newly printed money is like morphine for the economy. It can ease the pain, as long as it does not kill the patient" (Rickards, 2014, p. 181). Carrying on this analogue, arguably after a significant exogenous event that causes a substantial shock, monetary policy can ease the pain and be needed throughout the recovery,

but fiscal policy is what can bring the patient back to health. Overall to be effective, fiscal policy needs to be sustainable, sufficient, temporary and targeted. It needs to be sustainable in the sense that it does not overly burden future generations nor does it impair on debt sustainability. Furthermore, fiscal policy should be sufficient to kickstart the economy without letting the economy become self-reliant on such stimuluses which could impact debt sustainability. Lastly, it needs to be targeted to ensure an effective stimulus that minimizes for example, excessive precautionary savings or fiscal stimuluses to the high earners. It needs to truly stimulate aggregate demand and build an improved future economy.

As has been previously discussed, both debt sustainability and Ricardian equivalence are key factors policy makers must consider when implementing fiscal policy. Out of the 7 exogenous events studied, two events that implemented an expansionary fiscal policy explicitly referenced the need to maintain sustainable debt to GDP levels. The two events were the Christchurch and Japanese earthquake, both occurred post the GFC. With Christchurch a debt driven fiscal policy response was chosen due to the economic climate at the time, policy makers did not deem it suitable to implement a tax cut (English, 2011). Financing fiscal policy by debt can be suitable if it passes a three-stage test. The three stages include that the stimulus produces positive returns, there is no displacement of private sector efforts and there is sustainable debt levels (Rickards, 2014).

Therefore, the finance minister at the time, Bill English, clearly articulated when delivering the fiscal report that New Zealand was still committed to reaching a budget surplus by the year 2015/16. Actual values showed the New Zealand Government did reach a budget surplus in 2015 and this surplus continued to grow up until 2019 (Trading Economics, 2020). As previously mentioned, Bill English acknowledged the importance to decrease debt levels in order to absorb future shocks. The benefits of governments having these policy objectives can be seen with the current COVID-19 crisis. Compared to international standards, New Zealand has so far weathered the economic ramifications better due to a range of factors, with one being the country having a budget surplus before going into the crisis (Smyth, 2020). In essence fiscal policy should aim to be counter cyclical, which post GFC is what has occurred in New Zealand. Debts that are incurred during a crisis should begin to be repaid once the economy is operating at an improved stage in the business cycle. This is to ensure economic burdens are spread across generations, so economies can continue to respond to economic shocks.

Overall, as previously mentioned, the empirical results from the Christchurch earthquake on the nationwide level showed limited adverse impact to key macroeconomic variables. However, as discussed before, there were improvements made directly in the Christchurch region where impacts were predominately felt, additionally Christchurch received key transportation and social infrastructure seen through the likes of a new convention centre. Thus, showing the success of the fiscal policy responses without the need to significantly impair the debt sustainability of the nation. Additionally, there was no significant prolonged adverse impact to business confidence and whilst consumer confidence did decline greater than what was forecast, this was also attributed to other factors at the time, including the economy rebounding from the GFC. Therefore, whilst there was room for greater improvement in consumer confidence, businesses continued to have confidence in the state of the New Zealand economy.

Notably with the Japanese natural disaster, the Minister of Finance made explicit reference in the fiscal policy address that the government was still striving to ensure a sustainable fiscal deficit for numerous reasons as previously stated. Hence the expansionary fiscal policy was driven predominately by increase in taxes and reduction in government spending elsewhere. Additionally the Japanese government fiscal policy plan from the revenue side was a long-term plan, with the aim to increase taxes over 25 years to pay for some of the costs of the natural disasters (OECD, 2012b). A report by the OECD highlighted the significant vulnerability of Japan's public debt ratio to GDP. Stipulating that whilst Japan's saving grace has been prolonged periods of low interest rates, Japan would be significantly adversely impacted if there was a rise in interest rates. Such an increase could result in debt levels to grow unsustainable as demonstrated through the debt sustainability theory (OECD, 2012b). In turn, fostering an environment of lost market confidence. One estimate in 2012 predicted that a one percentage-point increase in bond yields would add 1 trillion yen, which is equivalent to 0.2% of GDP to debt servicing costs in the first year, with the ability to rise up to 4.1 trillion yen equivalent to 0.9% of GDP in the third year (OECD, 2012b).

Therefore, the movement to fund fiscal policy by other means than debt was significant to not exacerbate the debt sustainability in Japan. The empirical results for Japan showed no significant difference in actual consumer confidence values compared to forecasted and for business confidence the actual values did not show a significant prolonged dip. Further to this, there was no statistically significant differences in consumer spending levels between actual and forecasted figures. In terms of investment, whilst no statistically significant

inferences could be made from the event study analysis framework, the actual values did show a recovery in investment levels within the two-year period. Hence whilst as previously mentioned one cannot pin point the exact impacts policy had on the macroeconomic variables. Taking a holistic view, whilst the natural disaster was significant, post the disaster there was no excessively prolonged and significant adverse impact to key macroeconomic variables that reflect the thoughts and behaviours of households and businesses in the Japanese economy. In turn, giving strength to the idea that at the very least policy helped to maintain pre-existing confidence in Japan's economy to keep the economy stimulated.

Overall, as previously mentioned whilst there were key flaws in the fiscal policy response, specifically in the labour market within the three disaster-stricken regions. The response from the Japanese government is a textbook example of a government adapting its response to the economic climate and debt sustainability of the country at the time of the disaster. While there are other economic factors at hand, such as high domestic savings rate, the Japanese government balanced the needs of stimulating the economy whilst trying to maintain confidence.

As was evident in the empirical results, the statistical analysis did not show Hurricane Katrina causing any statistically significant adverse impact on the key macroeconomic variables studied compared to forecasted values. However, as previously mentioned, this was predominately due to the majority of economic effects being limited to the states directly impacted by the hurricane. The impacts in the specific states were felt for a prolonged period due to the inefficiencies in the fiscal policies implemented as has been previously explained. Hurricane Katrina lacked in a cohesive, planned and user-friendly fiscal policy response. In addition, as previously stated, September 11th showed the inefficiencies that can occur from an unprepared fiscal policy (Makinen, 2002). The bureaucracy in America's governmental system resulted in significant delays in the implementation of fiscal stimulus in response to the terrorist attacks, impacting the policies usefulness in stimulating the economy (Makinen, 2002). In contrast, the fiscal policy response for the Hong Kong SARS pandemic in 2003 showed the benefit of having a relatively more targeted fiscal response.

Whilst each event is unique between Hurricane Katrina, September 11th and Hong Kong SARS pandemic and whilst the fiscal policy response implemented by the Hong Kong government for the SARS pandemic did have its flaws, comparing and contrasting the three events shows the benefit of having a targeted fiscal policy response. As previously explained,

Hong Kong had schemes in place to help continue to stimulate the economy even during a time when physical restrictive measures were in place. The empirical results showed a favourable trend in the unemployment figures, unemployment declined more than what was forecasted over the two-year period as previously mentioned. Hence showing positive signs of the targeted employment approach Hong Kong took to get unemployed individuals back into work and continue to stimulate businesses. Thus, the fiscal policy response seen in Hong Kong was not bogged down by the same inefficiencies seen with Hurricane Katrina and September 11th.

Notable further examples can be seen post the GFC, the Obama administration ran U.S. fiscal deficits of over USD\$1.4 trillion in 2009 and USD\$1.2 trillion in 2010. A study by John B Taylor and John F Cogan at Stanford University analysed the multiplier effect created from these fiscal policy initiatives. Initially Taylor and Cogan asserted the Obama stimulus program multiplier was 0.96 in the initial stages and concluded a substantial fall to 0.67 by end of 2009 and 0.48 by end of 2010 (Cogan et al., 2010). Thus, all these multipliers were less than one, representing that there was diminishing returns within the private sector to government stimulus (Cogan et al., 2010). James Rickards argues that the theory of the Keynesian multiplier being produced by government spending only works in limited conditions (Rickards, 2012). He argues that the stimulus programs work better in the short run rather than the long run, in liquidity rather than solvency crisis and works better for economies that enter recessions with relatively low debt levels (Rickards, 2012). None of these conditions were present for the American economy during 2009, arguably causing the limited multiplier impact (Rickards, 2012). This once again provides support to the importance of having targeted fiscal policy responses whilst ensuring fiscal sustainability to not overly burden one generation but address the issues at hand and consider long term prosperity.

An example of a past government fiscal initiative that fulfilled the three-stage test of a successful debt financed fiscal stimulus was seen in 1956 under President Eisenhower. An interstate highway system was approved which cost approximately \$450 billion equivalent to today's dollars (Rickards, 2014). An evaluation of the program afterwards concluded that the benefits of such a program far exceeded the cost and arguably only the government could have implemented such a large scale nationwide cohesive project (Rickards, 2014). At the time the program was implemented, the debt to GDP ratios were stable, hence passing the three-stage test of effective and efficient government spending to justify the increasing debt

levels (Rickards, 2014). Notably it is key for policy makers to remember that for debt sustainability it is not just debt levels that matter rather the debt to GDP ratio (Rickards, 2014). Hence an increase in debt is justifiable if it results in an increase in GDP levels to keep the debt to GDP levels sustainable.

There is a new school of thought which has growing support for crisis such as the COVID-19 pandemic; Modern Monetary Theory (MMT) could be a viable policy response. This theory asserts that for countries which have complete control over their own currency, government spending should be viewed as how much money the government is contributing into the economy and how much is being taken out, rather than being thought of as a budget (Ehnts, 2016). Furthermore, governments that have control over their currency should print as much money needed to stimulate the economy, believing that the only limit governments have when it comes to spending is the availability of resources, such as workers (Ehnts, 2016). This clearly differs from traditional thinking of not allowing debt levels to exceed to such high levels. However MMT stipulates that countries like America can sustain large deficits and it can be extremely harmful if governments do not build up deficits (Ehnts, 2016). As implementing strict austerity post exogenous events can be detrimental, thus whilst there is validity in MMT it is only suitable for some economic environments and governments need to be responsible in their debt decision levels. Further to this, governments should only take on debt levels if it will provide meaningful differences, inefficiencies can occur if fiscal policies are not targeted and effective, ultimately leading to worse social outcomes.

Such inefficiencies can be seen with fiscal policies implemented in response to COVID-19, providing argument against excessive quasi-targeted fiscal stimulus driven by debt. Many have argued that Americas economic response to the COVID-19 pandemic was beginning to suffer from the same administrative burden that occurred during Hurricane Katrina (Bloomberg Politics, 2020). One of the fiscal policy responses by the American government was to issue stimulus cheques to taxpayers earning below a certain threshold with the whole program costing \$265 billion (Coibion et al., 2020). Whilst this was an efficient stimulus to distribute cash into households' hands in the hope they would spend, the effectiveness of such a policy has been called into question. For instance, a study interviewing 12,000 Americans who received the stimulus cheques found that 42% of the money was spent, 27% was saved and 31% was used to repay debts (Coibion et al., 2020). Hence the stimulus cheques did not result in the increase in consumer spending and aggregate demand that was hoped by the government in the short term. In addition, as of the end of April 2020 more than

1 million stimulus payments totalling nearly 1.4 billion was sent to dead individuals (Hansen, 2020), once again showing the inefficiencies of such a system.

Moreover, in New Zealand similar quasi-targeted fiscal responses have been implemented for COVID-19 such as the wage subsidy, as was done during the Christchurch earthquake.

Whilst on the whole the program was successful in providing households with income, it too had its inefficiencies seen with loopholes. For example, large corporations received the wage subsidy however there was no regulations in place to keep employees in work over the medium term and there has been complaints of employees not being fully reimbursed by employers (Lock, 2020). Overall Vitor Gaspar head of IMF fiscal affairs department stated in response to COVID-19 “Governments need to do whatever it takes, because what governments do now will determine the speed and strength of the eventual recovery” (Gaspar, 2020). Hence clearly it was important for governments to implement extensive fiscal stimulus’, however it does not mean policies have been the most efficient, clear improvements could be made.

Complexity Theory:

Looking at the empirical results for all the exogenous events clearly shows a mix of outcomes. Policy makers have used a range of economic policies to respond to the exogenous events studied. Each exogenous event had its own unique combination of demand and supply shocks which resulted in a variation of the magnitude and type of economic impact felt. This factor, combined with other factors; such as the economic and social climate at the time the event took place not only domestically but also internationally, the debt sustainability of the nation, the uncertainty of the event, degree of impact and whether it was constrained regionally or nationally has resulted in a mix and range of combinations of monetary and fiscal policy responses. Overall, none of the empirical evidence showed significant over stimulus post these exogenous events, in other words, there was no substantial positive movements in macroeconomic variables that could be seen to be unsustainable. However, there is debate as to whether all the economic responses implemented were efficient and effective and whether they were needed or better saved, given the chaotic dynamic world we live in with the continuous occurrence of exogenous events.

Consequently, there is no clear-cut answer as to the best economic policy response to exogenous events. In addition, whilst clearly different policy mixes yield different results, again no distinct conclusion can be made as to the best mix of policy responses. However,

notably as has been mentioned and will be explained in further detail, arguably monetary and fiscal policy is best used in unison and greater focus in the future should be placed on targeted fiscal policy. In addition, as mentioned, a lack of policy response can be beneficial and needed when an exogenous event does not require extensive economic policy response and rather policy makers need to hold a holistic viewpoint to be mindful about saving ammunition for future exogenous events. These summaries are in line with the prior expectations of this research, however notably the complexities of responding to exogenous events has greater grey areas than initially thought. Therefore, as will be explained, a more systematic interlinked approach is needed when deciding the best policy response.

Furthermore, there are key differences between the nature of the demand and supply shocks for the exogenous events in the three different categories studied. Moreover, there are unique factors to be considered for each category such as precautionary savings motives appearing to be more prevalent during pandemics. However, they all create elements of uncertainty, hence there is no clear policy response that best suits exogenous events in a particular category. Rather given the increasing chaotic and complicated society our world is evolving into; economic policy responses need to adapt; this differs with prior expectations. Arguably one-way policy makers can be more fluid in their policies, is by approaching monetary and fiscal policy decision making through the lenses of complexity theory. As mentioned, it is not realistic to assume that complexity theory can eliminate exogenous events from occurring and whilst there is still a place for both monetary and fiscal policy responses, there is room for improvement in economic policy responses.

A significant flaw of neoclassical economics is that it is grounded in the belief that economies operate like a machine and if policy makers make certain decisions or implement particular policies, an expected result will arise (Patrick & Julia, 2017). However, the reality is that economics is not a precise science that is applicable to all situations, rather it is a doctrine and as societies evolve doctrines need to progress as well (Patrick & Julia, 2017). As has been previously touched upon, there are key differences between a complex and a complicated system. Historically policy makers have dealt with economies as if they are complicated systems, such a viewpoint has resulted in policy makers to oversimplify economies. In turn, focus on one specific channel/sector, as seen with interest rates under monetary policy, to make generalised policy decisions for the economy (Patrick & Julia, 2017). Such an approach is outdated and fails to account for the rising complexity within modern day society and economies.

Complex systems can be thought of as a network of nodes. Nodes themselves can be interconnected to varying degrees and through single or multiple channels, therefore an impact to one node can affect other nodes in the system to varying extents (Patrick & Julia, 2017). Hence overall a system can be influenced by the number of nodes, number of interlinkages, the nature and scale of these interlinkages and the speed at which a shock or stimulus influences the nodes (Patrick & Julia, 2017). Complexity in economies has risen as the number of nodes has increased, demonstrated through the example of China (Patrick & Julia, 2017). An example of a country that turned an emerging economy into a developed economy, adding complexity to economies worldwide and increasing the number of nodes (Patrick & Julia, 2017). An increase in nodes increases the interlinkages between nodes (Patrick & Julia, 2017). In addition, developments in factors such as globalization, technology and complexity of supply chains are just a few factors again adding to the increase in connections between nodes and the scope of these connections (Patrick & Julia, 2017).

Therefore, by using complexity theory it can enable policy makers from both the monetary and fiscal policy side to work cohesively together and implement a system wide approach to include all dimensions that influence the economy to make meaningful differences. The COVID-19 crisis has highlighted key coordination between monetary and fiscal policy, economies around the world have been implementing these policies hand in hand (Lagarde, 2020). Central bankers have implemented expansionary monetary policy to provide emergency funding to banks whilst support from governments have allowed banks to make riskier loans (Lagarde, 2020). Accompanied with this, expansionary fiscal policy responses such as unemployment schemes and providing loans to businesses has ensured that households and businesses have been able to survive the crisis and continue to operate (Lagarde, 2020). However, there is still clear improvements that policy makers can enact.

The first step would be for policy makers to use complexity theory to identify exogenous events that require an economic policy response. As was evident in the empirical results, particularly in the category of terrorist attacks, some exogenous events do not require an economic response. What was once seen as an unprecedented event in modern times with the September 11th terrorist attack, now the normalisation from the increased frequency of terrorist attacks limits the impacts such attacks have on macroeconomic variables beyond a transitory short-term shock. Thereby limiting the need for economic policy responses. As evident with the 2004 Madrid and 2015 Paris attacks, whilst as previously stated not as

significant of an event as September 11th, no direct monetary or fiscal policy response was taken in response to the attacks. Now it is commonly argued that terrorist attacks are viewed as more of a human tragedy rather than an economic one (Makinen, 2002).

Whilst the COVID-19 crisis has been regarded by some as a one in 100-year pandemic, others argue that with key factors at play including the increasing rate of globalization, it can result in pandemics to become an increasing occurrence (Hilsenrath, 2020). Furthermore, threats from climate change is increasing the likelihood of natural disasters (Van Aalst, 2006). It is now more important than ever for policy makers around the globe to monitor and evaluate the severeness of a crisis before implementing responses by looking at key leading indicators such as stock market data.

Additionally, policy makers need to implement a complexity theory strategy to look at holistic measurements from different sectors to determine economic responses, for instance key health, geographical or societal indicators. For example, in the backdrop of the COVID-19 pandemic, global warming is an existential crisis that is not going away. With this complex dynamic at hand, fiscal stimulus to mitigate the economic downturn from the COVID-19 crisis can also help solve the issues within the climate crisis. If this pandemic was twenty years ago with the social and environmental climate at the time, it is all but certain green energy would have been low on the list. Thus, showing the importance of policy makers having fiscal stimulus being targeted and adaptive to wider factors at the time to maximise efficiency.

Furthermore, as has been previously asserted, undoubtedly monetary policy is a useful tool to respond to exogenous events, particularly for time sensitive situations. Such benefit was evident with the September 11th terrorist attack, monetary policy was implemented in a timely manner allowing for the economy to continue to be stimulated despite the delays in fiscal policy. However, improvements can be made. Firstly, in limiting its usage to avoid heading towards/being near the zero-lower bound for prolonged periods of time and central bankers reverting to greater omnipotent behaviours. With this, greater focus can be placed on sustainable targeted fiscal policy approaches to stimulate aggregate demand and in turn economies. In addition, fiscal policies can use long-term approaches to ensure no generation is overly burdened and ensure fiscal sustainability, so confidence is maintained in the market which is a key factor driving the success of the Keynesian Multiplier, in turn, stimulating aggregate demand.

By policy makers looking through the lenses of complexity theory it can encourage policy makers to look at improved and innovative mechanisms to use when implementing policies. For example, include greater advancements of technology into their decision making, specifically artificial intelligence (AI). Artificial Intelligence is significantly influencing many facets of society, in particular the economy. It is estimated that by 2035 AI will contribute an additional US\$15.7 trillion into the global economy (AI forum New Zealand, 2018). Artificial intelligence will not only benefit the private sector but also can be used by government agencies to make their operations more efficient. There is discussion in literature detailing how governments can use AI to make revenue agencies more efficient (Atalla & MacDonald, 2019). Already some countries have been using AI models to anticipate those who are a higher threat to not paying their taxes as well as determining what type of individual is more likely to react positively to certain tax interventions (Atalla & MacDonald, 2019). Overall, the results has shown an increase in tax revenue collected in combination with lower tax avoidance (Atalla & MacDonald, 2019).

Therefore, there is opportunity for AI to be used by policy makers when implementing fiscal policy to ensure policies are targeted and in turn effective as possible. For instance, currently it is unattainable for governments to have tailored stimulus cheques factoring in all personal circumstances on a case-by-case basis but this could be achieved with AI and metadata. This would enable a far more complete picture of each individual's needs, allowing for a more efficient decision to be made whilst wasting less resources. In addition, AI and metadata will allow for a more continuous and real time read of the state of the economy, which is analogous of going from an x-ray to an MRI.

Examples of policies that could occur as a result of AI, include determining to the dollar the precise amount of stimulus funds each household should get, in order to be the most efficient possible. Artificial intelligence will be able to gather extensive data points on each individual in order to make decisions surrounding the case, something social workers currently do not have the capacity to do. In turn, this would maximise total utility levels for society. In addition, in the context of America as an example, AI could provide policy makers with a real day by day view of all the underlying factors influencing the US economies health to allow for a more precise total level of stimulus to be determined in order to reduce graft. For example, should the stimulus package be 950 billion or 1 trillion or should a greater amount of the stimulus be paid this week or next. By allowing AI to be the driving influence on decisions will also help reduce political inefficiencies and red tape which has significantly

burdened fiscal stimuluses introduced by America's government during past exogenous events and currently seen with the COVID-19 crisis. A further example can be seen in the context of COVID-19, AI could provide answers to questions such as should stimulus cheques be more generous to airline employees or hotel staff, given hypothetically airline workers are twice as likely to get a job in Amazon warehouses thanks to their skill set.

Further to this, whilst policies will be unique to countries own economic environment, long term fiscal policy approaches can be appropriate to not overly burden future generations. For instance, in a country like New Zealand with their debt to GDP levels it could be useful for the country to implement an escalator tax, on for example petrol taxes, to help pay back debt from the COVID-19 crisis. Additionally, governments can start to use AI to determine what companies can afford to pay greater taxes to cover the costs from these exogenous events without disincentivising the private sector and hindering their efficiency. For instance, in the context of the COVID-19 crisis, such a strategy would help to ensure global giants like Amazon pay their fair share of taxes, particularly when the companies online presence allowed for its continued survival and success throughout the pandemic (Semuels, 2020).

In addition, it would be extremely advantageous if policy makers use a complexity theory approach to scenario plan before exogenous events occur. So, policy makers can respond in a timely manner which is needed after exogenous events, to implement planned, measured and effective policies rather than reactionary policies which has been commonly used in all of the exogenous events studied. Notably, as previously mentioned, exogenous events are unique in nature and therefore it is unrealistic to think no adaption will be taken once the exogenous events takes place. However, policy makers could significantly benefit by having monetary and fiscal policy plans dependent on whether an exogenous event occurs during an economic recession or boom or during a downturn or upturn on the business cycle. In addition, have plans continuously updated to reflect changes in key factors such as governments budget deficits or surpluses.

Furthermore, in terms of monetary policy, have contingency plans in place dependent on which political party is in government. As evident in an increasingly divided nation like America and the political polarization that has occurred during the COVID-19 crisis, the politicization of 13-3 in America is case and point in going backwards of central banks being omnipotent (Smialek, 2020). Lastly, as previously mentioned have policy responses constantly updated to reflect changes in wider society, for instance in today's world the key

focus on the climate crisis as well. Using COVID-19 as an example and as previously discussed, the stimulus cheques in America and wage subsidies in New Zealand were needed in response to COVID-19 as governments were unprepared for such a disaster. However, if governments scenario plan through the lenses of complexity theory they can have targeted effective programs ready to implement when disasters hit to ensure effective fiscal stimuluses are being implemented whilst ensuring debt sustainability.

Looking at countries like Taiwan that has so far had success in responding to COVID-19 in terms of both the health of the nation and its economy without the need to implement excessive lockdowns (Bremmer, 2020). This success occurred as Taiwan was prepared. The countries previous experience with the SARS 2003 pandemic meant the country had prior experience with such an event, in turn the Taiwanese government did not delay in their decision making as was seen in other countries such as America (Bremmer, 2020). Overall Taiwan's government response to stop the spread of the pandemic shows the importance of being prepared and the same lessons can apply to having prepared economic responses to exogenous events as well. Having prepared economic responses accompanied with responses to directly address the exogenous event ensures there is efficient plans implemented. In turn, creating less uncertainty within the wider economy which can signal to individuals that governments are prepared, giving confidence to individuals in a time of crisis. All these factors can lessen the blow of such economic downturns caused by the exogenous events.

Lastly, complexity theory encourages a system wide approach to modelling and designed to minimize the weaknesses of the system allowing for greater international and cross-sector policy making and overall coordination within policy (Patrick & Julia, 2017). Whilst all the exogenous events empirically studied, impacted directly one nation and had limited international impact, the same situation did not occur for COVID-19. It continues to be a global pandemic and crisis; hence international cooperation has been needed. The whole world has and continues to fight against a common enemy. Whilst there has been the pursuit of international cooperation in developing the vaccine to COVID-19, there has also been the call for international cooperation for the economic responses. There has been signs of success on this front, seen within the Eurozone, firstly with the ECB enacting bond buying to improve Italian debt (Stubbington, 2020) and discussions of a Eurobond (Lagarde, 2020).

However, there is room for further advancements, if an increasing number of policy makers implement international cooperation in their policy making approaches for worldwide

exogenous events like COVID-19 it could generate significant benefits. As previously discussed, monetary policy can lead to a race to the bottom with its impact on currency dynamics, resulting in what is commonly known as a zero-sum game. Furthermore, expansionary fiscal policy has the opportunity for positive externalities to occur overseas if spending is filtered overseas. Therefore, for such international crisis like COVID-19, it can be beneficial for cohesive fiscal policy responses to avoid any potential barriers to free trade being implemented in pursuit of limiting spending, in other words stimulus within the domestic economy.

Conclusion:

Overall, the explanations from the previous chapters will be used to provide answers for each research question. Further research to this study includes extending the analysis to exogenous events in developing nations to analyse whether there are any differences in economic responses needed post exogenous events in developing versus developed economies. As previous academic literature has produced findings that suggest developing economies and smaller economies experience more significant adverse shock to output compared to that of developed or bigger economies, who experience a similar magnitude of natural disaster (Noy, 2009). Suggesting factors such as a countries literacy rate, greater per capita income and higher level of openness to trade enable a country to be able to better cope with the shocks from a natural disaster whilst also preventing further prolonged impacts to the wider economy (Noy, 2009). A further study investigated fiscal policy spending after natural disasters and compared developing versus developed nations (Noy & Nualsri, 2011). Concluding that governments in developed nations tend to increase spending and cut taxes post natural disasters, hence implement an expansionary fiscal policy (Noy & Nualsri, 2011). Whereas governments in developing countries tend to decrease spending and increase revenues, hence contractionary fiscal policy (Noy & Nualsri, 2011). Therefore, clearly previous work has shown key differences in the impact and policy responses between developed and developing nations after natural disasters, thereby showing there is room to further extend the findings in this analysis to developing nations.

In addition, greater analysis could have been conducted at a regional level for the exogenous events of Hurricane Katrina and Christchurch earthquake that had a regional and state-wide impact. This would have allowed for a more in-depth analysis of the success of for example, fiscal policy responses in the area directly impacted. Lastly, as previously mentioned the focus of this thesis was to provide groundwork research to a holistic analysis on a range of exogenous events and subsequent economic policy to provide insight for future responses to exogenous events. However, there is room to evaluate the influence of policy on the macroeconomic variables post these exogenous events more directly when the scope of analysis allows it.

Firstly, addressing the research question: **Whether there is any significant difference in the influence on macroeconomic variables between different policy mixes or the lack of policy response.** The empirical results showed differing results for each exogenous event. It

was a suitable response for a few exogenous events studied to not have significant economic policy responses enacted after the events and rather have policy makers save ammunition. Contrastingly, other exogenous events showed examples of where arguably policy makers could have limited economic policy responses. The results clearly showed there is no single policy or mix of policy responses that yields the same results and is the most appropriate to use, rather other key factors, such as the economic climate of the time played a significant role in determining the success of a policy response.

Furthermore, in regard to the research question of: **analyse whether the differences in the nature of the exogenous events impact uncertainty and precautionary saving levels.** As was mentioned in the empirical results there was no statistically significant evidence of substantial precautionary savings occurring after the exogenous events studied. However, there was greater evidence in support of precautionary savings after the SARS 2003 pandemic and recent empirical results from the COVID-19 pandemic suggest evidence of precautionary savings being at play. Given pandemics cause significant prolonged restrictiveness on individuals everyday lives, adding to the uncertainty surrounding the event, likely resulted in the difference in outcomes of savings rates versus synthetic control, compared to the exogenous events in the natural disaster and terrorist attack categories.

In line with this, addressing the research question of: **whether there are any differences in the success of policy responses between the different categories of exogenous events.**

Clearly each exogenous event was unique, however within each category there was similarities across events which resulted in notable points for policy responses. As mentioned above, regarding greater uncertainty in pandemics, adding to the possibility of precautionary savings, arguably calls for greater need of targeted fiscal policy responses. Or regarding terrorist attacks, the increasingly frequent nature of attacks limits the economic ramifications from terrorism, in turn arguably reduces the need to provide economic responses. Overall, there were clear differences between each exogenous event category which can lend itself to different policy responses being needed for each category. However, given the idiosyncratic nature of all exogenous events and the chaotic world we live in, there is no mix of policy responses that can be frequently applied to best suit each particular exogenous event category. Rather the best policy mix can be seen in the answer to the primary research question.

The primary research question was: **to determine the most effective and successful economic policy response to exogenous events.** Overall, as discussed, monetary policy whilst it has its place, it has its key limitations due to its indirect nature. Monetary policy when used to prevent a liquidity crisis is arguably effective, however monetary policy to sustain a multi-year recovery delivers diminishing benefits. Therefore, in response to exogenous events, monetary policy should be treated as a defibrillator and not the rehab. On the other hand, fiscal policy, arguably is a predominant tool policymakers should be using to recover from these long-term exogenous shocks. The key caveat being stimulus is targeted and governments are responsible for taking on debt when the economic benefits stack up. In the backdrop of these two policy tools, policy makers should be very aware that they operate in a complex dynamic global economy. Meaning policy makers need to consider the new nuances of the wider economy when reacting to the exogenous event. For example, policy makers should consider the state and play of international relations, social issues, environmental issues and generational divides, to name a few, in order to make monetary and fiscal policy more effective. Ultimately the policy tools of monetary and fiscal policy have room to evolve to adequately mitigate downturns caused by exogenous shocks.

Data Appendix:

The event study analysis data was sourced from a range of sources including the FRED, IMF, The World Bank, OECD and from countries individual reserve banks and treasuries. The data for the synthetic control was sourced from The World Bank national accounts data, OECD and National Accounts data files (World Bank, 2020g). Data sets for the synthetic control varied as there was differences in the record of data for each country, therefore all data sets were filtered to ensure a balanced panel set. This analysis only studied exogenous events from first world developed nations to ensure all data used was reliable. However, notably for the synthetic control key indicators were used such as a country's statistical capacity indicator from The World Bank to ensure all data used was reliable (World Bank, 2020i).

A few further adjustments were made to the data for the synthetic control to improve the reliability. For example, the Hong Kong SARS pandemic spread across borders, thus other countries identified by WHO that were impacted from the pandemic were removed from the data set to overcome possible spill over effects that could adversely impact conclusions about the 'treatment.' Additionally, adjustments were made to account for economic events, for example for Hurricane Katrina, September 11th, Paris and Madrid terrorist attacks there was clear discrepancies around the early 1990's when many Western economies experienced economic recession. Thus, the donor set for these exogenous events was from G20 and OECD nations. Lastly, to support the analysis of the quantitative data throughout the thesis a wide variety of qualitative secondary sources was used. Including non-fiction books written by academics and professionals within the economic and financial environment, academic journal articles and a wide encompassing group of credited newspapers including The Washington Times, The Economist and The New York Times.

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