# Terrorism and the Impact on the Economic Growth in France: A Synthetic Control Approach

Reference from cnet.com (2016)


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**Master Thesis 2018**


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**FACULTY OF SOCIAL SCIENCES,**
**UIS BUSINESS SCHOOL**

# MASTER'S THESIS

| STUDY PROGRAM: | THESIS IS WRITTEN IN THE FOLLOWING SPECIALIZATION/SUBJECT: |
|---|---|
| **Master of Science in Business Administration** | **Economics**<br><br>IS THE ASSIGNMENT CONFIDENTIAL?<br>(**NB**! Use the red form for confidential theses) |

TITLE: **Terrorism and the Impact on the Economic Growth in France: A Synthetic Control Approach**



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# Foreword

This thesis is our final assignment as a part of our master program in Economic Analysis at University of Stavanger. The process has been long and challenging, but also a positive and educational experience. The topic and our methodology choice were unfamiliar for us at first, but this thesis have given us a lot of knowledge about statistical tools, as well as about socioeconomic contexts.

We would like to thank our supervisor Kristoffer Wigestrand Eriksen for great support and supervising. Kristoffer have been available whenever we needed help, and he has been a great source of motivation in difficult times. Honorable mentions also go to Gorm Kipperberg from University of Stavanger for helping us shaping our idea in an early stage and to Craig Bond from RAND Corporation in Washington for introducing us to the synthetic control method. We would also like to thank our good friend Sikke-Viktoria Østevik Ivarson for proofreading.

We are proud of the final product, and we hope our thesis will provide broader knowledge of how terrorism can affect a country's growth in real GDP, and how the synthetic control method can be used.

Stavanger, June 2018

# Abstract

This thesis maps out whether terrorism affects a country's economy and explains which factors it affects in order to have an impact on the economic growth. We have chosen to look at the coordinated terror attacks in Paris, 13th of November 2015, and our research question is as follows:

*"Did France experience a change in economic growth after the terrorist attacks 13th of November, 2015?"*. If the answer to this question is yes, we'll also try to answer the sub-question: *"How large was this impact?"*.

We think this is an interesting topic because terrorism is a current problem in Europe. Many countries rely on the tourism industry as an important source of income, and from theory we know that terrorists target tourist destinations.

To answer our questions we have used the synthetic control method as a tool to find and estimate the possible losses France have experienced from the terrorist attacks. We have gathered data from several European countries, and with synthetic control, we create a hypothetical France where terrorism is absent.

We found that terrorism have caused a negative effect on the economic growth in France, and that France have experienced a possible loss of €825 in real GDP per Capita. According to our analysis, we have discussed that factors that have an impact on this effect is touristic behavioral changes, costs involving renovation of the targeted areas, medical costs due to injuries, and increases in security measures.

# Table of Contents

# List of Figures, Tables, and Equations

## List of Figure:

## List of Tables:



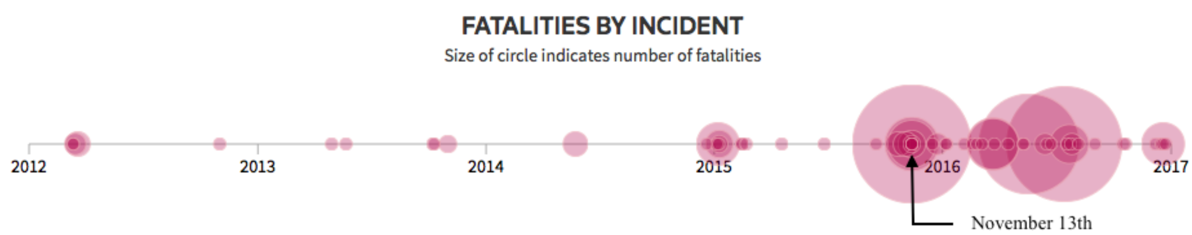
## List of Equations:

# 1. Introduction

## 1.1 Motivation

Terrorism will have an impact on all humans in different degrees and ways. People can both be affected physical and psychological. This will create a domino effect: Fear may prevent people from visiting countries that have experienced attacks, which can be financially damaging for the affected country. Terrorist attacks is a current problem and is therefore an interesting theme. Our research will therefore focus on a country's economic impacts after a terrorist event and identify drivers that are affected by terrorism.

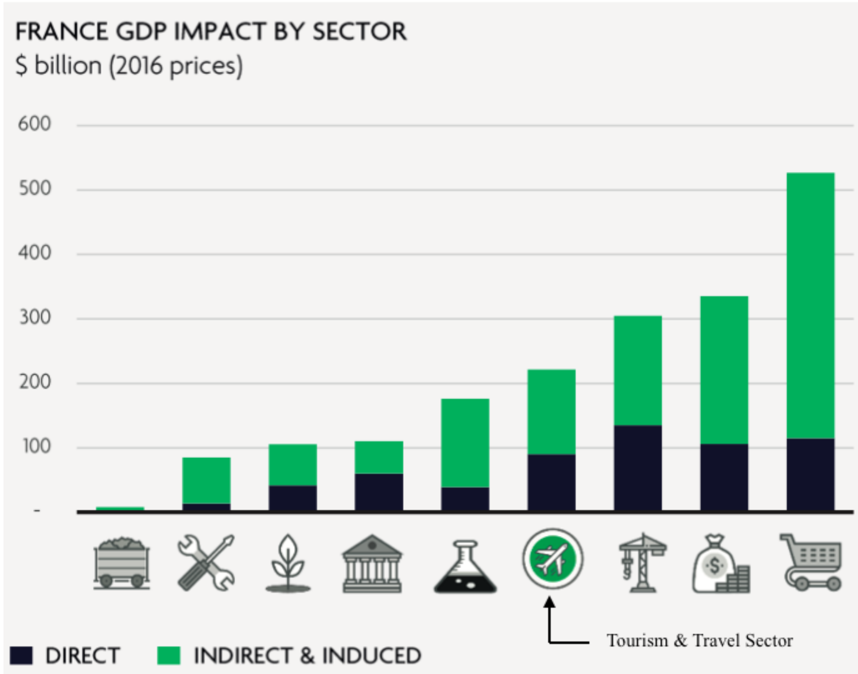
Figure 1.1: Fatalities by incident in Western Europe. Reference from uk.reuters.com (2017)




Note: Timeline from 2012 to 2017, that shows numbers of attacks and the size of fatalities. Each circle represents an attack, while the size of the circle indicates number of fatalities. The arrow points out the attack 13th of November 2015.

In order to answer our research question, we have chosen to focus on France and specifically, the event that occurred in Paris 13th of November 2015. The reason is that Europe did experience a large increase in terrorist attacks the last couple of years, and especially after this particular event. This is illustrated in figure 1.1, which is a timeline that shows the intensity of terrorist attacks from 2012-2016. We can see that there has been a huge increase in fatalities in the subsequent year after November 13th, 2015, but also an increase in occurrence. It is worth to mention that Paris also experienced an attack January that year. However, we believe that the November attacks had a greater impact on people's behavioral changes. This can lead to decline in the tourism industry, which can have a great impact on a country's economy, as the tourism industry accounts for a large part of many country's GDP. The January attacks was conducted on a specific target, the satirical weekly news magazine Charlie Hebdo, in contrast to the November attacks where random victims got involved.

Figure 1.2: France GDP impact by sector (2016). Reference from World Travel & Tourism Council (2017)




Note: The figure shows different sectors that have an impact on GDP in France. From largest to smallest impact are: Retail, Financial Services, Construction, Travel and Tourism, Chemicals Manufacturing, Banking, Agriculture, Automotive Manufacturing, and Mining.

As mentioned, travel and tourism accounts for a large part of the GDP. Figure 1.2 shows the impact different sectors has on the total GDP in France. We can see that only the retail, financial services and construction sector takes a larger share of the GDP than travel and tourism. According to World Travel & Tourism Council (2017) Paris is one of the most popular destinations by international travelers, and depend more on foreign than domestic tourism demands. France is an interesting country to investigate due to its popularity and exposure to terrorist attacks.

## 1.2. Research question

Our research question is: “Did France experience a change in economic growth after the terrorist attacks 13th of November, 2015?”. If the answer to this question is yes, we’ll also try to answer the sub-question: “How large was this impact?”.

## 1.3 Methodology choice

In order to answer our research question, we will use quantitative analysis and conduct an event study. Our event is the coordinated attacks the 13$^{th}$ of November, 2015 in Paris, where the concert arena Le Bataclan was the primary target. We will estimate the possible economic effects France suffered using a method called the "synthetic control approach", with real GDP per capita as our outcome variable. We believe that there has been a negative effect on the economic growth caused by this attack, where one cause may be the change in tourism behavior. The purpose with this method is to estimate how the economic growth would have been if the event never took place. In order to implement the synthetic control method, we also need to find comparable countries. These countries will be weighted differently to get the most comparable combination. Furthermore, the validity of the results will be checked using several robustness tests.

# 2. Background and Theory

In this chapter, we will provide relevant material to give the readers necessary background information and theories. We start by briefly explaining what the GDP measures. We then move on to terrorism, where we highlight issues such as different classes of terrorism, terrorist motives and different classes of economic costs resulting from a terrorist attack. We are also briefly defining tourism and how tourism contributes to a country's GDP, and how tourism and terrorism are linked. Further, we will discuss media and its relation to terrorists, as well as the impact media has on tourist's behavior. Behavioral theories are then discussed, where we explain the possible underlying causes for why people are changing their behavior. Finally, we are examining how Paris and France have been affected from 2015 in terms of hotel bookings, and visits to popular tourist attractions.

## 2.1 Gross Domestic Product

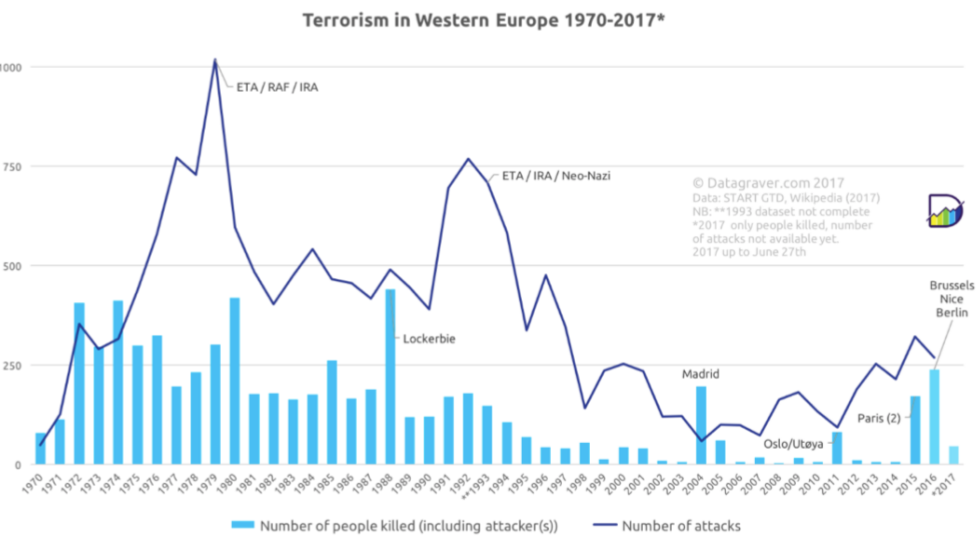
Gross domestic product (GDP) is defined as "the monetary value of all finished goods and services produced within a country's border in a specific time period" (Investopedia, n.d.). The GDP consists of public and private consumption, government spendings, investments, and net exports. From figure 1.2, we see that World Travel and Tourism Council divide sectors that have an impact to the GDP into nine categories: Agriculture, mining, chemicals manufacturing, automotive manufacturing, retail, financial services, banking, construction, and travel & tourism. We can also use the term real GDP, which is GDP adjusted for inflation. GDP is commonly used as an indicator of a country's economic health, but also a measurement of a country's standard of living (Investopedia, n.d.).

## 2.2 Terrorism

The term "terrorism" originated in 1793, where Maximilien Robespierre led the "reign of terror" under the French revolution. It is said to be the foundation of modern terrorism (Zalman, 2017). Pizam and Smith (2000) defines terrorism as "a systematic and persistent strategy practiced by a state or political group against another state, political or social group through a campaign of acts of violence, such as assassinations, hijacking, use of explosives, sabotage, murder and the like, with the intent of creating a state of terror and public intimidation to achieve political, social or religious ends".

Western Europe has experienced an increase in terrorist attacks lately, but according to history, the number of attacks was much higher from the late 70's to mid-90's. Figure 2.1 illustrates the development in number of attacks in Western Europe from 1970 to 2017, complemented with numbers of people killed.

Figure 2.1: Development of terrorist attacks in Western Europe. Reference from datagraver.com (2016)




Note: This figure shows the development of attacks in Western Europe from 1970 to 2017. The line shows number of attacks, while the columns shows number of killed. The most known attacks are highlighted.

Hegghammer has done a lot of research on terrorism and highlights that in the 70's and 80's it was more geographically limited, occurring mainly in Britain and Spain. Figure 2.1 shows a decrease in terrorism from 1992, where the main reason is that Britain and Spain did experience a decrease in terrorist attacks. The decrease for the rest of Europe has not been that large (Honningsøy, 2015). The largest difference between terrorism today compared to terrorism in the 70's and 80's is therefore that people today fear that terrorist attacks can happen anywhere. Another important factor is the changes in security services, and the higher possibility of averting terror attacks today.

### 2.2.1 Different Classes of Terrorism

Dixon, Greenfield, & Jackson (2007) have in their report divided attacks into different classes depending on the degree of frequency and intensity. High-frequency, low-intensity attacks are defined as campaign terrorism, and the opposite, that is, low-frequency and high intensity, are defined as episodic terrorism. These are the most relevant types of terrorism. Attacks with both low-frequency and low-intensity would have a small impact, and are therefore of less concern. This is what we have defined as general crime in the table below. The opposite, attacks with both high-frequency and high-intensity, are of limited probability and are defined as war in the table. The different classes of attacks are designed by the attack planners to generate economic cost. Campaign terrorism is designed so that costs will be build up and compound over time, while episodic terrorism generate large economic cost from one specific attack (Dixon et al., 2007).

Table 2.1: Different classes of attacks

| Different classes of attacks | | Intensity | |
|---|---|---|---|
| | | High | Low |
| Frequency | High | War | Campaign terrorism |
| | Low | Episodic terrorism | General crime |

Note: This table shows the different classes of attacks based on the frequency and intensity of the attack. Both frequency and intensity is divided into high and low.

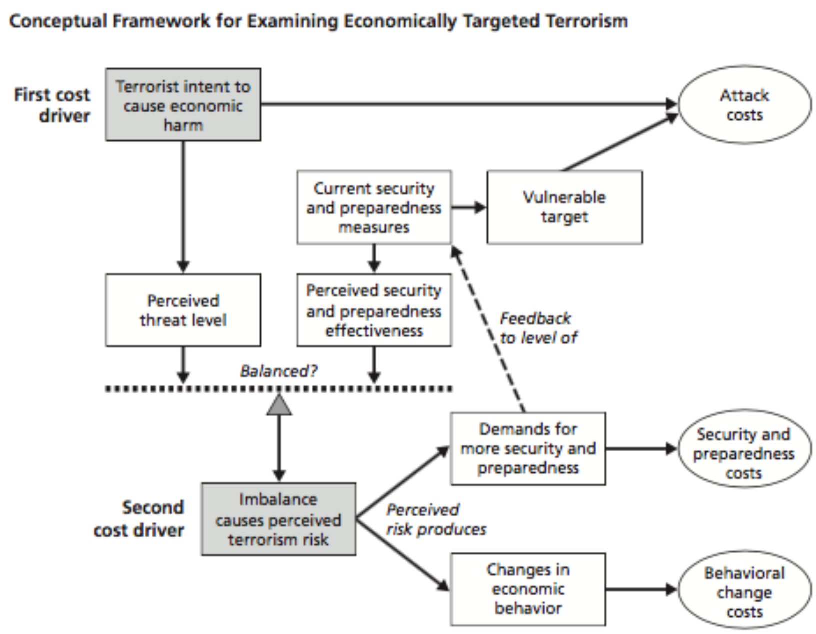
### 2.2.2 Terrorist Motives

There may be many reasons that terrorists conduct attacks, but, as already mentioned in the definition of terrorism, we can divide terrorists motives in three categories: Political, religious and socioeconomic (Zalman, 2017). Aziz (1995) describes how socioeconomic factors may have motivated attacks directed at tourists in Egypt in the late 80's. She describes that conflicts rose due to the large gaps in lifestyle between tourists and inhabitants. Soldiers who was fulfilling their military service was located beside luxury hotels, while living in miserable conditions themselves. It led them to set fire to these buildings (Aziz, 1995). Muslim activists on the other hand conducted attacks based on religious motives, because tourists violate the Islamic cultural values by consumption of pork and alcohol, gambling, dress codes and so on (Aziz, 1995). An example on terrorism driven by political motives is the attack 22nd of July, 2011 in Norway, where the terrorist attacked the annual summer camp arranged by the youth Norwegian labor party to fight against the multiculturalism in Norway.

### 2.2.3 Three Classes of Economic Cost

Dixon et al. (2007) points out three classes of economic costs that arise related to terrorist attacks. The first one is the direct costs; damages incurred at structures, capital costs, the costs resulting from injured and killed individuals et cetera. The second class is the costs from implementing security and precautions for future attacks. This class includes expenditures for security, but also the indirect costs, such as wait times for security searches, transport inefficiencies or complications in the supply chain. The final class is the costs resulting from changes in behavior due to perceptions of the threat of future attacks. This can alter people's fear and uncertainty, which lead to reductions in demand. Other costs that may be arising can be from changes in investor behavior due to changed risk perceptions, change in value of assets et cetera.

Figure 2.2: Conceptual Framework for Examining Economically Targeted Terrorism. Reference from Dixon, Greenfield, & Jackson (2007).




Note: The figure shows the different costs that occur because of terrorism. The costs are divided into two different drivers, which are the terrorist intent to cause economic harm, and imbalances that is caused due to perceived terrorism risk. The first cost driver causes direct attack costs, and gives people a perception of the threat level. If there are imbalances between the perceived terrorism risk and perceived security and preparedness effectiveness, there will be demands for more security, which leads to security and preparedness costs. The imbalances will also create changes in economic behavior, which lead to behavioral change costs.

From figure 2.2, we can see how the different types of costs are linked. Terrorists can either perform an actual attack which leads to direct costs, or threaten to attack, which leads to indirect costs. If there are imbalances between the perceived threat level and the perceived security and preparedness measures, peoples risk perceptions for an attack will increase. This can lead to a higher demand for security and changes in economic behavior. Dixon et al. (2007) describes that security and preparedness costs can reduce the potential direct costs; however, it is important not to waste the resources, as it can help the terrorists to achieve economic instability in the country.

### 2.2.4 Terrorism in Europe

Table 2.2 shows terrorist activity in Europe from 2000 to 2016 where more than ten people were killed.

Table 2.2 Terrorism in Europe. Reference from (Wikipedia, 2018)

| Date | Country | Incident | Casualties |
|---|---|---|---|
| 16 February 2001 | FR Yugoslavia | Bus Bombing | 12 killed, 40 injured |
| 11 March 2004 | Spain | Train Bombings | 192 killed, 2,050 injured |
| 7 July 2005 | United Kingdom | Bombing | 56 killed, 784 injured |
| 11 April 2011 | Belarus | Metro Bombing | 15 killed. 319 injured |
| 22 July 2011 | Norway | Utøya attack / Oslo bombing | 77 killed, 319 injured |
| 7-9 January | France | Charlie Hebdo Shooting | 20 killed, 22 injured |
| 9 May 2015 | Republic of Macedonia | Kumanovo clashes | 22 killed, 37 injured |
| 13 November 2015 | France | Paris Attacks | 137 killed, 368 injured |
| 22 March 2016 | Belgium | Brussel bombings | 35 killed, 340 injured |
| 14 July 2016 | France | Truck Attack | 87 killed, 340 injured |
| 19 December 2016 | Germany | Christmas market attack | 12 killed, 56 injured |

Note: This table shows a timeline of the attacks, where more than ten people were killed, that have occurred in Europe from 2000 to 2006. The first column shows the date of the attack, the next column states the country in which the attack occurred. Then column number three explains how the attack was performed. The last column shows how many people that where killed and injured in the attack.

### 2.2.5 Terrorism in France

Table 2.3 shows terrorist incidents in France from 2015 – 2016.

Table 2.3: Terrorist Incidents in France 2015 and 2016. Reference from (Wikipedia, 2018)

| Date | Incident | Causalities |
|---|---|---|
| 7-9 January 2015 | Shooting, Charlie Hebdo | 17 killed, 22 injured |
| 3 February 2015 | Stabbing, Jewish community center in Nice | 3 injured |
| 19 April 2015 | Shooting, Unsuccessful attack against two churches | 1 killed |
| 26 June 2015 | Beheading, Saint-Quetin-Fallavier attack | 1 killed, 2 injured |
| 21 August 2015 | Shooting and Stabbing, Thalys train attack | 4 injured |
| 13 November 2015 | Shootings, hostage taking and suicide bombings, at restaurants football stadium and concert arena in Paris | 130 killed, 368 injured |
| 1 January 2016 | Vehicle ramming into soldiers | 2 injured |
| 7 January 2016 | Police Station Stabbing | 1 killed |
| 13 June 2016 | Magnaville Stabbing | 2 killed |
| 14 July 2016 | Vehicle ramming on Bastille Day | 86 killed, 434 injured |
| 19 July 2016 | Stabbing at a holiday resort in Garda-Colombe | 4 injured |
| 26 July 2016 | Stabbing, Normandy church attack | 1 killed, 1 injured |
| 19 August 2016 | Strasbourg Stabbing | 1 injured |
| 30 August 2016 | Police Station Stabbing | 1 injured |
| 2 September 2016 | Nurse and Police Stabbing | 2 injured |
| 4 September 2016 | Prison Stabbing | 2 injured |

| | | |
|---|---|---|
| 4 September 2016 | Author Melee attack | 2 injured |
| 8 September 2016 | Essonne Stabbing | 1 injured |

Note: This table is a timeline of the attacks that have occurred in France from 2015 to 2016. The first column shows the date of the attack, the next column explains how the attack was performed. Then the last column shows how many people that where killed and injured in the attack

## 2.3 Tourism

A tourist is defined as a person who are traveling in their own and/or in other countries for pleasure (Store Norske Leksikon, 2012). Tourism has over the decades experienced a continuing growth and have therefore become one of the fastest growing economic sectors in the world. From World Tourism Organization, we learn that the business volume of tourism equals to or even surpasses that of oil exports, food products and automobiles. This gives us a picture of the scale and importance of tourism. Tourism have now become one of the major players in international commerce, and represents at the same time one of the main income sources for many developing countries (World Travel & Tourism Council, 2017)

### 2.3.1 Tourism Contribution to GDP

The impact tourism can have on the economy can be divided into three broad classes: Direct, indirect, and induced contribution (World Travel & Tourism Council, 2017). Direct contribution is generated by industries that deal directly with tourists, such as hotels, airlines, restaurants and so on. Direct contributions include both residents and non-residents for both leisure and business purposes. Government spending on museums and national parks is also regarded as a direct contribution to the GDP.

The indirect contributions can be divided into three subcategories: Capital investments, government collective spendings, and supply-chain effects. Capital investments is the investment spendings by industries on tourism assets; for example purchase of new aircrafts in the airline industry and building new buildings in the hotel industry. Government collective spendings can be regarded as spendings on activities that supports the travel and tourism activities, such as marketing and promotion, administrative services, and security services. Supply-chain effects defines the domestic purchases of goods and services as inputs to the final tourism outputs.

Examples could be the purchase of food for hotels, fuel for aircrafts and IT services for travel agents (World Travel & Tourism Council, 2017).

Induced contributions are the spendings and expenditures by employees which are directly or indirectly employed in the travel and tourism industry (World Travel & Tourism Council, 2017). Which class the contributions belongs to depends on who makes the payments. Government taxes paid by tourist enterprises will be regarded as direct contributions, while taxes paid by employees in the sector will be classified as induced contributions (Lemma, 2014).

### 2.3.2 Tourism and Terrorism

As destructive a terrorist attack can be, it seems like a country recovers faster from terrorism than other disasters. According a study from World Travel and Tourism Council, it takes 13 months in average for a country to recover from terrorist attacks (Zillman, 2015). In contrast, it takes in average 21 months to recover from diseases, 24 months after environmental damages, and 27 months after political unrest. It makes sense that it takes a long time to recover after environmental damages, as the destruction often is severe (Zillman, 2015). Why terrorism is one of the factors that has the least recovery time is not easy to answer, but one reason can be that people still wishes to visit the place to show their support.

## 2.4 Media

Media have gone through a huge transformation through history; from physical newspapers to digital and social media like electronic newspapers and Facebook. Torres (2010) describes that 84% of leisure travelers used the internet to plan their vacations. As mentioned, results from Sönmez & Graefe (1998) shows that there was a statistical significant relationship between risk perception level and information search for decision making. As information search is a widespread method among tourists for vacation planning, media coverage on terrorist attacks can have a big impact on the chosen destination. Wilkinson (1997) states that the media and terrorists have a symbiotic relationship to each other. This means that there is a mutual benefit between the two instances; terrorists achieve publicity as they through media coverage spread their ideologies and fear, and media gets a higher, temporary readership. However, it is worth mentioning that media doesn’t represent terrorist values. Media is in a competitive market where it is important to be the first publishers in order to win over their rivals, and experiences therefore pressure to cover cases like terrorism in order to keep their readership (Wilkinson, 1997).

Wilkinson (1997) points at four main reasons for terrorist's objective to use media; their desire for spreading fear among the target group, to mobilize wider support among the population, to disrupt and make frustration regarding government and security force, and to inspire, mobilize, and incite with the purpose of attracting actual and potential supporters. Awan (2017) describes how Islamic State of Iraq and al-Sham (Isis) uses social media in form of Facebook, Twitter and YouTube to spread propaganda and recruit young supporters. One example is their use of YouTube where they have uploaded videos from visiting injured fighters in hospital or videos where they are offering sweets to children, this to get positive reputation.

## 2.5 Behavior

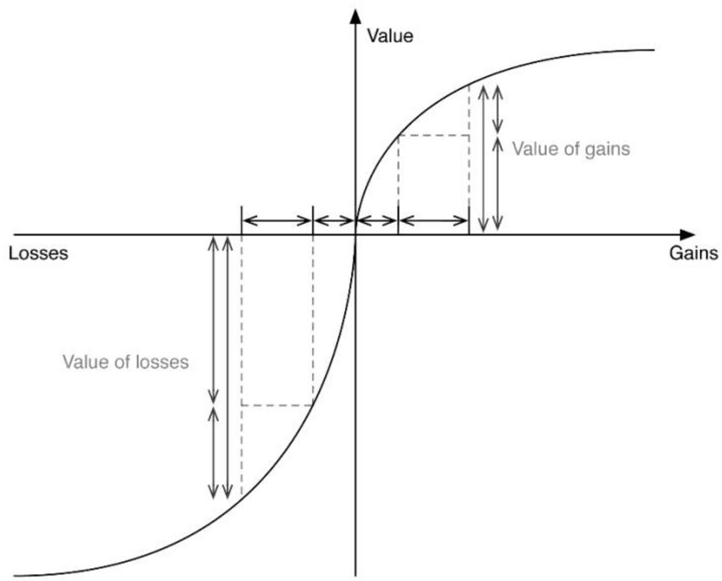
As already mentioned, perceptions that a terrorist attack is high is one of the drivers of costs occurring from terrorism. As presented earlier, figure 2.2 shows behavioral change costs as one of the classes of economic costs related to terrorism. It is therefore important to take behavioral theories into account.

### 2.5.1 Behavioral Theories

One of the main goals for a terrorist is to generate fear, and behavioral theories can explain people's decision-making after terrorist attacks. People perceive situations as positive or negative. Daniel Kahneman, who received the Nobel prize in economics due to his contribution to behavioral theories, highlights that negativity catches people's attention easier than positivity, and people get more emotionally affected by negativity. It is also shown that words which people have negative associations with, like terrorism and war, gets attention faster than words associated with something good, like peace and love. In other words, negativity dominates positivity, and loss aversion is one result of negativity dominance (Kahneman, 2012).

Figure 2.3 shows the relative value between gains (positive) and losses (negative) graphed as a value function. It shows that the value of gains is smaller relative to the value of losses. This is represented as the graph is steeper in the "loss area" than in the "gains area".

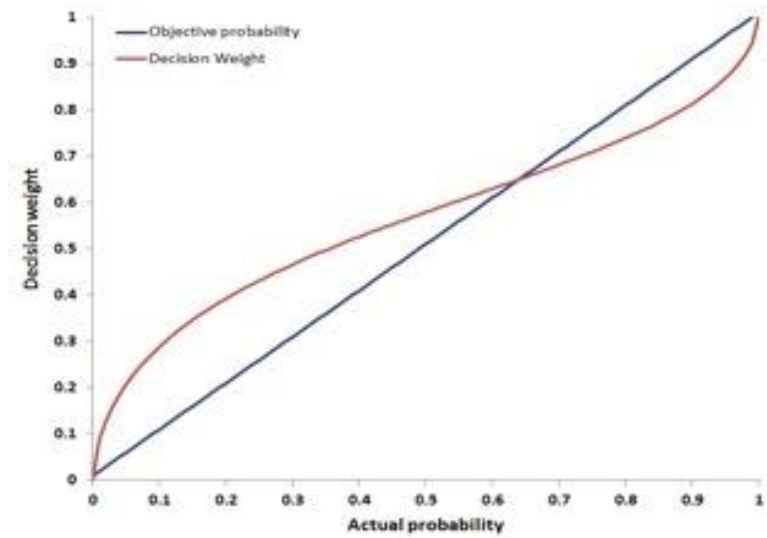
Figure 2.3: Value Function. Reference from ui.patterns.com (n.d)




Note: The value function illustrates that the value of losses is larger than the value of gains, which is shown by that the graph is steeper in the loss area than in the gains area.

Kahneman & Tversky (1979) have developed a theory called prospect theory and suggests that individuals overweight outcomes with small probabilities. Figure 2.4 shows that the perceived probability is weighted higher than the real probabilities of a situation will occur. Overweighting of small probabilities is one of the behavioral factors individuals do if they alter their behavior due to a terrorist attack.

Figure 2.4: Overweighting of probabilities with decision weights. Reference from breakingdownfinance.com (n.d)




Note: The blue line shows a linear relationship between the actual probabilities, and the decision weights. The red line shows how peoples perceived probability compared to the actual probabilities. It shows that people are overweighting small probabilities, while underweighting large probabilities.

Kahneman (2012) explains how people are taking rare events into account. He uses a personal example from a trip to Israel to highlight that even experts in behavioral theories overweight outcomes with small probabilities. He visited the country during a period where bus bombings happened more frequently than normal. Even though he knew that the chances of getting injured in a road accident was greater than the probability that a bus would explode next to him, he felt discomfort close to buses. The discomfort he had affected his behavior, and he tried to avoid getting close to buses (Kahneman, 2012). The probability of an individual being targeted by an attack is diminishing low, and Mykletun (2016) illustrates this probability. He explains us to imagine a graveyard consisting of 10.000 graves for people who have deceased before the age of 65. If you walk past all the graves, you wouldn't find "terrorism" as a cause of death. In fact, you'd need to double the site of the graveyard to find one grave which terrorism is the cause of death. In contrast, every second grave would specify cancer, cardiovascular disease on every third, suicide on every 15th and transport accidents on every 30th grave.

Even though we are well aware of the real probabilities, a set of heuristics can help us explain why strong reactions occur after an attack. The availability heuristic can be explained as one of the reasons that the perceived risk is higher (Tversky & Kahneman, 1973). This heuristic says that events that easily are called to mind are believed to have a higher likelihood of occurring. Salience bias can amplify the availability heuristic, which occurs when information is easy in reach (Taylor, 1982). Terrorist attacks are usually covered on several media platforms, and such events may get publicity weeks after it happened. Sunstein (2003) argues that such publicity is likely to exaggerate our risk perceptions for an upcoming attack. He also describes the effect of probability neglect, which is the negligence of small probabilities when disastrous events occur. People focus on the negative outcome instead of the probabilities and react thereafter (Sunstein, 2003).

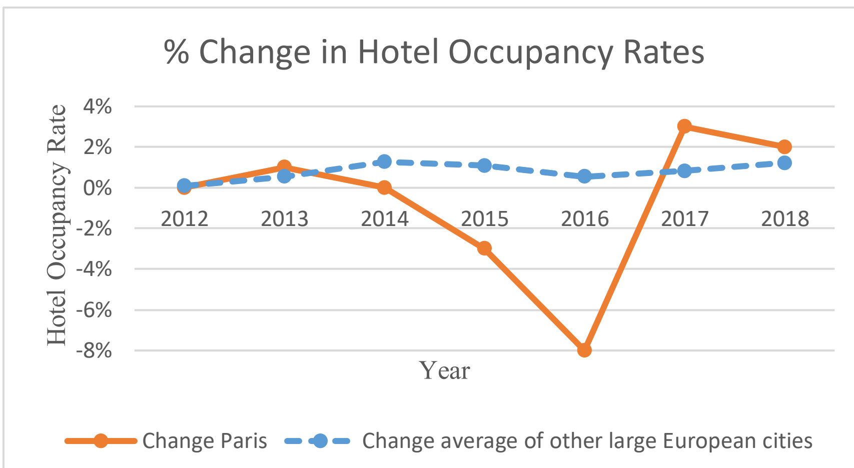
Gigerenzer (2006) uses the term dread risk, which you can find in low-probability and high-damage event. People usually responds to dread risk with avoidant behavior; the flight and tourism industry suffered financial losses in the aftermath of the 9/11 attacks (Gigerenzer, 2006). In contrast, people do not avoid hospital visits, even when people get presented how many patients that have died because of internal failures within the hospital (Gigerenzer, 2006). This sets people's thinking pattern in perspective; we are generally bad at evaluating probabilities and let negative and impactful events alter our behavior. However, the presented behavioral theories are not the whole explanation of why individuals choose not to visit an affected country. There could be other rational reasons behind it; for example, that people doesn't want their vacation to be affected by the bad mood in the country after an attack.

## 2.6 The Case of Paris and France

Given that Paris is one of the most popular destinations by international travelers, it is highly plausible to think that a terrorist attack can have severe impacts on the tourism sector. Despite that Paris still is in the top 10 most popular European destinations, Paris dropped in ranking after the attacks (Bremner, Geerts, Nelson, & Popova, 2017). Before conducting a larger analysis, we have gathered a small dataset to see if we can find any effects after the attacks in 2015. Chen (2016) points out that "the tourism market is expected to have a strong effect on the hotel industry". We have therefore decided to take a look at the historical occupancy rates of hotels in Paris, as well as number of international arrivals to tourist accommodations in France as a whole. The reason we wish to filter out numbers from residents, is that the attacks had a stronger reaction on foreign visitors than domestic visitors (World Travel & Tourism Council, 2017). We will also compare Paris and France to other cities and countries, to see if there has been a general decline for hotels, or if the effect is persistent in Paris and France only.

Figure 2.5 shows the percentage change in hotel occupancy rates for Paris and an average for following cities: Amsterdam, Berlin, Rome, Brussels, London, Prague, Zurich, Lisbon, Moscow, Geneva, and Vienna. We chose cities that is popular among international travelers, and also based on what was available at Statista. If the line is above 0%, there have been a positive change in the occupancy rates. If the line is below 0%, there have been a decline. As we can see, the average cities have had a quite stable growth in hotel occupancy rates over the years. Paris experienced a smaller decline of 3% between 2014 and 2015, before a much bigger decline of 8% between 2015 and 2016.

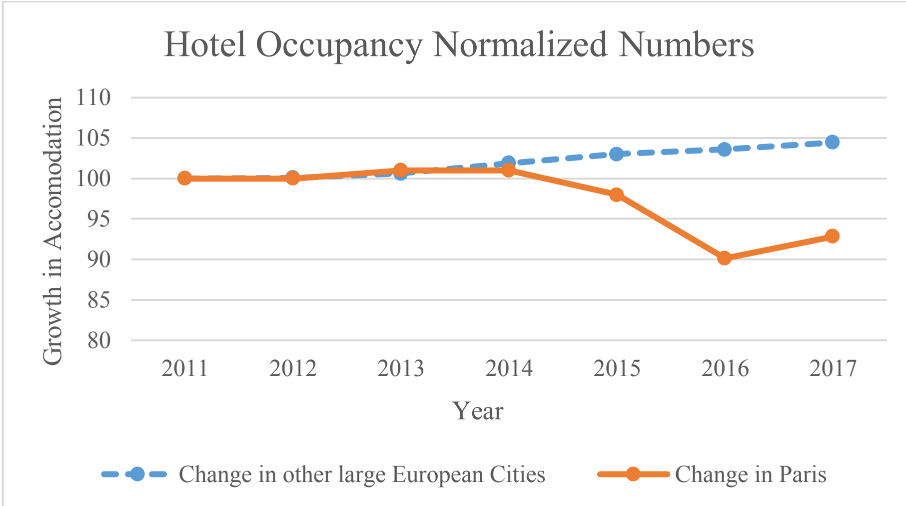
Figure 2.5: % Change in Hotel Occupancy Rates, Cities. Data from Statista.com




Note: The graph shows the percentage change in hotel occupancy rates in Paris, and the average change for Amsterdam, Berlin, Rome, Brussels, London, Prague, Zurich, Lisbon, Moscow, Geneva, and Vienna from 2012. It clearly illustrates a large decline in Paris compared to the average of the other cities.

We have also decided to include a graph where we have normalized the numbers. We transformed the percentage change into an "index", where both Paris and the average cities starts at 100. It is a little easier to see the relative development of the occupancy rates between Paris and the average.

Figure 2.6: Hotel Occupancy Normalized Number. Data from Statista.com

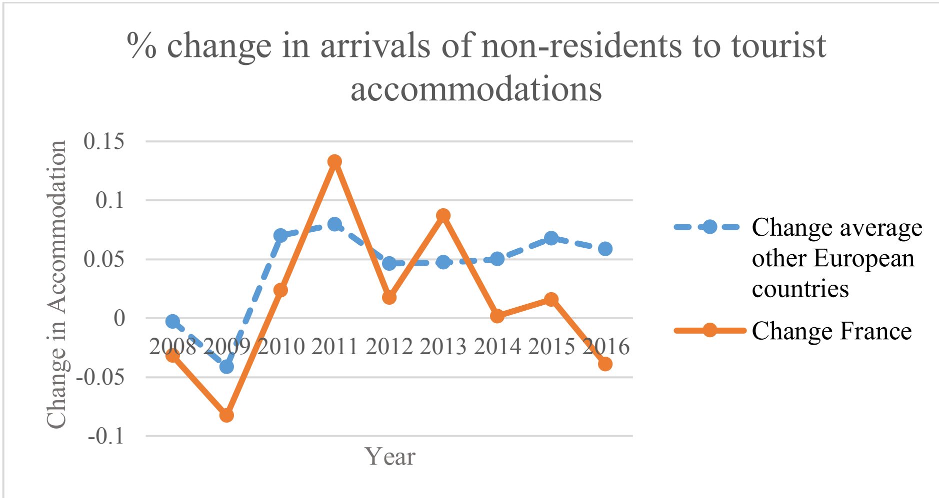



Note: The graph shows normalized numbers of how the occupancy rates changes in Paris, and the average change for Amsterdam, Berlin, Rome, Brussels, London, Prague, Zurich, Lisbon, Moscow, Geneva, and Vienna from 2012. The value of 100 represents no change, above 100 is a positive change, and below 100 is a negative change.

Although it would be ideal to isolate the effects in Paris, it turns out that it is quite hard to find good data specific to regions. We have therefore also included a graph which shows the number of international arrivals to tourist accommodations in France.

Here we have used the following countries to average against France: Belgium, Bulgaria, Czech Republic, Germany, Estonia, Greece, Spain, Croatia, Italy, Lithuania, Hungary, Netherlands, Austria, Poland, Portugal, Romania, Slovenia and Slovakia. The data is retrieved from Eurostat. Both France and the average countries had a decline during the financial crisis, which is as expected. The interesting case is that both the average countries and France had a positive growth in arrivals after the financial crisis, until the period between 2015 and 2016, where France experienced a decline again. The effect is much lower in France in general compared to the effect in Paris, but there is still an observable decline. If this is due to the attacks, it shows how important Paris is for the tourism industry in the country.

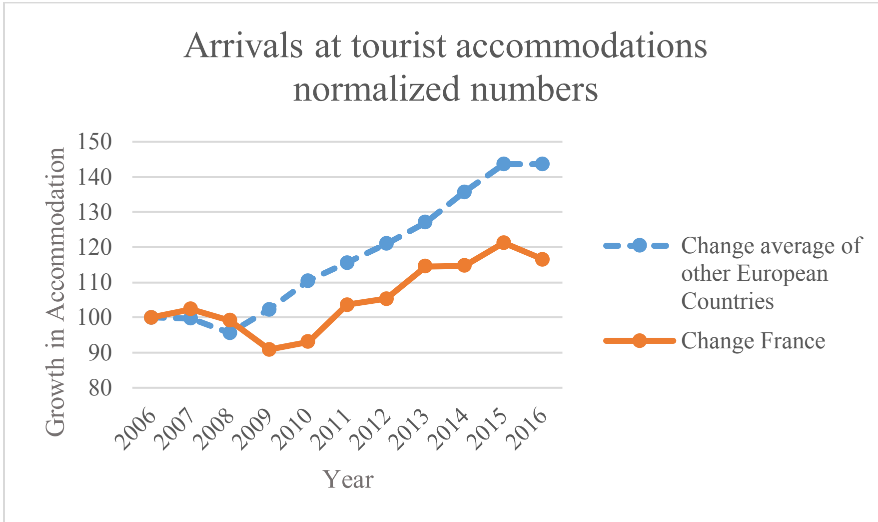
Figure 2.7: % Change in Arrivals of Non-residents to Tourist Accommodation. Data from Eurostat.com




Note: The graph shows the percentage change in arrivals of non-residents to tourist accommodation in France, and the average change for Belgium, Bulgaria, Czech Republic, Germany, Estonia, Greece, Spain, Croatia, Italy, Lithuania, Hungary, Netherlands, Austria, Poland, Portugal, Romania, Slovenia, and Slovakia from 2008.

The normalized numbers from figure 2.8 makes it easier to see that both France and the average countries have had quite stable growth from 2009, where France experiences a decline from 2015 to 2016. These findings alone don't conclude that terrorism is the single cause of the effects, however it is rational to believe that the attacks may be one of the causes that both Paris and France experienced a hotel decline in the same period.

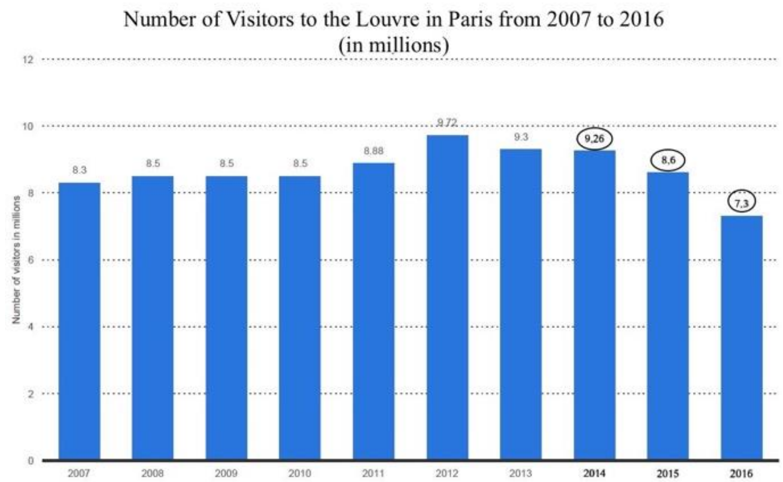
Figure 2.8: Arrivals at Tourist Accommodation Normalized Numbers. Data from Eurostat.com




Note: The graph shows normalized numbers of how the arrivals at tourist accommodation changes in France, and the average change for Belgium, Bulgaria, Czech Republic, Germany, Estonia, Greece, Spain, Croatia, Italy, Lithuania, Hungary, Netherlands, Austria, Poland, Portugal, Romania, Slovenia, and Slovakia from 2008. The value of 100 represents no change, above 100 is a positive change, and below 100 is a negative change.

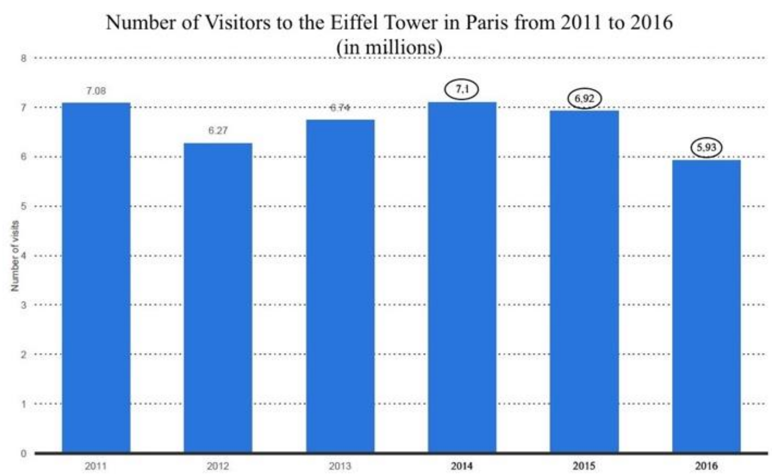
It is not only the hotel industry in Paris and France that has experienced a decrease from 2015 to 2016. By looking at tourist attractions in Paris, like Louvre, the Eiffel Tower, and Disneyland, we can see a decrease in number of visitors. Both the Eiffel Tower and Louvre experienced a small decline from 2014 to 2015, and a much larger decline from 2015 to 2016. Disneyland experienced an increase from 2014 to 2015, but similar to the Eiffel Tower and Louvre, Disneyland experienced a large decline from 2015 to 2016.

Figure 2.9: Number of Visitors to the Louvre in Paris. Reference from statista.com



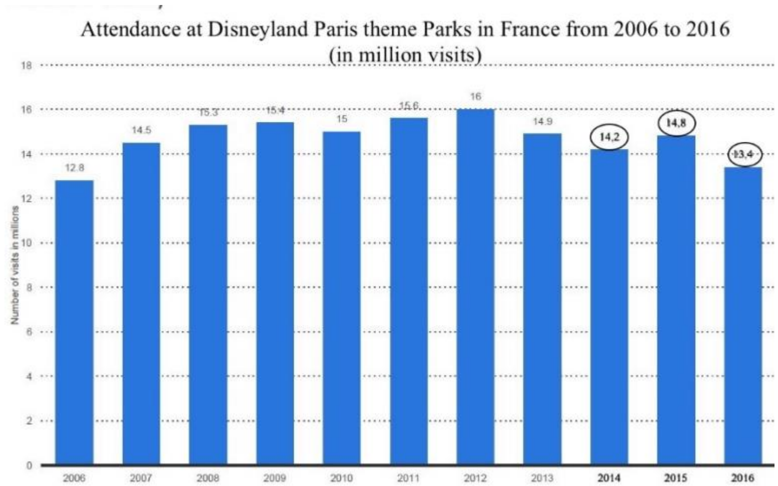

Note: This figure shows the development of number of visitors to Louvre from 2007 to 2016. We can clearly see a decrease in numbers of visitors from 2015 to 2016.

Figure 2.10: Number of Visitors to the Eiffel Tower in Paris. Reference from statista.com




Note: Here we can see the development of number of visitors to Eiffel Tower in Paris from 2011 to 2016. We can clearly see a decrease in numbers of visitors from 2015 to 2016.

Figure 2.11: Attendance at Disneyland Paris Theme Park in France. Reference from statista.com




Note: This figure shows the development of number of visitors to Disneyland Paris Theme Park in France from 2006 to 2016. We can clearly see a decrease in numbers of visitors from 2015 to 2016.

The data we have found is supported by an article from the Norwegian broadcasting company NRK, which covers the decline in tourism in Paris and France after the attacks. Yearly, there are 84 million tourists who visits France, and there are two million people working in the tourism sector. In August and September, 2016, there were a 20% decline in airline ticket reservations to France. The decline in visitors have resulted in closed restaurants and hotels, which have led to termination of employees accordingly (Tollersrud, 2016). Even though the attacks started in 2015, the later attacks may also have had an impact on tourism. From table 2.3, we see that there has been a major attack in Nice prior to the decline in the airline ticket reservations.

According to the data and the article, there are clear evidences that France have experienced a downturn in tourism, and it is plausible to think that a large part of the decline is caused by the terrorist attacks. However, there may be several other factors that can affect this decline as well and is something we have to control for in our analysis.

# 3. Literature Review

There has already been some research regarding how the tourism industry is affected by terrorist attacks, and different methods has been used to study this matter. In this section, we are going to list some of the articles we found most useful regarding our own topic, and explain what they are about, what methods were used, and the results.

Enders, Sandler, & Parise (1992) uses an econometric approach, trying to calculate the financial losses the tourism sector suffered in different Europeans nations. Findings are presented in terms of present discounted value. Estimating the forecast for a country's tourism share is done by "using an ARIMA model with a transfer function, based on the time series of terrorist attacks in the country of interest (Enders et al., 1992). This is done because there was not any available data on the full prices of travel and tourist services at the time. They find that continental Europe lost as much as 16 billion SDRs, apart from lost lives and constructional damages. What they also found was that an attack in France, for example, didn't affect the tourism revenues in France isolated, but that the effect spread to the whole continent.

Feichtinger, Hartl, Kort, & Novak (2001) developed a model where the government is the decision maker, with the goal of maximizing the income generated by the tourism industry. They find that the optimal solution has a cyclical behavior; the starting point is a country with low tourism and low terrorism level. To attract tourists to the country, the government needs to invest in tourism, such as building hotels, ski lifts and alike. There is a positive correlation between tourists and terrorists; more tourists make it more attractive for terrorists to act. A high level of terrorism will lower the number of tourists visiting the country, which again lowers the government spending in the industry. This will make it more unattractive for terrorists to act, and we are at the starting point again. According to the researchers, the key to reach the optimum may be achieved with periodic investments and enforcements programs in order to keep terrorist activity down (Feichtinger et al., 2001).

Graefe & Sönmez (1998) uses regression to see how the terrorist risk influences foreign tourism destinations. They made a questionnaire to answer via e-mail and called some of the individuals who didn't respond to conduct a survey over phone. It seems like the biggest influences to where to go on vacation in this study was linked with international attitudes, risk perception level and income level. Risk perception level was statistically significant in both the propensity for international tourism and whether information search was conducted during the decision-making process of where to travel.

Others have done research on terrorism targeted specifically on tourists. Sönmez (1998) conducted a literature study where he describes the relationship between terrorism, tourism and political turmoil, including studies on impacts terrorism and political instability has on tourist demand, motives of terrorists in targeting tourists and so on. Aziz (1995) wrote an article about understanding the attacks on tourists in Egypt. She points out that the attacks conducted at tourists in 1993 had a big impact on the tourism: It resulted in a drop of 21,9 % in number of tourists, and about a 42,5% decline in tourism receipts compared to the previous year. Pizam & Smith (2000) found that tourists constituted 71% of the victims from terror attacks in the period 1985 until 1998 by using quantitative analysis and conducting information in tables. Their results also states that acts resulting in bodily harm or death have a longer negative effect on tourism demand than acts resulting in property loss. 79 % of the terrorist acts causes a significant decline in tourist demand that lasts from one to six months (Pizam & Smith, 2000). Sönmez, Apostolopoulos & Tarlow (1999) have used a literature study to estimate the possibility of managing the effect of terrorism on tourism. The tourism industry is highly vulnerable to both internal and external shocks, and tourist destinations is often a terrorist target (Sönmez et al. 1999). There are different reasons why terrorist's targets tourist; to achieve strategic objectives (Richeter & Waugh, 1986) and ideological objectives (Hall & O´Sullivan, 1996). The article state that there are great reasons to believe that terrorism will continue. It is therefore important for a country and then especially countries that are dependent on tourism for economic viability, to have a crisis management plan in order to save valuable time, energy and other resources (Sönemez et al.,1999).

Pizam & Fleischer (2002) have done research to find out whether frequency or severity had the largest impact on tourism demand. This study evaluates Israel in the time frame between May 1991 and May 2001, and estimates two models using least square regression. Their findings confirmed their hypothesis, and they could therefore conclude that the frequency of acts of terrorism has a larger negative impact on the international tourist arrivals than the severity of these acts (Pizam & Fleischer, 2002).

There have also been done some previous research regarding the economic effect of tourism on a country. Adams & Parmenter (1995) analyzed the economic impact of tourism on a quite small and quite open economy, using a computable general equilibrium model. In this article, Australia is the country that has been evaluated. The results from this article shows the structural effect of an increase in international tourism (Adams & Parmenter, 1995). One interesting finding from this article was that Queensland, who is a tourism-oriented state in Australia, would experience a negative effect of an economy-wide expansion of tourism. This is because the state also is heavily dependent of the agriculture and mining sector, which may be ignored because of an expansion of international tourism (Adams & Parmenter, 1995).

Sometimes, methods as pure time series and simple comparisons isn’t suitable as data can get noise from other variables. Abadie & Gardeazabal (2003) uses a synthetic control approach to investigate the economic effects the terrorist conflicts with ETA had in the Basque countries from the late 60’s, which within a time period over 30 years killed over 800 people. To minimize distortion from other variables that could have an impact on the economy, the researchers constructed a “synthetic” control region consisting other Spanish regions that has economic characteristics which resembles the Basque region prior to the attacks. They then compared the counterfactual Basque region without terrorism with the actual Basque region which experienced terrorism. They found that per capita GDP in the Basque country was 10% lower relative to the synthetic control region (Abadie & Gardeazabal, 2003). To test if the gap was present because of the attacks, they also conducted a “placebo” study, where they made a synthetic region of Catalonia, which didn’t experience terrorist attacks. Comparing the synthetic Catalonia to the actual Catalonia shows a nearly identical growth pattern of the GDP (Abadie & Gardeazabal, 2003)

# 4. Methodology

## 4.1 Event Study with Comparative Case

Event studies can be used to estimate the effects on Y after an event X have occurred. In our case, X would be the terrorist attacks in Paris that occurred November 13$^{th}$, 2015, and Y would be the economic changes the country experienced after the event. To estimate the economic effects, we have chosen to compare France to other countries that have not experienced terrorist attacks during this period. This is defined as comparative case. There are however some issues regarding the use of comparative case studies. First of all, it would be nearly impossible to find a country that has the identical characteristics as France. Abadie, Diamond, & Hainmueller (2010) explains that there is some degree of ambiguity about how comparison units are chosen. In our case, we could have chosen countries based on tourism attractiveness, the countries size, number of inhabitants et cetera. If we were able to find an effect between France and a comparable country, we wouldn't know if the effect is due to the terrorist attacks or because of the different characteristics the countries has. Another problem is that the techniques used in comparative case studies only measure the uncertainty about the aggregated data, even when the retrieved data typically is in disaggregated units (Abadie et al., 2010). Because of these limitations, we will use a technique introduced by Abadie & Gardeazabal (2003) called the synthetic control method.

## 4.2 The Synthetic Control Method

Abadie et al. (2010) emphasizes that a combination of units will provide a better comparison to the country exposed to the event than a single unit alone. One country receives a "treatment", in our case a terrorist attack, while a group of control countries does not. The gap between the outcome path for the treated country and the path for the control group is the "treatment effect", or the effect of terrorism (McClelland & Gault, 2017). The synthetic control method uses a weighted average of the control units to create a counterfactual version of the country which experienced the event. This way, we can estimate how the development in the country could have been if the event never took place. To be able to conclude that the effect is because of the received treatment, the path for the treated country and the control group has to match closely in the pre-treatment period, before diverging after the treatment is received (McClelland & Gault, 2017). To ensure that the synthetic control method is effective in the research, three assumptions need to hold: Only the treated country is affected by the treatment, that there's no effect before the treatment is received, and that the treated country's counterfactual can be replicated by a fixed combination of control countries (McClelland & Gault, 2017).

### 4.2.1 The Model

Abadie et al. (2010) explains the synthetic control method with a simple model. The synthetic control is made out of *J+1* regions, where only the first regions is affected by the treatment. *J* consist a number of control regions which purpose is to create its "synthetic" version, which Abadie et al. (2010) refers as the donor pool. $Y_{it}^{N}$ is defined as the value of the outcome variable where no treatment is given for region $i = 1, \ldots, J + 1$ in time $t = 1, \ldots, T$, where *N* is the number of regions in the donor pool. The pretreatment period is defined as $T_0$, with $1 < T_0 < T$. It simply means that it must be at least one period before and after the treatment occurs. The outcome variable for region *i* during the post-treatment period $T_0 + 1\ to\ T$ when treatment is present is defined as $Y_{it}^{I}$. As already mentioned, we assume that there is no effect of the treatment in the pre-treatment period, where $Y_{it}^{I} = Y_{it}^{N}$ when $t \in \{1, \ldots, T_0\}$ and $i \in \{1, \ldots, N\}$. The treatment effect for unit *i* at time *t* is shown as $\alpha_{it} = Y_{it}^{I} - Y_{it}^{N}$. $D_{it}$ is defined as an indicator which takes value one if unit *i* is exposed to the treatment at time *t*, and zero otherwise. The observed outcome for unit *i* at time *t* can be shown as: $Y_{it} = Y_{it}^{N} + \alpha_{it} D_{it}$. As mentioned above, only the first region is exposed to the treatment, and happens after period $T_0$, so $D_{it}$ takes value of one if $t > T_0$. To estimate $\alpha_{1t}$, which is the effect in the treated region, we only need to estimate $Y_{1t}^{N}$, which is the synthetic version. We only need this estimation because $Y_{1t}^{I}$, the real values for the treated region is observable ($\alpha_{1t} = Y_{1t}^{I} - Y_{1t}^{N}$).

Abadie et al. (2010) defines the synthetic control region as:

$$Y_{it}^{N} = \delta_t + \theta_t Z_i + \lambda_t \mu_i + \varepsilon_{it}$$

Equation 4.1 Synthetic Region Factor Model. Reference from Abadie, Diamond, & Hainmueller (2010)

"where $\delta_t$ is an unknown common factor with constant factor loadings across units, $Z_i$ is a (r x 1) vector of observed covariates (not affected by the intervention), $\theta_t$ is a (1 x r) vector of unknown parameters, $\lambda_t$ is a (1 x F) vector of unobserved common factors, $\mu_i$ is an (F x 1) vector of unknown factor loadings, and the error terms $\varepsilon_{it}$ are unobserved transitory shocks at the region level with zero mean" (Abadie et al., 2010).

To create a synthetic control, we use different weights for all regions in the donor pool. Abadie et al. (2010) introduces a (J x 1) vector of weights $W = (w_2, \dots, w_{j+1})$ where $w_j \geq 0$ for $j = 2, \dots, J+1$ and $w_2 + \cdots + w_{j+1} = 1$, which means that all the weights must sum up to one. Each value of W represents a potential synthetic control, where we have to find the optimal weights in order to replicate the treated region as accurate as possible. When weights are introduced to the factor model, we get:

$$\sum_{j=2}^{J+1} w_j Y_{jt} = \delta_t + \theta_t \sum_{j=2}^{J+1} w_j Z_j + \lambda_t \sum_{j=2}^{J+1} w_j \mu_j + \sum_{j=2}^{J+1} w_j \varepsilon_{jt}$$

Equation 4.2: Factor Model with Weights. Reference from Abadie, Diamond, & Hainmueller (2010)

The sum of the optimal weights $(w_2^*, \dots, w_{j+1}^*)$ in the pre-treatment period is given as:

$$\sum_{j=2}^{J+1} w_j^* Y_{j1} = Y_{11}, \quad \sum_{j=2}^{J+1} w_j^* Y_{j2} = Y_{12}, \quad \dots, \sum_{j=2}^{J+1} w_j^* Y_{jT_0} = Y_{1T_0} \quad and \quad \sum_{j=2}^{J+1} w_j^* Z_j = Z_1$$

Equation 4.3 Sum of Optimal Weights in the Pre-Treatment Period. Reference from Abadie, Diamond, & Hainmueller (2010)

It is important to point out that the optimal weights are theoretical, and we often don't find weights that equation 5 holds exactly in practice. The weights we find should be considered as approximate weights. Finally, the effect of the treatment is written as:

$$\hat{\alpha}_{1t} = Y_{1t} - \sum_{j=2}^{J+1} w_j^* Y_{jt}$$

Equation 4.4: The Treatment Effect. Reference from Abadie, Diamond, & Hainmueller (2010)

### 4.2.2 The Models Goodness of Fit

The method to evaluate the accuracy in the synthetic control is to evaluate the root mean square prediction error (RMSPE). In general, the RMSPE measures the difference between the actual and predicted values, which is called residuals. In synthetic control, "the RMSPE measures the lack of fit between the path of the outcome variable for any particular country and its synthetic counterpart" (Abadie et al., 2015). The formula for RMSPE is:

$$RMSPE = \sqrt{\left(\frac{1}{T_0}\sum_{t=1}^{T_0}(Y_{1t} - \sum_{j=2}^{J+1} w_j^* Y_{jt})^2\right)}$$

Equation 4.5 Root Mean Square Prediction Error. Reference from Abadie, Diamond, & Hainmueller (2015)

A good model will thus have a small RMSPE in the pre-treatment period, which means that the synthetic control manages to replicate the actual outcome with low errors. If there is any effect in the post-treatment period, you'll find a large RMSPE. With a large RMSPE, we'll observe a gap between the measured country and its synthetic version, which is the effect of the outcome.

RMSPE is measured in the same unit as the outcome variable. The extent to which RMSPE is defined as high or low, depends therefore on the range of the outcome variable. For example, an RMSPE on 0.7 can be low if the outcome variables range from 0-1000, but can at the same time be high if the variable has a range of 0-1.

### 4.2.3. Placebo studies

To ensure that the observed effect is present due to the received treatment, this method allows us to conduct placebo studies. To find out if the observed gap really occurred from terrorism, Abadie & Gardeazabal (2003) applied the same method to compute the gap for the Basque Country to Catalonia, a region which did not suffer from terrorism under this time period. The reason is to compare the economic evolution for a region which resembles the Basque Country, but that is absent from terrorism, to its synthetic version. This way, the researchers can test if the effect comes from terrorism or other factors. If a gap is still observable between the non-affected region and its synthetic version, it cannot be concluded that terrorism is the reason behind the observed effect. Abadie, Diamond, & Hainmueller (2015) uses the term "in-space-placebos" where placebo tests are conducted on all the countries in the donor pool. They do also calculate the post / pre- treatment RMSPE ratio, which means that a large ratio indicates a larger post-treatment RMSPE than the pre-treatment RMSPE. The idea is to compare the RMSPE ratio for each country to see if some of the untreated countries has a similar or larger ratio than the treated country. However, Abadie et al. (2015) states that a large post-treatment RMSPE does not necessarily indicate a treatment effect, if the pre-treatment RMSPE also is large.

Abadie et al. (2015) describes another method of conducting placebo tests, called “in-time-placebos”, where you apply the treatment period to a period where the treatment did not occur. If large effects are observable within this period, validity of the assumption that the actual treatment have an effect dissipates. This method can be applied if we have enough time periods to capture eventual effects (Abadie et al., 2015).

### 4.2.4. Implementation

McClelland & Gault (2017) have made a step-by-step guide of how to implement the method. The first choices you have to make is to identify both the outcome variable and the predictor variables, where the predictor variables have to affect outcomes in the countries both before and after the treatment. Furthermore, the range of the pre-treatment years for over which the predictors will be averaged have to be chosen, where a longer time period is better than a shorter. We also have to include lagged variables in the model, where the intention is to highlight the trend of the outcome in the pre-treatment period. After the variables are chosen, we have to find possible donor countries to estimate the synthetic country. It is important to exclude countries that have received a similar or larger treatment during the selected period; small treatments will on general not be disruptive on the data. Ideally, the value of the predictors for the treated country should lie towards the middle relative to the predictors in the donor pool. McClelland & Gault (2017) further explains that we have to choose a method for selecting predictor weights; however, this is done automatically using the synth package for Stata.

After the preparation phase, we have to run the synthetic control and evaluate the goodness of fit of the synthetic control country in the pre-treatment period. This is normally done by a visual check of the graph, and checking the root mean square prediction error (RMSPE). If the fit seems to be poor, we can conduct a test using all possible outcome lags. If the fit still is poor after the test, it is advised not to use the synthetic control method. However, using too many lagging variables can bias the outcome path.

Finally, we run a placebo test to assess if there is a significance of the results for the treated country. As already mentioned, if the post-treatment effect between the treated country and its synthetic control is larger than for non-treated countries and their synthetic control, there is evidence that the treatment had an effect. To test the credibility of the results, sensitivity analysis can be conducted (McClelland & Gault, 2017).

### 4.2.5. Advantages and Limitations with the Synthetic Control Method

As with every models, the synthetic control approach has both advantages and drawbacks. One of the big advantages is that the model is convenient and easy to use, thanks to Jens Hainmuellers synth package for Stata, R, and MATLAB. The package is readily available, and Hainmueller has a webpage which explains how to use the package. The synthetic control method can be regarded as an extension from the much well-known method difference-in-difference; however synthetic control excels as this method allows the effects of unobservable data to vary with time, whereas difference-in-difference has strong assumptions such that effects of unobservable data has to be fixed (Abadie et al., 2010). Other advantageous features mentioned by Abadie et al. (2010) is transparency and safeguard from extrapolation. It is a transparent method because: The synthetic control is a weighted average of the control units, where the relative contribution of each control unit is explicit, and it shows clearly how the treated country and the synthetic control matches on pre-treatment outcomes. It offers a safeguard from extrapolation because the weights can be restricted to be positive and sum up to one.

We can also identify some limitations with the method. McClelland & Gault (2017) points out that the synthetic control can get a bad fit if the treated country has extreme values compared to the values in the donor pool. You will also get a bad fit if some of the countries in the donor pool has extreme values compared to the other countries and should be removed from the analysis. This is to reduce the interpolation bias (Abadie et al., 2015). Another limitation is that it is not possible to get a synthetic control if there are missing observations for the treated country in the outcome variable, where availability of data can limit the time period we wish to examine. If the treated country misses a value in the middle of the dataset, we risk that the analysis cannot be conducted with this variable at all.

We have to be careful and precise when collecting data because of these limitations, but as long as we have them in mind while searching for data and accounting for them, it will not obstruct the analysis. Despite the limitations, we believe that this method is appropriate to use in our analysis.

# 5. Data

In this chapter, we will present the data we have gathered and used. We'll explain where we got the data from, how we proceeded in order to find the information needed, and the choices we made to narrow the dataset to get a best possible fit.

## 5.1 Presentation of Data

We have gathered most of the data from the Eurostat database, but we also found useful information from the OECD database. Eurostat provided data for 30 European countries (including France), so we downloaded the data for all the countries. For some data, other countries were present as well, but we removed them in order to get the same countries for all the variables. We have also gathered annual data from 2000-2016. We want to find if the terrorism in France have affected the economic growth in the country, and we have therefore chosen to use real GDP per capita as the outcome variable for our analysis, which is measured by euros in thousands. Ideally, we wanted to collect monthly data instead of annual, and capitals instead of countries, but this data wasn`t available. When choosing variables, we have taken inspiration from Abadie & Gardeazabal (2003) as their research is based on the economic effects of conflicts. There are great similarities between their study and our thesis, as both papers use the synthetic control method, and looks at the effect caused by terrorism. The main difference is that our paper is an event study, while Abadie & Gardeazabal (2003) examines the effect over a long time period of terrorist incidents.

With their paper in mind, we have chosen to use the following control variables: Population density, investment ratio, production divided into different sectors, human capital, and unemployment rate. The population density is measured in persons per square kilometer, and investment ratio is defined as gross total investment divided by GDP. The sectoral productions are divided into four subcategories, which is agriculture, forestry and fishing, industry and energy, construction, and services. These variables are defined by the contribution to gross value added growth. Human capital is divided into three categories, which defines the educational level in the country. The numbers are the percentage of inhabitants who have completed the tertiary stage, the upper secondary stage, and those who are below the upper secondary stage. The sectoral productions and human capital is also the only data gathered from OECD. Last, the unemployment measures the total unemployment rate in the country. This ratio is not included in Abadie & Gardeazabals (2003) paper, but we feel it is a relevant factor. Terrorism is expected to harm the tourism industry, which may lead to a higher unemployment in this sector.

Table 5.1: Variable Description

| Variable | Measurement |
|---|---|
| Dependent Variable | |
| Real GDP per Capita | Euros in thousands |
| Predictor Variable | |
| Population Density | Persons per square kilometer ($km^2$) |
| Investment Ratio | Gross total Investment/GDP |
| Production | |
| Agriculture, Forestry & Fishing | Contribution of agriculture, forestry and fishing to gross value added growth. |
| Industry & Energy | Contribution of industry and energy to gross value added growth. |
| Construction | Contribution to gross value added growth. |
| Services | Contribution to gross value added growth. |
| Human Capital | |
| Below Upper Secondary | Percentage of inhabitants who are below the upper secondary stage |
| Upper Secondary | Percentage of inhabitants who have completed the upper secondary stage |
| Tertiary | Percentage of inhabitants who have completed the tertiary stage |

Note: This table lists all the variables used in our analysis and shows how the different variables is measured.

## 5.2 Choosing donor pool and sample period

After examining the data, we first removed the countries which had a lot of missing values. For example, Bulgaria, Croatia, Cyprus, Lithuania, Malta, and Romania missed all the sectoral production and human capital variables. As mentioned in chapter 4.3.5, we also have to remove countries which has extreme values in the outcome variable. Our method to eliminate extreme values was to calculate the average of real GDP per capita for each country and compare them with the average for France. The average of real GDP per capita for each country is shown below in table 4. The average of real GDP per capita for France is 29.57, and as mentioned in chapter 4.3.4, it is important that the donor pool consist of countries that have values both below and above the value of France. In table 4, countries that are included in the donor pool is labeled with "**", and the one`s exclude is labeled with "*". The average for the other included countries has a value of 30.81, which puts France nearly in the middle. Choosing limits for extreme values is not easy, as we need countries that have both higher and lower average real GDP per capita than France. There are no rules for how to set limits for extreme values, as it will vary between datasets. For instance, Greece, Slovenia, and Portugal was all in the limit to be excluded due to a large gap between the average values to France. To assess the best fit, we tried to conduct synthetic control with different combinations of countries, where we focused on countries which was on the limit to be excluded. We found that the inclusion of Greece, and the exclusion of Portugal and Slovenia gave us the best possible fit. The same goes for the countries in the upper limits, where we included Sweden and excluded Ireland.

Table 5.2: Average Real GDP per Capita for all Countries.

| Country | Belgium | Czech | Denmark | Germany | Estonia | Ireland | Greece | Spain |
|---|---|---|---|---|---|---|---|---|
| Average Real GDP per Capita | 31.8 ** | 12.6 * | 41.7 * | 31.34 ** | 10.56 * | 40.4 * | 17.6 ** | 21.5 ** |
| Country | France | Italy | Latvia | Luxembourg | Hungary | Netherlandss | Austria | Poland |
| Average Real GDP per Capita | **29.57** | 25.87 ** | 8.4 * | 73.5 * | 9.2 * | 35.8 ** | 33.85 ** | 8.171 * |
| Country | Portugal | Slovenia | Slovakia | Finland | Sweden | United Kingdom | Iceland | Norway |
| Average Real GDP per Capita | 15.7 * | 16.1 * | 10.1 * | 33.68 ** | 38.35 ** | 32.7 * | 38.34 ** | 60 * |

Note: Average real GDP per capita is measured by calculating average of real GDP per capita for each country from 2000 until 2016. Numbers labeled with ”*” is extreme values, and the one that are excluded from the donor pool. Numbers labeled with “**” is values that are included in the donor pool.

We have also already mentioned that we cannot include predictors where France have the highest or the lowest values, and that the predictors to France ideally should lie towards the middle compared to the predictors for the other countries. Table 5.3 shows the average values for predictors for France, and the average for the other countries in the donor pool. For most of the predictors, France lies fairly towards the middle. There are two predictors where France is off, which is population density and industry & energy. We tried to run a synthetic control where these variables were excluded, and we got a poorer fit. Therefore, we chose to still include these predictors.

Table 5.3: Predictor value France, and average value of countries in the donor pool.

| Predictor | Value France | Average Value of Countries in the donor pool |
|---|---|---|
| Population Density | 102.4 | 339.6 |
| Investment ratio | 22.27 | 21.40 |
| Agriculture, Forestry and Fishing | -0.003 | 0.005 |
| Industry and Energy | 0.052 | 0.13 |
| Construction | -0.064 | -0.084 |
| Services | 1.015 | 0,86 |
| Below Upper Secondary | 27.893 | 28.33 |
| Upper Secondary | 42.272 | 40.59 |
| Tertiary | 29.835 | 29.49 |
| Unemployment | 9.025 | 8.82 |

Note: In the column to the left is all the predictors listed. The column in the middle shows the average value of each predictor for France in time period 2005 to 2016. The column to the right shows the average value of each predictors, for all the countries in the donor pool, in time period 2005 to 2016.

In chapter 4.3.4 it is also specified that countries which have received a similar or larger treatment during the period has to be excluded. However, determining what is meant with "similar or larger treatment" can be discussed, and we have to make some assumptions. Table 2.2 in chapter 2.2.4 shows the deadliest terrorist attacks in Europe during the period 2000 – 2016. To determine whether a country have received a similar or larger treatment, we have decided to take both number of deaths and injuries into consideration. The terror attacks in France have a total of 505 people who got directly involved. The train bombings in Spain had a total of 2242 people who got involved, while the number of people involved in the bus bombings in the United Kingdom is 840. All the other countries have a lower number of people involved than in the France attacks, and we have therefore decided to count on these terror attacks when deciding the donor pool. Since we have a low number of control countries that have value below the value of France, will it be important for us to include Spain in the donor pool, and we therefore choose to use data from 2005 - 2016 to exclude the terror attack in 2004 from our data set. It may be discussed whether or not it is enough to just exclude 2004 from the dataset, as there still could be spillover effects from the attack. However, as mentioned in chapter 2.3.2, it takes approximately 13 months in average for a country to recover from a terrorist attack. Based on this, we do not believe that spillover effects will be a problem. We tried to proceed the same way with United Kingdom as we did with Spain, and conducted a synthetic control from 2006, to eliminate the attack that happened in London in 2005. We got a poorer fit this way and decided to exclude United Kingdom entirely from our analysis. The average real GDP per capita for United Kingdom is above the average of France, and since we have enough control countries with approximately the same value, the exclusion of United Kingdom is not a problem.

After taking these considerations into account, the donor pool has been reduced from 29 to 10 countries: Belgium, Germany, Greece, Spain, Italy, Netherlands, Austria, Finland, Sweden, and Iceland.

# 6. Analysis

We know from the background and theory chapter that there has been a negative impact in the tourism industry in France from 2015. Hotel bookings and foreign arrivals in hotel accommodations have dropped, and the number of visitors to popular attractions like Disneyland, Louvre, and the Eiffel Tower experienced a decline. As we have already pointed out, the travel & tourism sector is the fourth biggest contribution to the GDP by sectors. What have caused this decline? In thread with theories and previous research, it is expected that terrorist attacks will lead to economic losses. Our goal is to prove that the terrorist attacks in 2015 had a negative impact on Frances economy, which will be done by a deeper analysis.

In this chapter, we will conduct the synthetic control, using the synth package for Stata. The weights of the countries used will be presented in tables, and we'll show how the synthetic control looks like in comparison to the average. The outputs will be presented graphically, together with the respective RMSPE values. We will further perform different placebo tests so we can with greater confidence assume that the eventual effects are because of the terrorist attacks. We have chosen to conduct in-space placebos, and decided not to include in-time placebos, because of lack of time periods.

## 6.1 Estimations

In chapter 5.2, we chose the donor pool and sample period based on the criteria's presented in chapter 4.2.4. When we run the synthetic control, STATA takes care of the estimations. The program chooses and puts different weights on the countries in the donor pool, in order to get a graph that replicates France the best possible way in the pre-treatment period. Table 6.1 shows the countries that have been included in synthetic France. The table shows that six of the ten countries have been weighted, which are Austria, Belgium, Germany, Iceland, Italy, and Spain, where Belgium have been assigned most of the weight (43.7%). Italy, Austria and Spain got smaller, but substantial weights (24.5%, 15.2% and 12.4%). Germany and Iceland have also been weighted, but on a much lower level (0.32% and 0.11%). The rest of the countries got a weight of 0%, and is therefore not a part of synthetic France.

Table 6.1: Synthetic Control Weights

| Country | Weights |
|---|---|
| Austria | 0.152 |
| Belgium | 0.437 |
| Finland | - |
| Germany | 0.032 |
| Greece | - |
| Iceland | 0.011 |
| Italy | 0.245 |
| Netherlands | - |
| Spain | 0.124 |
| Sweden | - |

Note: Column one shows all the countries in the donor pool, while the second column shows the percentage weights that each country is given when conducting the synthetic France. The countries without any percentage rate is not included in the synthetic France.

After the weights have been chosen, STATA produces values for the predictor outputs. Table 6.2 shows the values of the predictors to the synthetic France compared to actual France. We have also decided to include the average values of the control units, which contains all ten countries in the donor pool. The average shows how the output would look like if all the countries were weighted equally. We can see that for most of the predictors, synthetic France resembles France more than the average of the control units. The average control units get a better fit than the synthetic France for some of the predictors; however, we believe the comparison illustrates that the synthetic control method is better than just averaging all the countries in the donor pool.

Table 6.2: Predictor Balance

| Predictor Balance | France | Synthetic France | Average of Control Units |
|---|---|---|---|
| Population Density | 102.11 | 239.499 | 159.757 |
| Investment Ratio | 22.37 | 22.12 | 21.499 |
| Production Sectors | | | |
| Agriculture, forestry & Fishing | 0.0122 | -0.0056 | -0.00032 |
| Industry & Energy | 0.0225 | 0.1029 | 0.126 |
| Construction | -0.0665 | -0.0665 | -0.129 |
| Services | 1.03 | 0.829 | 0.7618 |
| Human Capital | | | |
| Below Upper Secondary | 29.036 | 35.142 | 29.108 |
| Upper Secondary | 42.029 | 35.935 | 40.459 |
| Tertiary | 28.935 | 26.452 | 28.74 |
| Unemployment | 8.87 | 8.79 | 8.68 |
| Real GDP per Capita (in thousand) 2011 | 31.5 | 31.672 | 32.51 |
| Real GDP per Capita (in thousand) 2008 | 30.4 | 30.57 | 33.17 |

Note: Column one shows the different predictors that are included in the synthetic control. Column two shows the value of the predictors for actual France, while column three shows the value of the predictors for the synthetic France. In column four we have calculated the value of each predictor as an average for all the control countries.

## 6.2 Results

Based on the weights and the output we got in the previous sub-chapter, we now get a visual representation of any eventual effects. As mentioned, the program has weighted the different countries in the donor pool to get a replication of France in the pre-treatment period. Synthetic France in the post-treatment period illustrates how the economic growth in France could have been without terrorism. Figure 6.1 compares the synthetic France, which is the dotted line, and the actual France, which is the solid line. This graph has an RMSPE of 0.094, which indicates that the model has a low error level, and that the model was able to produce a good counterfactual. Referring to chapter 4.2.2 about the models goodness of fit, a low-numbered RMSPE is a good fit unless the range in the dependent variable has a small range. Our variable ranges from 16.2 to 54.5 and can therefore conclude that our RMSPE is low. We can also observe the goodness of fit visually. From the graph, we see that the counterfactual follows France very closely in the pre-treatment period, with some deviations along the way. From the graph we can see that France has experienced a steady growth in the pre-treatment period except during the financial crisis. In 2015, the graph for France is kinked, and it creates a gap between France and its synthetic version in 2016 at €825 per capita. There is a tiny separation between the graphs right before the terrorist attack, but nothing substantial. One explanation for the separation prior to the event could be because the data is collected annually. We expect an immediate effect after the attack 13$^{th}$ of November, and it is reasonable to think that this has led to a lower economic growth between 2014-2015 than the potential growth. The Charlie Hebdo shootings in January can also be a reason for this lower growth.

Figure 6.1: France and Synthetic France

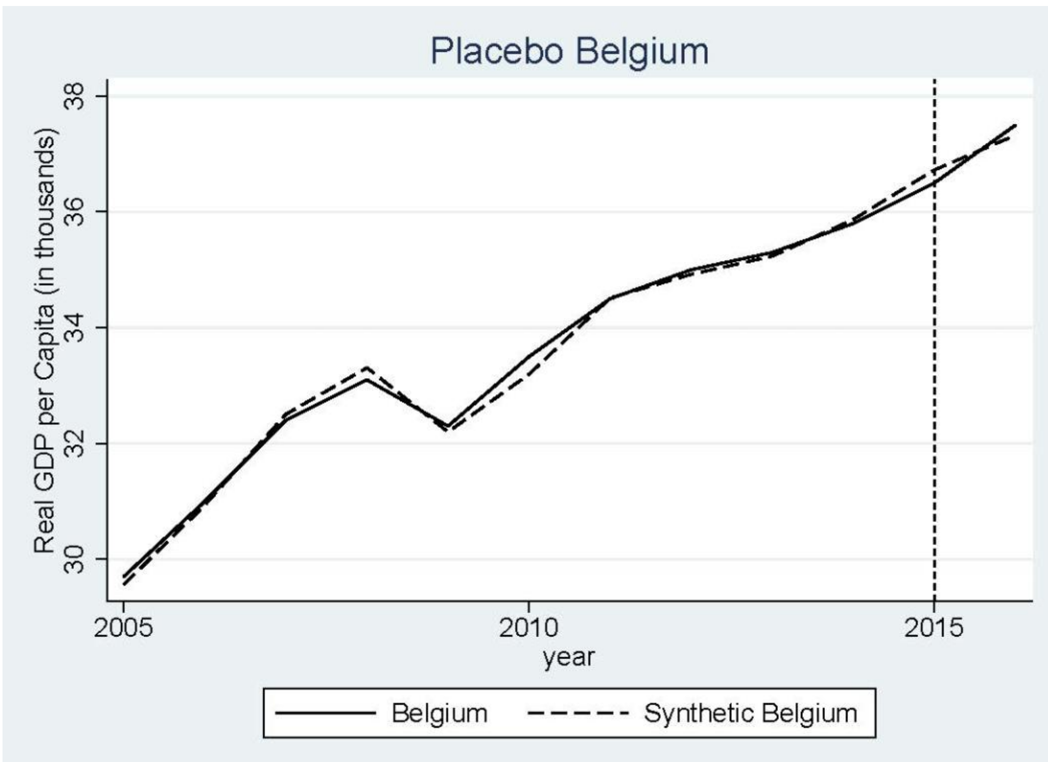

Note: The dotted line replicates France with the following weighted countries: Austria, Belgium, Germany, Iceland, Italy, and Spain. The solid line shows the development of real GDP per capita of France. Real GDP per capita in France in 2016 was €33 300. The synthetic France shows that France could potential have a real GDP per capita at €34 125 in 2016.

### 6.2.1. Robustness Tests and Sensitivity Analysis

As mentioned in chapter 4.3.3, we need to conduct sensitivity analyses to verify the robustness of the results. In this part, we are going to perform several in space-placebo tests, where we test if the different countries in the donor pool have experienced a similar or larger effect during the same time period. If that is the case, we cannot conclude that terrorism is the factor that creates eventual effects. It is also possible to conduct in-time-placebo test, which is applicable if we have enough time periods. We do only have one year in the post-treatment period, and in-time placebo test is therefore not suitable in our case.

As Belgium is the country with the largest weight in the synthetic control, we have chosen to perform a placebo test on Belgium, where we run a new synthetic control and compare Belgium to its counterfactual. This can give us an indication if the observed gap between France and its counterfactual can be linked to the terrorist attacks. As we know, a similar or larger gap for the synthetic control for Belgium will tell us that there is no evidence that the treatment had an effect. From figure 6.2, we can see that Belgium and its synthetic control have a good pre-treatment fit, with an RMSPE of 0.135. We also observe that there is no negative change in Belgium from 2015. A small gap can be observed before 2015, which actually shrinks and closes the gap entirely during the post-treatment period. Taking this analysis into consideration, there is evidence that the terrorist attacks may have contributed to the gap we observed in figure 6.1.

Figure 6.2: Placebo test Belgium

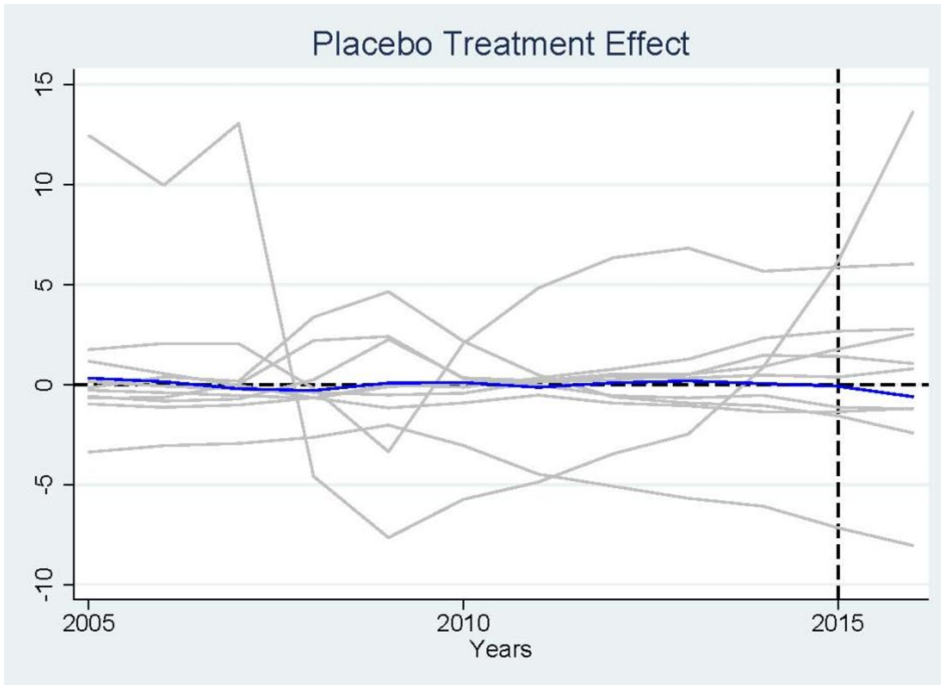



Note: The dotted line replicates Belgium with the following weighted countries: Austria, Germany, Italy, Netherlands and Sweden. The solid line shows the development of real GDP per capita of Belgium.

We have also conducted a test where we estimate the treatment effect for France and all the countries in the donor pool. The treatment effect is calculated as the difference between the actual countries and their respective synthetic versions in the post-treatment period. The blue line in figure 6.3 is the difference between actual and synthetic France, while the gray lines is the difference between actual and synthetic for all the other countries in the donor pool. The graph shows that France has a good pre-treatment fit, as the line in general lies around zero. This is as expected, as the pre-treatment fit has an RMSPE of 0.094. This graph also catches the negative effect we observe in figure 6.1, as the line has a kink right after 2015. According to Abadie et al.

(2015), we cannot conclude that the effect is caused by terrorism if the control countries have a similar or better pre-treatment fit, and an equal or larger effect after 2015 than France.

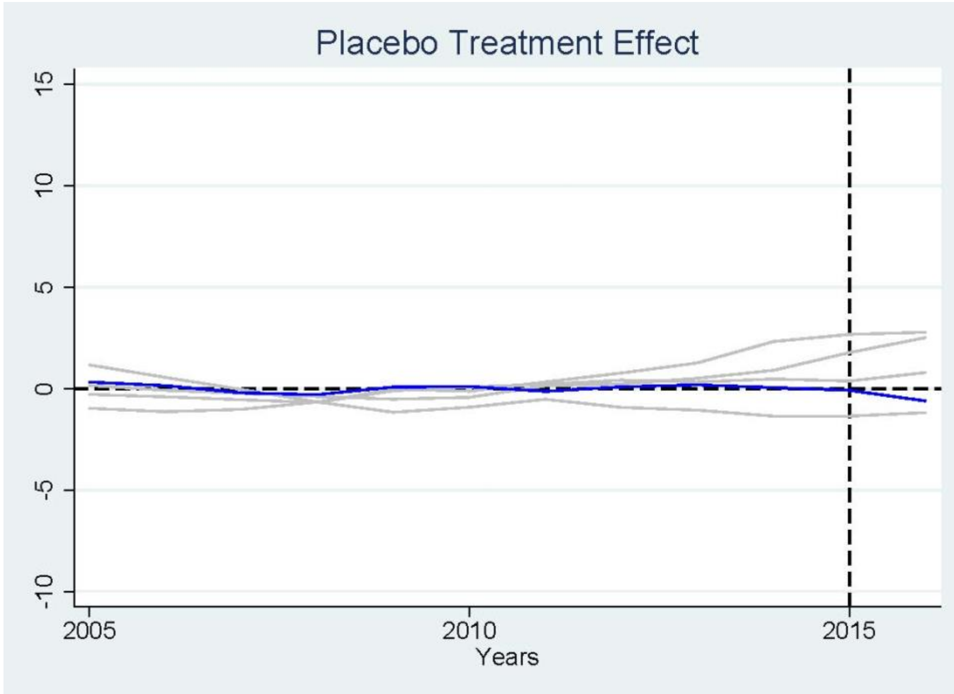
Figure 6.3: Placebo Treatment Effect




Note: Placebo Treatment Effect shows the difference between the actual countries and their respective synthetic versions. The blue line represents France, while the grey lines represents Austria, Belgium, Finland, Germany, Greece, Iceland, Italy, Netherlands, Spain and Sweden.

We have also decided to include a graph where we have excluded countries with extreme deviations between actual and synthetic in the pre-treatment period, because the countries with a poor pre-treatment fit won't have any impact on the outcome. In figure 6.4, we have excluded Austria, Finland, Greece, Iceland, Netherlands, and Sweden. None of the remaining countries have a better pre-treatment fit than France, and there is no sign of effect on the donor countries. Based on this analysis, we still have evidence that terrorism can have contributed to the observed negative effect in figure 6.1.

Figure 6.4: Placebo Treatment Effect Excluding Extreme Values

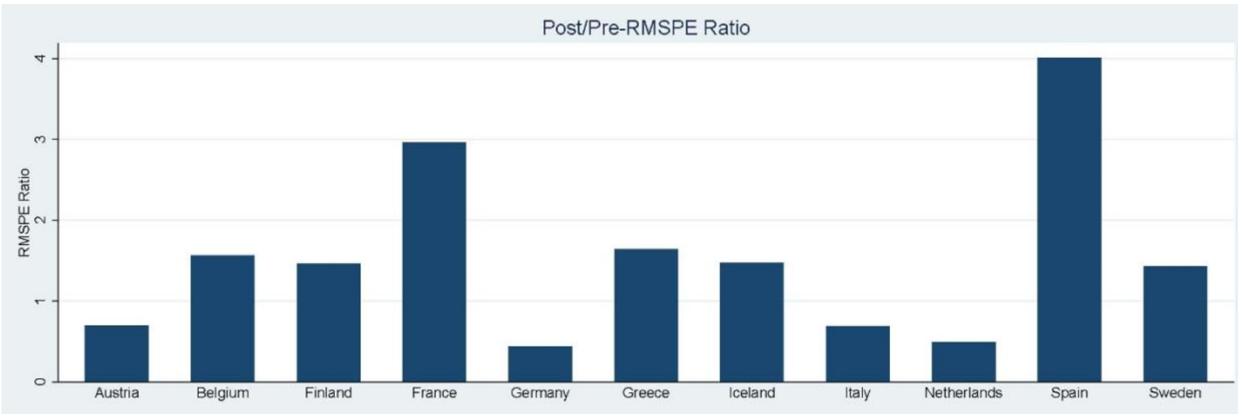



Note: Placebo Treatment Effect shows the difference between the actual countries and their respective synthetic versions. Countries with extreme values have been excluded in this figure. The blue line represents France, while the grey lines represents Belgium, Germany, Italy, and Spain.

Further, we have calculated the post / pre-treatment RMSPE ratios for each country and graphed them in a bar-chart. We are comparing the ratios for all the countries as we have described in chapter 4.3.3, where a high ratio for France could be indicative that the treatment had an effect, given this ratio is the largest. However, figure 6.5 illustrates that Spain has an RMSPE ratio on 4.01, which is the largest ratio compared to the other countries. Spain is the only country that surpasses Frances ratio, which is 2.96. To assess if there has been a treatment effect or not based on the graph, we need to examine the pre-treatment RMSPE for Spain, as a large pre-treatment RMSPE indicates a poor fit in the pre-treatment period. Spain has a pre-treatment RMSPE at 0.48 and a post-treatment RMSPE at 1.93. The pre-treatment RMSPE is greater than France's RMSPE, but it is still quite low. One drawback with this test is that it doesn't take the direction of the treatment into account. This means that we get a high ratio even if the effect after 2015 is positive. Referring to figure 6.6, we can indeed observe that Spain has a positive treatment effect, which indicates that Spain has a growing real GDP per capita from 2011. Even though

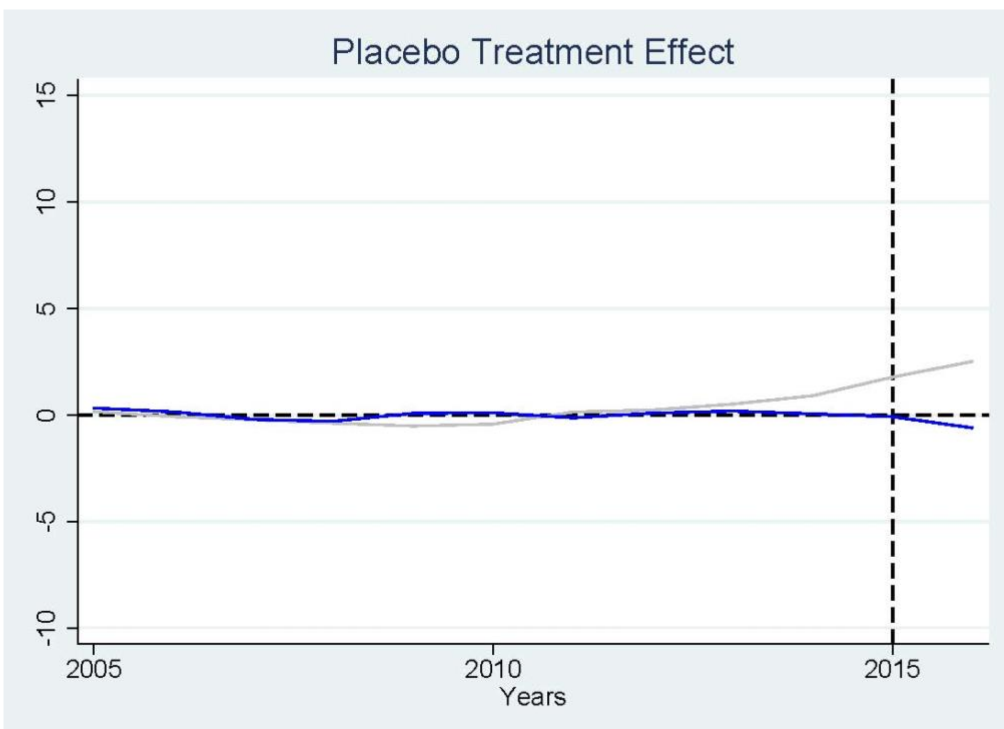
Spain has the largest RMSPE ratio, it is a positive effect, and therefore doesn't disprove that terrorism is a cause to the decline in France.

Figure 6.5: Post-/Pre- RMSPE Ratio




Note: This figure shows each countries Post/Pre-PMSPE Ratio. A high ratio indicates that the RMSPE in the post- treatment period is higher than the RMSPE in the pre-treatment period. Spain has the highest Post/Pre-RMSPE ratio, which could be indicative that there has been an effect in Spain. However, the effect in Spain is positive, and doesn`t disapprove that terrorism is a cause for the decline in economic growth in France.

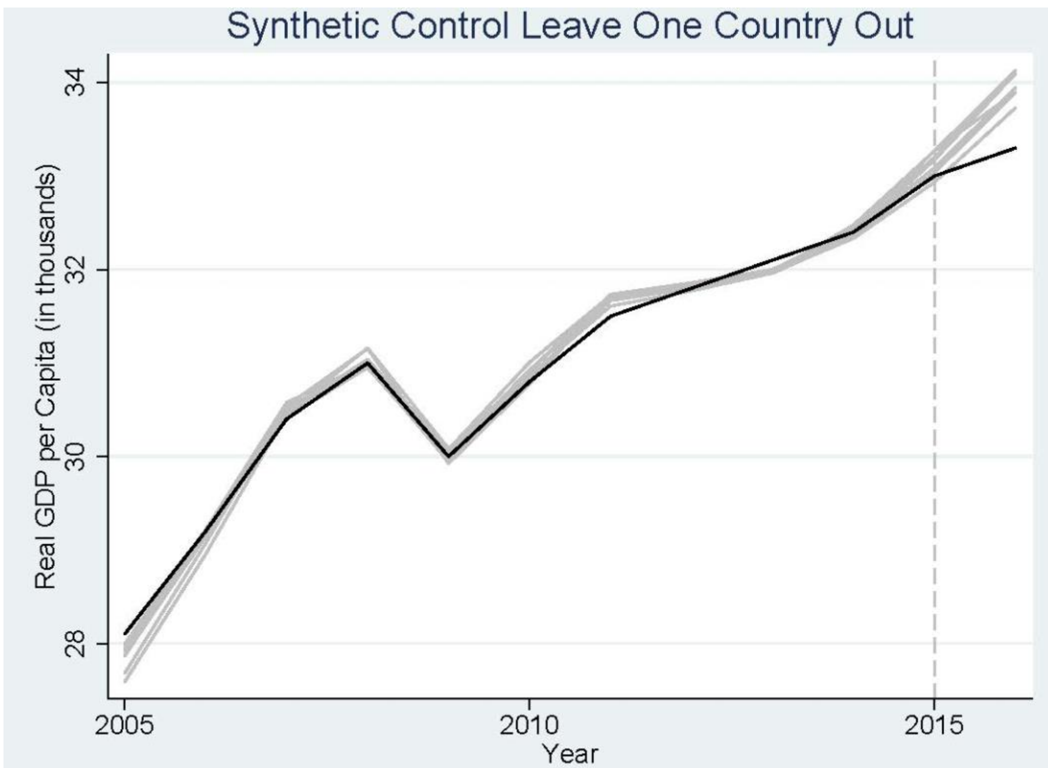
Figure 6.6: Placebo Treatment Effect with only France and Spain.




Note: The blue line represents the difference between France and its synthetic version, while the grey line represents the difference between Spain and its synthetic version. Here we can see that Spain has a positive effect.

Last, we conduct a robustness test to assess if some of the countries in the analysis drives our results. The procedure is to create several new versions of synthetic France, where we remove one country at a time with relocation. The intuition is if some of the new synthetic controls do not approximately follow the original synthetic control, that removed country is driving the results. From figure 6.7, we see that all the synthetic control matches closely to each other, and compared to figure 6.1, also matches the original synthetic control. This gives us an evidence that there are no countries that are driving the results in another direction, not even Belgium which is the largest weighted country in synthetic France.

Figure 6.7: Synthetic Control Leave One Control Country Out




Note: The black line shows actual France, while the grey lines represent different versions of synthetic France where we have removed one country at a time with relocation.

All of the conducted robustness tests holds, which gives us a good indication that terrorism has been an important factor for the potential loss of €825.

# 7. Discussion

Our results show that there is an observable gap between France and synthetic France, and that there have been a decline in the growth of real GDP per capita in the post-treatment period. As we saw from figure 6.1 in chapter 6.2, there is a gap between France and it's synthetic of €825 real GDP per capita. The World Bank reports that there were approximately 66.9 million inhabitants in France in 2016, which means that in total, according to our analysis, France has a potential loss of €55 199 190 000 in real GDP. The several robustness tests indicate that terrorism is indeed an important player contributing to the decline, none of the tests disapprove it. In this chapter, we are discussing the results in light of the theory and background information, where we explain the results and provide our thoughts of how terrorism may have affected the country's growth.

Recent behavioral theories explain that people do not act rationally, and that feelings, thoughts, and opinions affect people's decision making. In the theory and methodology chapter, we presented how negativity catches attention faster and in larger degree than positivity. Because of this, events like terrorism affect people's behavior. We believe that an important reason for the decline in real GDP per capita is because terrorism have affected touristic behavior. The article from NRK confirms that tourism in France is heavily affected by the terrorism, and from figure 1.2, which shows the GDP impact by sector in France, we know that the tourism sector is an important part of the total GDP. The article states that both flights and hotels in France have experienced a decline in bookings, and that several hotels and restaurant have been forced to close down, which have a direct impact on the tourism sector and the contribution to GDP. This have also led to resignations in the sector, which affects the induced contribution to the GDP.

Our first intent was to examine the effect in Paris isolated, as we believe that we would find a greater effect because the attacks in November happened in the capital. It turned out that it was not possible at the time to find the data we needed for cities exclusively. What's interesting is that we still managed to observe an effect for the whole country. According to our mini-analysis on hotel bookings in chapter 2.6, we see that the decline in Paris is larger compared to the decline in France in general. Figure 2.5 and 2.7 doesn't measure the exact same, as figure 2.5 measures the percentage change in hotel occupancy rates in Paris, while figure 2.7 measures the percentage change in arrivals of non-residents to tourist accommodations in France. However, we believe they are similar enough for comparison, and it shows that a great decline in Paris can affect the country as a whole. We did also find visitor numbers to some of the most popular tourist destinations in Paris in chapter 2.6, where we see that there is a decline in Disneyland, the Louvre Museum, and the Eiffel Tower. These numbers give even stronger indications that tourism is a big factor that have led to the general decline in France.

Another reason for the decrease in the growth of real GDP per capita can be explained by increases in costs due to the terror attacks in France, 13th of November. Three classes of economic cost are explained in chapter 2.2.3, and shows how terrorism, in different ways, leads to costs. France experienced direct costs due to damages on for example the concert arena Le Bataclan, and medical cost due to a large number of dead and injured people. Figure 1.1 shows that this terror attack was the first major attack in recent time, which have led to a number of new security measures and precautions. For example, the streets of Paris were full of armed police officers and military which roamed the streets in the wake of the terrorist attacks. Even though security measures have been implemented, there was a decline in visitors. According to figure 2.2, which illustrates the three classes of economic costs, a second cost driver appears because of imbalances between the perceived threat level and the perceived security effectiveness. These imbalances cause costs related to behavioral changes.

The lack of tourists in the country can be explained by behavioral theories which we highlighted in chapter 2.5.1. Gigerenzer (2006) used the term dread risk, which occurs in low probability and high damage events, where people reacts with avoidant behavior. According to the article from NRK, tourists in Paris almost felt they had the city for themselves, and it is plausible to think that people have responded because of this dread risk. Another factor that can lead people away from the county is the media. In this era, most of us are searching for information about the country we’re visiting before deciding whether to go or not. It is nearly impossible to miss all the news headlines about the attacks, and as mentioned in the theory and methodology chapter, salience bias amplifies the availability heuristic. A terrorist attack is something that comes easily to mind, especially one in this scale. People that chooses not to go to France may have exaggerated the probability of an upcoming attack, as the events are perceived to have a higher probability than they really have.

From our results in figure 6.1, we can see that France starts to differ from synthetic France already between 2014 and 2015. As mentioned earlier, one explanation for this is that our data is collected annually due to difficulties in obtaining monthly data. Therefore, the data collected for 2015 includes incidents that happened before November 2015, as well as the immediate effect after the attack 13th of November. The wave of attacks in France started in January where Charlie Hebdo was attacked, as shown in table 2.3. However, as the attack rammed one particular target and not random people in the streets, we believe that this attack did not have as large impact as the attacks in November.

In chapter 6.2.1, we have performed several different sensitivity tests to check the robustness of our results. The first placebo test we performed was a placebo study of Belgium, where we justified the choice of country with it being the largest weighted county in the synthetic France. There are several other reasons why Belgium is a suitable country. Belgium is the country which is most similar to France when it comes to real GDP per capita before the terrorist attack. They are also neighboring countries, leading to similarities in the language and culture. Based on this, it is expected that Belgium would experience a similar decline in real GDP per capita from 2015 to 2016 if terrorism was not the reason for the effect. The next robustness test we conducted was an in-space placebo test to look at the pre- and post-treatment fit between France and its synthetic, and all the countries in the donor pool. As explained in chapter 6.2.1, we can see from figure 6.3 that France has a good pre-treatment effect, most likely because the donor pool is trimmed for countries and periods as explained in chapter 5.2. Countries was excluded to avoid possible interpolation bias. In figure 6.4, countries with extreme values in the pre-treatment period are excluded, so we can easier conclude whether other countries have a similar or larger effect than France. It is often better with a longer post-treatment period when conducting this test, but in our case we can easily see that France experienced the largest effect, since none of the other countries experienced a decrease after 2015. The "leave one out test" shows that none of the countries in the donor pools drive our results, not even the largest weighted country Belgium. Based on the conducted robustness tests, there are strong indications that terrorism is a great reason for the decline in the growth of real GDP per capita in France.

The only robustness test which seems contradictory to the results of the other tests, is the measurement of RMSPE ratio. From figure 6.5, it looks like there are other reasons than terrorism which creates a high RMSPE ratio, as Spain have a larger ratio than France. The pre-treatment RMSPE is low, and the post-treatment RMSPE is high, which could be indicative that there has been a significant effect in Spain as well. However, as mentioned in chapter 6.2.1, the test doesn't take the direction into account, and as we can see from figure 6.6, the real GDP per capita for Spain is increasing in the end of the pre-treatment period and continues in the post-treatment period. Based on the direction for Spain, this test doesn't disapprove that terrorism is an important factor for the decline in France, even though Spain has a high RMSPE ratio.

One drawback with our analysis is the lack of post-treatment periods. We can observe an effect, but we don't know for how long this effect lasted. We pointed out in chapter 2.3.2 that the recovery time after a terrorist attack is on average 13 months, and it is possible that the effect dissipates already from 2017. However, France have experienced many smaller and attempted attacks after November 13th, and one severe one 14th of July, 2016 on Bastille Day in Nice. It is not unthinkable that the recovery time have been extended in France relative to what theory states, because of this frequency. Pizam & Fleischer (2002) states that frequency of attacks has a larger impact on international tourist arrivals than the severity of attacks, and it is therefore possible that we would find a longer ongoing effect, and perhaps also an increase in the effect. Our analysis can be seen as a fundament for further research, where these questions can be answered in a couple of years.

It is worth to mention that we have also investigated key events that have occurred in France during this time period, to see if there were potential other events that have caused the effect. The key events is shown in appendix 10.1. In September, 2015, France launched air strikes against Isis targets in Syria, which may have provoked the attacks in November. The table shows that France haven't been through other major events than the terrorist attacks, such as a presidential election et cetera that would affect our conclusion.

# 8. Conclusion

Our purpose with this thesis was to answer whether the terrorist attacks the 13th of November, 2015 in Paris have affected the economic growth in France. We also wanted to estimate the eventual effects in Euros. Based on yearly data, we can clearly see that there is a negative effect in the growth of real GDP from 2015. We conducted a synthetic control to measure how the economic growth could have looked like if the terrorist attacks did not happen. The difference between France and its synthetic version shows France's potentially losses in real GDP, which is measured to be €825 per capita. The total potential losses in 2016 is measured to be €55 199 190 000, as the population in 2016 was approximately 66.9 million.

We conducted several robustness tests to prove that terrorism had an influence on the economic growth in France. All the conducted tests indicate that terrorism indeed have been the main cause to the decline. Even though it is not captured directly in our synthetic control analysis, we believe that touristic behavioral changes caused by terrorism is the main driver for the observed effect. This is backed up by newspaper articles which clearly shows that tourism has been in decline, but also by theories from educational research papers, statistical numbers from hotel bookings, and visitor attendance to popular tourist destinations. We have mentioned that the tourism sector is an important part of the total GDP for France, and a decline in the tourism sector will of course affect the country's economic growth. Other relevant causes are the direct costs caused by terrorism, as renovation of the targeted areas, medical costs due to injuries, and the increase in security measures.

The analyses drawbacks are identified as the lack of post-treatment periods, and the use of yearly instead of monthly data. Given the drawbacks our analysis have, we have still managed to find a measurable effect caused by terrorism. However, if we managed to collect monthly, or even daily data, the analysis could have been even more accurate. With more post-treatment periods, we could also have estimated the duration of the effect. This thesis has a good foundation for further research, and some years from now, the duration can be estimated.

We have only been estimating the effect in France, but according to previous research and theories, it is reasonable to think that we would find similar effects if we conducted an analysis on a different country in a different time period. We hope that this thesis can provide useful knowledge about the power of terrorism to alter the economic growth in a country, and a good insight on how to implement the synthetic control method in different cases.

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# 10. Attachments

## 10.1 Key events in France from 2015-2016

Table 10.1: Key events in France from 2015-2016

| Time | Event |
|---|---|
| January 2015 | Charlie Hebdo, terror attack |
| September 2015 | French launches air strikes again Islamic State group targets in Syria |
| November 2015 | Terror attacks in Paris |
| February 2016 | Government begins dismantling notorious `Jungle`migrant camp at Calais on the English Channel. |
| May 2016 | Following weeks of street protests, government pushes through legislation making France`s protective labor laws less restrictive, with the aim of encouraging firms to recruit. |
| Juli 2016 | Terror attack on Bastille Day in Nice |
| December 2016 | President Hollande announces that he will not stand for a second term in 2017. |

Note: This table shows key events that happened in France from 2015-2016. Reference from: bbc.com

## 10.2 Do-file

*Synth.do*

*Panel data by country and year*

*Define countries by number*

```
egen countrynum =group(country)

list country countrynum in 1/10, sepby(country)

xtset countrynum

xtset countrynum year, yearly
```

*Save edited file for later use*

```
save "Masterthesis.dta", replace
```

*Install synth package for comparative case studies*

```
ssc install synth, replace all
```

*Create synthetic control*

```
synth gdppercapitathousand popdensity investmentratio agricultureforestryfishing industryenergy construction services belowuppersecondary uppersecondary tertiary unemployment gdppercapitathousand(2011) gdppercapitathousand(2007), trunit(4) trperiod(2015) nested fig
```

*Create placebo test Belgium*

```
synth gdppercapitathousand popdensity investmentratio agricultureforestryfishing industryenergy construction services belowuppersecondary uppersecondary tertiary unemployment gdppercapitathousand(2021) gdppercapitathousand(2007) gdppercapitathousand(2006, trunit(2) counit(1 3 5 6 7 8 9 10 11) trperiod(2015) nested fig
```

*Save graph Belgium*

```
graph save Graph "C:\Users\238355\OneDrive - Universitetet i Stavanger\Grafer Master\Placebo_belgium.gph"
```

*Calculate mean of all the predictors for the control group in the pre-treatment period*

*Make dummy equal to one if treated and zero if not*

```
gen treatment = 0

replace treatment = 1 if countrynum == 4
```

*Make dummy equal to one if pre-treatment period and zero if not*

```
gen pre = 0

replace pre = 1 if year < 2015
```

*Calculate mean of gdppercapitahousand 2011*

```
egen gdppercapitathousand2011 = mean(gdppercapitathousand) if year == 2011 & treatment == 0
```

*Calculate mean of gdppercapitahousand 2007*

```
egen gdppercapitathousand2007 = mean(gdppercapitathousand) if year == 2007 & treatment == 0
```

*Take the mean of all the predictors for the control group in the pre-treatment period*

```
collapse(mean) gdppercapitathousand popdensity investmentratio agricultureforestryfishing
industryenergy construction services belowuppersecondary uppersecondary tertiary unemployment
gdppercapitathousand2011 gdppercapitathousand2007 gdppercapitathousand2007 if treatment ==
0 & pre == 1
```

*In Space Placebo Test*

*Loop through units*

```
forval i=1/11{

qui synth gdppercapitathousand popdensity investmentratio agricultureforestryfishing
industryenergy construction services belowuppersecondary uppersecondary tertiary unemployment
gdppercapitathousand(2011) gdppercapitathousand(2007), /// trunit(`i') trperiod(2015)
keep(synth_`i', replace)

}
```

*Loop through saved dataset, create relevant variables*

```
forval i=1/11{

use synth_`i', clear

rename _time years

gen tr_effect_`i' = _Y_treated - _Y_synthetic

keep years tr_effect_`i'

drop if missing(years)

save synth_`i', replace

}
```

*Load first dataset and merge remaining datasets*

```
use synth_1, clear

forval i=2/11{

qui merge 1:1 years using synth_`i', nogenerate

}
```

*Make the graph*

```
local lp

forval i=1/11 {
```

```
local lp `lp' line tr_effect_`i' years, lcolor(gs12) ||

}

twoway `lp' || line tr_effect_4 years, lcolor(blue) legend(off) xline(2015, lpattern(dash) lcolor(black))
yline(0, lpattern(dash) lcolor(black))
```

*RMSPE Ratio*

*Calculate pre- and post treatment RMSPE*

```
forval i=1/11 {

use synth_`i', clear

gen sq_effect_`i' = tr_effect_`i'^2

qui egen premspe`i' = mean(sq_effect_`i') if year < 2015

qui egen postmspe`i' = mean(sq_effect_`i') if year >=2015

collapse premspe`i' postmspe`i'

gen prermspe`i' = sqrt(premspe`i')

gen postrmspe`i' = sqrt(postmspe`i')

keep prermspe`i' postrmspe`i'

qui save "rmspe`i'.dta", replace

}

use "rmspe1.dta"

forval i = 2/11 {

qui merge 1:1 _n using "rmspe`i'.dta", nogenerate

}
```

*Calculate pre- and post-treatment RMSPE ratio*

```
forval i=1/11 {

use synth_`i', clear

gen sq_effect_`i' = tr_effect_`i'^2

qui egen premspe`i' = mean(sq_effect_`i') if year < 2015

qui egen postmspe`i' = mean(sq_effect_`i') if year >=2015

collapse premspe`i' postmspe`i'

gen prermspe`i' = sqrt(premspe`i')

gen postrmspe`i' = sqrt(postmspe`i')
```

```
gen rmsperatio`i' = postrmspe`i' / prermspe`i'

keep rmsperatio`i'

qui save "rmspe`i'.dta", replace

}
```

*Merge dataset for graphing*

```
use "rmspe1.dta"

forval i = 2/11 {

qui merge 1:1 _n using "rmspe`i'.dta", nogenerate

}
```

*Transpose data and prepare for graphing*

```
xpose, clear

rename v1 rmsperatio

save "rmsperatio.dta", replace
```

*Collect country variable and compile with rmsperatio*

```
use "Masterthesis.dta", clear

collapse (mean)gdppercapitathousand, by(countrynum)

keep countrynum

qui merge 1:1 _n using "rmsperatio.dta", nogenerate
```

*Create graph*

```
graph bar (asis) rmsperatio, over(countrynum) xsize(12)

 graph save Graph "C:\Users\224543\OneDrive - Universitetet i Stavanger\RMSPE A

> ll Countries.gph"
```

*Robustnesstest for control units'

```
use "Masterthesis.dta", clear

tsset countrynum year
```

*Create synthetic control*

```
synth gdppercapitathousand popdensity investmentratio agricultureforestryfishing industryenergy
construction services belowuppersecondary uppersecondary tertiary unemployment
gdppercapitathousand(2011) gdppercapitathousand(2007), trunit(4) trperiod(2015) keep(counit1,
replace) nested
```

*Create Synthetic Control excluding Austria*

```
synth gdppercapitathousand popdensity investmentratio agricultureforestryfishing industryenergy
construction services belowuppersecondary uppersecondary tertiary unemployment
gdppercapitathousand(2011) gdppercapitathousand(2007), trunit(4) trperiod(2015)
counit(2,3,5,6,7,8,9,10,11) keep(counit2, replace) nested
```

*Create Synthetic Control excluding Belgium*

```
synth gdppercapitathousand popdensity investmentratio agricultureforestryfishing industryenergy
construction services belowuppersecondary uppersecondary tertiary unemployment
gdppercapitathousand(2011) gdppercapitathousand(2007), trunit(4) trperiod(2015)
counit(1,3,5,6,7,8,10,11) keep(counit3, replace) nested
```

*Create Synthetic Control excluding Germany*

```
synth gdppercapitathousand popdensity investmentratio agricultureforestryfishing industryenergy
construction services belowuppersecondary uppersecondary tertiary unemployment
gdppercapitathousand(2011) gdppercapitathousand(2007), trunit(4) trperiod(2015)
counit(1,2,3,6,7,8,9,10,11) keep(counit4, replace) nested
```

*Create Synthetic Control excluding Iceland*

```
synth gdppercapitathousand popdensity investmentratio agricultureforestryfishing industryenergy
construction services belowuppersecondary uppersecondary tertiary unemployment
gdppercapitathousand(2011) gdppercapitathousand(2007), trunit(4) trperiod(2015)
counit(1,2,3,5,6,8,9,10,11) keep(counit5, replace) nested
```

*Create Synthetic Control excluding Italy*

```
synth gdppercapitathousand popdensity investmentratio agricultureforestryfishing industryenergy
construction services belowuppersecondary uppersecondary tertiary unemployment
gdppercapitathousand(2011) gdppercapitathousand(2007), trunit(4) trperiod(2015)
counit(1,2,3,5,6,7,9,10,11) keep(counit6, replace) nested
```

*Create Synthetic Control excluding Spain*

```
synth gdppercapitathousand popdensity investmentratio agricultureforestryfishing industryenergy
construction services belowuppersecondary uppersecondary tertiary unemployment
gdppercapitathousand(2011) gdppercapitathousand(2007), trunit(4) trperiod(2015)
counit(1,2,3,5,6,7,8,9,11) keep(counit7, replace) nested
```

*Graphing*

```
use "counit1.dta", clear

rename _time year

rename _Y_treated gdppercapitathousand

rename _Y_synthetic synthgdppercapitathousand1

keep year gdppercapitathousand synthgdppercapitathousand

drop if missing(year)

save "counit1.dta", replace
```

```
forval i=2/7 {
use "counit`i'.dta", clear
rename _time year
rename _Y_synthetic synthgdppercapitathousand`i'
keep year synthgdppercapitathousand`i'
drop if missing(year)
save "counit`i'.dta", replace
}
```

*Merge datasets*

```
use "counit1.dta", clear
forval i=2/7 {
qui merge 1:1 year using "counit`i'.dta", nogenerate
}
*Graphing*
local lp
forval i=1/7 {
local lp `lp' line synthgdppercapitathousand`i' year, lcolor(gs12) ||
}
twoway `lp' || line gdppercapitathousand year, lcolor(black) legend(off) xline
(2015, lpattern(dash) lcolor(gs12)) yline(0, lpattern(dash) lcolor(gs12)
```