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Terror Attacks, Foreign Exchange Markets and Class Dynamics

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Abstract

This paper examines the effect of major terror attacks of the twenty-first century on the forex market. The “event study” methodology is used to assess whether, following a terror attack, the currency of the country attacked experienced a negative effect. It also examines whether this effect is permanent or transitory and whether there are differences between recent and earlier attacks. Results suggest that earlier events cause substantial negative “event-day” returns for the specific currency, which seem to persist for some days. This is particularly evident in pairs involving the currency of the country attacked and “safe heaven” currencies (e.g. Yen, Swiss Franc). The paper also documents that terror attacks that occurred recently appear to have very little influence on the currency pairs examined, thus suggesting that, over time, market participants have learnt to better assess such events. Given our findings, and particularly the one suggesting that the effects of terror attacks on the foreign exchange market, and hence the economy, are transitory, it would appear that class dynamics are not likely to be affected by them; forex markets appear to be particularly efficient in dealing with such events, absorbing short-term shocks and continuing to function effectively, thus maintaining economic stability.

Keywords: event-study methodology, terrorism, foreign exchange market, market reaction, class dynamics

1. Introduction

At a time when terror attacks have been making major headlines and shocking the whole free world, from Paris to London and from Brussels to Barcelona, many investors and other

market participants might be wondering how such events might impact the economies and the currencies of the countries or economic unions affected by such unfortunate events. By nature, terror attacks create uncertainty and reduce confidence, hence potentially leading to lower rates of investment, trade and eventually economic growth. According to [1], the estimated fall in US investment, due to terror threats, was about 0.2% of GDP. Obviously, such a fall in investment and thus income will most probably be transmitted to other economies, through lower US demand for imports. Moreover, it might be possible that such effects may also have implications for national and global class dynamics.

Reference [2] suggests that the economic costs of terror attacks can be divided into the following three categories: (a) direct economic damage inflicted by the attack, e.g. destruction of infrastructure and loss of productive lives; (b) cost of government response to terror acts, e.g. money spent on national defence and homeland security; and (c) costs related to the way people react to the fear of terrorism, e.g. the value of extra time spent waiting in line to pass through airport security. These various costs constitute a supply side shock to an economy and can potentially be very large.

According to [3], the indirect effects of terror attacks, that is to say changes in risk attitudes, transaction costs, demand, public finances and growth, may eventually outweigh the direct effects. It is moreover argued that the magnitude of the effects from such an attack is likely to depend on factors such as the nature of the attack, the type of policies adopted in response to the attack and, importantly, the resilience of the markets of the affected country or economic union. Such resilience can be quite significant when one considers the financial markets, as one of their key functions following such a shock is to 'digest' the information contained therein and efficiently incorporate it into prices. Reference [4] suggests that the initial effect of such an event could involve an overreaction from the market, but once the full set of information has been digested, markets tend to return to their pre-event levels.

Looking at it from a fundamental perspective, after an unexpected event such as a terror attack, financial markets and market participants, i.e. investors and market analysts, would need to reassess expectations related to the economy and how these may (or may not) be revised downwards. For example, because of a terror attack, there might be capital outflows from a specific country or a reduction of incoming visitors, thus lowering inflows of foreign exchange. In addition, market participants would also need to assess whether market risk premia increase, since terrorism involves greater uncertainty about the prospects of the economy. This assessment is likely to influence the actions of market participants and eventually the way financial markets react to the specific event, including the time they will require to 'bounce back'.

Motivated by the potentially negative effects of a terror attack on the economy of the country targeted, in this paper we aim to investigate the effects of major terror attacks that have occurred in the twenty-first century on the value of the currency of the country affected (i.e. the exchange rate). More specifically, we examine 11 attacks, which have occurred in the USA (two attacks), the UK (three attacks), France (two attacks), Spain (two attacks) and Belgium and Germany (one attack each). Therefore, the currencies examined are the US dollar (USD), the British Pound (GBP) and the euro, and their value is assessed—after the terror attack—versus one another, plus versus the Japanese yen (yen) and the Swiss franc (CHF). So, for example, after 9/11, the value of the USD will be assessed versus the euro, the GBP, the yen and the CHF and so on.

It should be noted that there are a number of papers that have examined the impact of terror attacks on stock markets (e.g. see [5–7]), but very few of them have examined whether the effect of terrorist attacks goes beyond stock markets to affect the foreign exchange markets too. Our paper, by focusing on the impact of terror attacks on exchange rates, aims to ‘connect’ with the existing literature and in doing so help to broaden the growing body of literature, which examines the effect of terror attacks on the economy and, in particular, the financial markets. Moreover, in light of our findings, our paper also aims to provide an initial discussion regarding how terrorism, through its effects on the foreign exchange market, could influence national and global class formation.

The rest of the paper is organised as follows: Section 2 presents an overview of existing literature and sets the research framework of this paper; Section 3 describes the data and the empirical method used; Section 4 presents and discusses our results; Section 5 concludes the paper.

2. Literature review

Literature for terrorism-related studies is not abundant, but work in this area has expanded significantly in recent time, given the increasing concern about terrorism in the world. The economic effects of terrorism have been analysed across various dimensions (an excellent survey may be found in [8]). It is our belief, however, that our paper is mostly related to two layers of literature: The first refers to the general economic impact of terror attacks, and the second one refers to the effect of terror attacks on markets (e.g. the stock market or the foreign exchange market).

Starting with the first layer, [9] identifies three possible channels through which terrorism may influence macroeconomic activity: through decreased insurance coverage, as a result of the perception of increased risk; through higher trade costs, possibly leading to lower levels of international transactions; and through greater security and defence spending. In [10] the economic impact on firms of terrorist attacks in the Basque Country, Spain, was examined, and it was documented that stocks of firms with a significant part of their business in that part of Spain showed a positive relative performance when truce was possible and a negative one when it was not. In addition, [11] examined the impact of terror attacks on foreign direct investment (FDI) and documented that countries that are being subjected to higher terror risk are associated with lower levels of FDI.

Reference [12] examines the economic consequences of terrorism and finds that the incidence of terrorism is negatively related to GDP growth. The study indicates that a terror attack in a country in a given year reduces its GDP growth by 0.57% points, on average. It moreover finds that the negative effect of terrorism on investment is matched by a positive effect on government spending, thus suggesting that terrorism redirects resources from investment to less socially enhancing government spending.

In [13] the impact of terrorism on the output of the Israeli economy is assessed, and it was found that an increase in terror attacks results in a decrease in investment, consumption and income in the long run. It moreover argues that, in this case, a government that acts optimally would increase the proportion of output spent on defence. Moreover, in [14], the effects of

terrorism on trade flows were examined, and it was found that countries subjected to terrorism trade less with each other. Moreover, it was documented that a 100% increase in the number of terrorist incidents reduces bilateral trade by about 4%.

In addition to the effects on the whole economy, there is also evidence in the literature that terror attacks are also associated with significant differential effects on different economic sectors. For example, given their specific vulnerability to terror attacks, tourism and airline demand have received special attention by researchers. The consensus points to a negative impact on both of these sectors (e.g. see [15–17] on tourism and [18, 19] on airline demand).

Moving now to the second layer of the literature survey which will focus on the effect of terror attacks on financial markets. In [7] the impact of 14 major terrorist/military events on the capital markets of the USA during the period 1915–2001 was examined. The first event was the torpedoing of the luxury ocean liner *Louisiana* on 7/5/1915, and the last one was 9/11. Moreover, the effect of two of these events, Iraq's invasion of Kuwait and 9/11, was examined in relation to other global capital markets too. It is documented that US capital markets are more resilient than in the past and recover sooner from terrorist attacks, in comparison to other global markets. According to the study, this can be partially explained by a more developed and stable US banking and financial sector, which is capable of providing liquidity, in order to maintain market stability.

In [20], the reaction of the world's financial markets after 9/11 was examined, and it was documented that a 'contagion effect' took place, that is to say an increase in the correlation between markets, as a result of both their strong interconnection and of the simultaneous flow of news. Moreover, in [21] specific cases where financial markets were directly or indirectly affected by terror attacks were examined (study focused on the reaction of markets to 9/11 and the attacks in Madrid in March 2004). The main finding was that financial markets were not only confronted with major disruptions caused by extensive damage to property and communication systems but also with high levels of uncertainty, especially in the case of 9/11.

In [5], the effect of terror attacks on the behaviour of the financial markets of six countries (Indonesia, Israel, Spain, Thailand, Turkey and the UK) is examined. It is documented that the magnitude of terrorism effects is greater in emerging markets than in more developed ones. In [6], the price reactions of major stock markets to terror attacks are compared, and it is concluded that such effects might be considered 'mildly negative', except for the case of 9/11. However, it is also argued that the impact of terror attacks is larger than those of comparable natural disasters, such as earthquakes.

The reaction of the FTSE 100 Index after 9/11, the Madrid bombings in 2004 and the London bombings in 2005 was studied in [22], and it was found that these attacks increased stock market uncertainty. Moreover, in [23] the effect of the same events was examined on the major US, European and Japanese stock markets, pointing out that over time, the size of the impact of the event and its duration has diminished. It is moreover argued that this might be due to two reasons: investors have overcome their initial 'overreaction' of 9/11 and more objectively measure the true economic

repercussion of a terror attack, and they have also become more accustomed to the terrorist threat, thus incorporating the associated risk more systematically into share prices.

The impact of terrorism on the behaviour of stock, bond and commodity markets is addressed in [24], which considers terrorist attacks that took place in 25 countries over an 11-year time period and concludes that most of the events led to a significant negative impact on at least one market under consideration. It moreover documents that the insurance and airline sectors tend to exhibit the highest vulnerability to terrorism, while the banking industry is the least sensitive. In [25] the 'event-study' methodology is used to examine the impact of the Madrid and London bombings on equity sectors. Significant negative abnormal returns were found to be widespread across most sectors in the Spanish markets, but not so in the case of London. Moreover, it is also documented that the time of recovery was much faster in the case of London.

In [26] the impact of the Boston bombings in 2013 on the financial markets of Frankfurt, London, Madrid, Paris, Milan, New York and Tokyo is examined, and its effects are compared to those of earlier terrorist attacks (9/11, 2004 bombings in Madrid, 2005 bombings in London). It is documented that the market indices exhibited statistically significant negative abnormal returns on the day of the event, but the magnitude of these abnormal returns was lower than the previous events. The effect of terrorist attacks on global capital markets was also examined in [27], and it was found that the economic consequences of terrorist attacks tend to 'spill over'. More specifically, it is documented that when a bigger economy is targeted, the 'spillover' is quite prominent for economically smaller trading partners.

Despite the growing number of studies examining the economic effects of terrorist attacks, the number of studies examining the impact of such attacks on exchange rates is rather limited. In [28], the effect of terror attacks on the stock and foreign exchange markets in Israel is examined. A number of terror attacks during the period 1990–2003 are considered, and it is documented that they had a significant effect on both the stock and foreign exchange markets. Nonetheless, it is argued that financial markets continued to function efficiently. Reference [29] examines whether terrorist attacks affect the exchange rates of 21 countries against the US dollar. It is found that the exchange rate returns of all countries are significantly affected by terror attacks. More specifically, it appears that terrorist attacks lead to the appreciation of some currencies and the depreciation of some others. Moreover, it is argued that as information on terror attacks becomes stale, its effect on exchange rates weakens but may persist after the attack.

This paper aims to enrich the limited literature related to the effect of terror attacks on exchange rates and by doing this contribute further to the growing body of literature that is related to the economic effects of terror attacks and more specifically their effect on the financial markets. It also aims to provide an initial discussion of how this effect might influence class dynamics. As such, in this paper we examine the impact of 11 major terrorist attacks that occurred in the twenty-first century on the behaviour of the exchange rates of the countries that were targeted by the attack. More specifically, we aim to provide answers to the following questions:

1. Did the specific attack affect the value of the currency of the country attacked versus other major currencies at all? (the currencies considered are the USD, the euro, the GBP, the yen and the CHF).

2. If yes, was the effect permanent or transitory? If permanent, how long did it last?
3. Did the response of the foreign exchange market to such events change over time? More specifically, do more recent terror attacks have the same effect as previous ones?
4. Given our results and the answers to the above questions, what is the possible effect of these attacks on the formation of national and global classes?

3. Data and methodology

According to the US government's Incident Review Panel Criteria, a terrorist incident is significant 'if it results in loss of life or serious injury of persons, major property damage, and/or is an act or attempted act that could reasonably be expected to create the conditions noted'. Given the aforementioned definition, the terror events selected for the purposes of this paper can be considered to be significant and, as such, may affect financial markets, including foreign exchange markets. We should note here that other papers that have addressed questions related to the effect of terror attacks on financial markets have built their samples of events in a way that best facilitates the examination of their research questions (e.g. see [7, 21, 23]). Along the same lines, it is our belief that the 11 events selected in this paper are adequate to address our research questions and provide a 'platform' upon which to discuss the effect of terror attacks on foreign exchange markets, as well as their potential effect towards class dynamics. The events selected are presented in **Table 1**, along with some useful information related to the events, such as who were the perpetrators, and what was the number of casualties.

Given that one of the aims of this paper is to discuss the effects that terror attacks may have on class dynamics, through the foreign exchange market, it is appropriate at this point to briefly focus on the ideological status of the above events, in other words, what kind of targets were attacked. All the above attacks were religious-driven and aimed targets such as the transportation system (airports, trains); public places (such as restaurants, theatres, etc.), including popular tourist locations; and of course 9/11, which through the attacks on the World Trade Center in New York and the Pentagon in Virginia, clearly targeted American economic and military power. Especially the attack on the World Trade Center can be thought to be an attack on a 'symbol' of international finance, which represents international payments, trade financing, international movements of capital, global stock markets and the determination of exchange rates, i.e. the foreign exchange market. International finance is also thought to be closely related to a so-called upper or elite class of people, who have at their disposal a lot of wealth and power. As such, 9/11 can also be thought to be an attack on this specific class. Apart from 9/11, the other targets examined are clearly 'soft targets', which unfortunately have been relatively easy to access. By doing this, terrorists are attacking normal people going to work, or going on holiday, and appear to aim at achieving objectives such as inflicting high casualties, hence scaring people, causing extensive damage to property and, importantly, undermining the way of life and the morale of national and international populations. It becomes apparent then that modern terrorist organisations use an anti-capitalist and anti-liberalism narrative to justify their actions, despite themselves operating within the capitalist sphere. Their targets of preference are 'symbols' of wealth-producing capitalist enterprises, and so an attack on them signifies the rejection of the Western financial paradigm. This condition does not prevent them, however, from engaging in capitalist ventures to fund their terrorist activities.

Country	Event	Date of event	Period of interest	Perpetrator group	Casualties (deaths)
USA	September 11 attacks	11/09/2001	8/5/2001–1/10/2001	Al-Qaida	7365 (2997)
Spain	Madrid train bombings	11/03/2004	6/11/2003–2031/3/2004	Abu Hafs al-Masri Brigades	>1800 (191)
UK	London bombings	07/07/2005	3/3/2005–2027/7/2005	Al-Qaida	784 (56)
USA	Boston marathon bombing	15/04/2013	10/12/2012–3/5/2013	Muslim extremists individuals	264 (3)
France	November 2015 Paris attacks	13/11/2015	13/7/2015–4/12/2015	ISIL	423 (137)
Belgium	2016 Brussels bombings	22/03/2016	17/11/2015–11/4/2016	ISIL	270 (35)
France	Nice 2016 attack	14/07/2016	10/3/2016–3/8/2016	Claimed by ISIL	433 (87)
Germany	Berlin 2016 attack	19/12/2016	15/8/2016–6/1/2017	ISIL	48 (13)
UK	London attack	22/03/2017	16/11/2016–11/4/2017	Muslim extremists	50 (6)
UK	Manchester bombing	22/05/2017	16/1/2017–9/6/2017	Muslim extremist	512 (23)
Spain	Barcelona 2017 attack	17/08/2017	13/4/2017–6/9/2017	Claimed by ISIL	>100 (16 + 8)

Source: Data for the first four events was obtained from Global Terrorism Database (<http://www.start.umd.edu/gtd/>). For the 2015, 2016 and 2017 events, data was collected from various media sources.

Note: Period of interest refers to the time period utilized both for the ‘estimation’ and ‘event’ windows.

Table 1. Events and background information.

The central hypotheses tested in this paper refer to the possible effect that the terror attacks mentioned above had on the currency of the country which suffered the attack. Towards this direction, we analyse this effect relative to other major global currencies and more specifically the USD, the euro, the yen, the GBP and the CHF. For instance, when analysing an event related to an attack in the USA, we examine the effect of this event on the USD relative to the euro, the yen, the GBP and the CHF. All data regarding these indices were collected from Forex Forum and are daily.

The relevant currency pairs were transformed into daily returns using the following equation:

$$R_{it} = \ln\left(\frac{P_{it}}{P_{it-1}}\right) \quad (1)$$

where

R_{it} are the daily returns of currency pair i .

P_{it} and P_{it-1} are the daily prices of currency pair i at time t and $t-1$.

The methodology employed in this paper is the ‘event study’ methodology. Event studies examine the potential effects of one or more events on the value of assets, such as stocks and bonds, commodities and, as in our case, currencies. The ‘event study’ methodology is based on the efficient market hypothesis (EMH), which according to [30] asserts that as new information arrives at the market, market participants immediately and accurately assess its current and future impact on prices. This assessment results in price changes, which reflect the effect of this new

information on the value of the asset under consideration. As such, significant price changes can be attributed to specific events, which resulted in the release of this new information.

On the basis of the above, it is no surprise that the ‘event study’ methodology has been broadly used to assess the impact of events such as earnings (e.g. see [31]) and mergers and acquisitions announcements (e.g. see [32]), regulatory changes (e.g. see [33]), the effect of macroeconomic announcements on the foreign exchange market (e.g. see [34]) and actions related to corporate social responsibility (e.g. see [35]). As far as terror attacks are concerned, there are also several papers that have used the ‘event study’ methodology to assess the effect of such attacks on stock markets (e.g. see [7, 21, 23]).

A general framework of the analysis that needs to be followed to carry out an ‘event study’ is provided in [36, 37]. Firstly, the date of the event needs to be determined; in this paper, this is defined as the day on which the specific terror attack took place. Next, to carry out the necessary time-series analysis, the ‘estimation period’ and the ‘event period’ need to be defined. In [36] it is pointed out that the ‘estimation period’ is the period that will be used to determine the estimated return predicted by the market, around the ‘announcement date’. In this paper we will use a period of 90 trading days before the date of the event as our ‘estimation period’.

The ‘event period’ is typically defined to be longer than the specific period of interest to accommodate the examination of periods around the event, thus capturing, where applicable, possible effects of insider trading as well as the longer-term effects of the specific event. Unfortunately, in the case of terror attacks, they cannot be foreseen, and as such, our analysis of their impact on the various currency pairs starts from the date of the event. Apart from the ‘event date’, ‘event windows’ of 5, 10 and 15 days after the event are also utilized to assess how quickly the market ‘absorbed’ (or did not ‘absorb’) the news. On the one hand, it is possible that on some occasions, initial worries might persist (e.g. of further attacks), hence keeping the exchange rate down, while, on the other hand, it is possible that uncertainties might be quickly eased through the release of new information (e.g. the government taking certain steps to ‘comfort’ markets), hence causing the exchange rate to recover.

To measure the reaction of the foreign exchange market to the announcement of a terror attack, an ‘expected’ or ‘normalised’ return for each currency pair employed must be estimated during the various ‘event windows’. This ‘normalised’ return must then be subtracted from the actual return, $R_{i,t}$, observed on the day of the event and on subsequent days, in order to determine whether there is any abnormal return that might have been caused by the specific event.

This abnormal return is given by the following equation:

$$AR_{i,t} = R_{i,t} - E(R_{i,t}) \quad (2)$$

where

$AR_{i,t}$ = the abnormal (or excess) return of currency pair i at time t .

$E(R_{i,t})$ = the expected or normalised return of currency pair i at time t .

An important element of the above equation is the estimation of $E(R_{i,t})$, where in this paper we follow the methodology used in [7, 23] and compute $E(R_{i,t})$ as follows:

$$E(R_{i,t}) = \frac{1}{90} \sum_{t=-90}^{-1} R_{i,t} \quad (3)$$

The date of the event is $t = 0$; hence the above equation estimates the expected return of currency pair i over 90 trading days, i.e. from $t = -90$ to $t = -1$.

One difference in this paper, relative to [7, 23] regarding the estimation of $E(R_{i,t})$, is that we employ a relatively longer 'estimation window' (90 days, as opposed to 30 days in [7, 23]). The logic behind this is that we also use longer 'event windows' (up to 15 days), and therefore we also need to use a relatively longer 'estimation window'. Employing a longer 'event window' gives us the opportunity to better assess the possibility of transitory (vs. permanent) effects on currency pairs, over a longer period.

To examine the immediate reaction of the currency pair(s) to the specific event, the 'event-day' abnormal returns need to be examined. Nonetheless, to assess the effect over the next days or weeks, the cumulative abnormal returns (CAR) also need to be examined. It should be noted that CAR may provide a stronger and potentially more useful measure of the currency's resilience and ability to recover from the attack. As such, after the time series of abnormal returns has been established, it would be particularly interesting, and important, to test whether CAR are different from zero over the 'event windows' that span after the 'event day'.

Cumulative abnormal returns for currency pair i can be estimated using the following equation:

$$CAR_{(t1,t2)} = \sum_{t=t_1}^{t_2} AR_{it} \quad (4)$$

where $t1$ and $t2$ are the start and end of the 'event window', respectively.

Therefore, the null and alternative hypotheses for each event window can be defined as follows:

$H0: CAR_{(t1,t2)} = 0$ vs. $H1: CAR_{(t1,t2)} \neq 0$.

We will be examining each of the 11 events separately, and as such, we will need to carry out standard t-tests for each event and for each 'event window', within the specific event.

The relevant t-statistic is.

$$t - statistic = \frac{CAR_{(t1,t2)}}{\sqrt{L \sigma^2(AR_i)}} \quad (5)$$

where

$\sigma^2(AR_i)$ is the variance of the one-period average abnormal return over the 'estimation window'.

L is the number of days corresponding to each 'event window', i.e. the CAR will have a higher variance the longer is L (i.e. the bigger is the 'event window').

Effectively, the question being addressed here is whether, given the effect of the terror attack, the abnormal returns of the relevant currency pair are significantly different from zero on

the day of the event and the cumulative abnormal returns are significant during the various subsequent 'event windows'. This will in turn help provide answers regarding our research questions, which focus on whether terror attacks affect and to what extent global currency markets and potentially national and global class dynamics.

4. Results

In this section, we proceed with the presentation of our results where, regarding each event, we present t-tests for the abnormal returns of the relevant currency pairs, on the day of the event and for the CAR in 'event windows' consisting of 5, 10, and 15 days. Our first event is 9/11, i.e. the four attacks on the USA in the morning of 11/9/2001 when two planes crashed on the World Trade Center, one into the Pentagon and another one in Pennsylvania. The USA had seen terror attacks before (e.g. Oklahoma, 1995; New York, 1975), but the scale of this one was unparalleled. The perpetrators were Al-Qaida, and the attack killed 2997 people, injuring many more and causing huge losses in property and infrastructure. Moreover, the attack had other significant indirect effects, such as the employment of substantial Federal emergency funds to cover heightened airport security, the introduction of sky marshals, government takeover of airport security and the cost of military operations in Afghanistan.

As can be seen from **Table 2**, on the day of the attack, the USD exhibited significant negative abnormal returns, i.e. depreciated against all four currencies examined (the biggest depreciation was vs. the CHF). From then onwards, negative CAR persisted for 5 days in the case of the yen and the euro and for 10 days in the case of the Swiss franc (reaching almost -5% on a cumulative basis). There is no evidence of any significant CAR in the 15-day 'event window'. It is worth to note here that previous work, which has focused on the effect of 9/11 on the stock exchange, such as [7] documented significant negative abnormal returns on the 'event day' and negative CAR for the 6 days that followed it. It also found that CAR, 11 days after the event, were statistically insignificant. [24] also documented significant abnormal returns on

	Event-day AR	5-day CAR	10-day CAR	15-day CAR
USD/Euro	-0.016298**	-0.027550*	-0.016634	-0.016687
<i>T-statistic</i>	-2.436896	-1.842260	-0.786513	-0.644218
USD/yen	-0.013459**	-0.028719**	-0.027811	-0.005296
<i>T-statistic</i>	-2.131922	-2.034358	-1.393025	-0.216589
USD/GBP	-0.011843	-0.004639	-0.001486	-0.011128
<i>T-statistic</i>	-2.367117**	-0.414660	-0.093917	-0.574266
USD/CHF	-0.027558***	-0.048169***	-0.049692**	-0.036522
<i>T-statistic</i>	-4.314637	-3.372736	-2.460291	-1.476383

Note 1: ***significance at the 1%, **significance at the 5% level and *significance at the 10% level.

Note 2: Table presents t-tests for the 'event day' and 'event windows' of 5, 10 and 15 days (H_0 , CAR = 0; H_1 , CAR \neq 0); t-statistics in italics.

Table 2. 'Event-day' AR and 'event-window' CAR for the USD after 9/11.

	Event-day AR	5-day CAR	10-day CAR	15-day CAR
Euro/USD	0.005187	-0.004191	-0.017084	-0.006541
T-statistic	0.698183	-0.252272	-0.727124	-0.227327
Euro/yen	0.006802	-0.026944	-0.060380	-0.066985
T-statistic	1.082066	-1.916971	-3.037679***	-2.751574***
Euro/GBP	0.004510	-0.006186	-0.017963	-0.014488
T-statistic	1.229986	-0.754545	-1.549276	-1.020269
Euro/CHF	-0.004712	-0.008945	-0.017190	-0.011739
T-statistic	-2.011023**	-1.707278*	-2.319992**	-1.293578

Note 1: ***significance at the 1%, **significance at the 5% level and * significance at the 10% level.

Note 2: Table presents t-tests for the 'event day' and 'event windows' of 5, 10 and 15 days (H_0 , CAR = 0; H_1 , CAR \neq 0); t-statistics in italics.

Note 3: In the case of the euro/yen pair, CAR becomes statistically insignificant after day 35.

Table 3. 'Event-day' AR and 'event-window' CAR for the euro after the Madrid bombings in 2004.

the 'event date' and for the 6-day CAR. As such, and in line with the findings related to the US stock exchange, it seems that 9/11 affected the US dollar too, but the effect was not long-lived.

The second event examined is the attack on the Madrid commuter train system in March 2004. The perpetrators behind this attack, which resulted in the death of 191 people and injuries to 1800 others, were the Abu Hafs al-Masri Brigades. Spain had been on the receiving end of terror attacks before, especially by Basque Fatherland and Freedom (ETA) (e.g. Barcelona, 1987), but this attack was by far the worse in terms of casualties. Moreover, the attack had two important political repercussions: the first one was a change in government (the PP lost the forthcoming elections), and the second one was that Spain withdrew its troops from the war in Iraq.

The results depicted in **Table 3** are particularly interesting for three reasons: (a) There appears to be no significant effect whatsoever on the euro/USD and euro/GBP; (b) on the 'event day', the euro exhibits significant negative abnormal returns only versus the Swiss franc; (c) beyond the event day, the euro exhibits negative CAR versus the Swiss franc up to the 10-day 'event window' and versus the yen up to the 15-day 'event window' (reaching almost 7% on a cumulative basis). It seems that the market took some time to digest and assess the effects of this attack, probably due to the fact that immediately after the bombing, leaders of the PP governing party claimed evidence indicating that ETA was responsible for the bombings; Islamist responsibility would have had the opposite political effect, as it would have been seen as a consequence of the PP government taking Spain into the Iraq War, a policy extremely unpopular among the people of Spain. As in the case of 9/11, our results regarding this event appear to be aligned with previous work, which has focused on the effect of the attack on the stock market. More specifically, [24, 25] documented significant and rather lasting—but not permanent—CAR for this event.

The third event focuses on the bombings that took place in London in July 2005, when three bombs exploded aboard London underground trains along with a fourth one, which exploded on a bus. The perpetrators of this attack, which resulted in 56 people dying and 955 injured, were members of the Secret Organisation of Al-Qaeda in Europe. Britain had seen

	Event-day AR	5-day CAR	10-day CAR	15-day CAR
GBP/USD	-0.005330	0.005630	0.001201	0.009131
T-statistic	-1.126561	0.532147	0.080257	0.498283
GBP/euro	-0.008184**	-0.013467*	-0.028921**	-0.019585
T-statistic	-2.270231	-1.670697	-2.537006	-1.402744
GBP/yen	-0.007248*	0.000042	-0.001698	-0.001711
T-statistic	-1.765482	0.004583	-0.130816	-0.107580
GBP/CHF	-0.009913***	-0.009547	-0.024205**	-0.015055
T-statistic	-2.936683	-1.264904	-2.267566	-1.151603

Note 1: ***significance at the 1%, **significance at the 5% level and * significance at the 10% level.

Note 2: Table presents t-tests for the 'event day' and 'event windows' of 5, 10 and 15 days (H_0 , CAR = 0; H_1 , CAR \neq 0); t-statistics in italics.

Table 4. 'Event-day' AR and 'event-window' CAR for the GBP after the London bombings in 2005.

terror attacks before, especially from the Irish Republican Army (IRA), but this was by far the worst attack it suffered since the bombing of the Pan Am Flight in Scotland in 1988.

As can be seen from **Table 4**, on the day of the event, the GBP exhibited significant depreciation against the euro, the yen, and the Swiss franc, but not against the US dollar. This effect appears to persist up to the 10-day event window for the euro (reaching almost -3% on a cumulative basis) and the Swiss franc (reaching almost 2.5% on a cumulative basis) and from there onwards seems to disappear. As such, it appears the GBP took some time to recover from this attack, at least against some currencies. This is somewhat in contrast to what was documented in [25] regarding the London stock market, which documented that the market was quick to recover after the attack.

Our results so far merit a comment regarding the significance of currency pairs involving the yen and the CHF. More specifically, in most of the cases of both 'event-day' abnormal returns or 'event-window' cumulative abnormal returns, the currency of the country that suffered the attack seems to depreciate versus these two currencies, thus suggesting that, following the aforementioned terror attacks, investors sought 'safe-haven' assets, such as the CHF and the yen. These two currencies tend to remain relatively stable in times of turmoil or crisis and hence 'defend' investments from the adverse impact of currency risk. This 'flight-to-safety' effect is clearly demonstrated in **Figure 1**.

The fourth event refers to the Boston marathon bombing in April 2013 when two bombs exploded during the marathon, resulting in three people being killed and more than 264 being injured. As can be observed from **Table 5** and **Figure 2**, the response of the USD to this attack is quite different from that to the 9/11 attack. More specifically, there does not appear to be any effect on the value of the dollar in terms of the euro, the GBP and the CHF, and there appears to be an 'event-day' effect only, in the case of the yen, which nonetheless is clearly not permanent.

The next seven events that are examined in this paper are more recent ones and have occurred between 2015 and 2017. These refer to the November 2015 Paris attacks, the March 2016 Brussels attacks, the July 2016 attack in Nice, the December 2016 attack in Berlin, the March 2017 attack in London, the May 2017 attack in Manchester and the August 2017 attack in Barcelona.

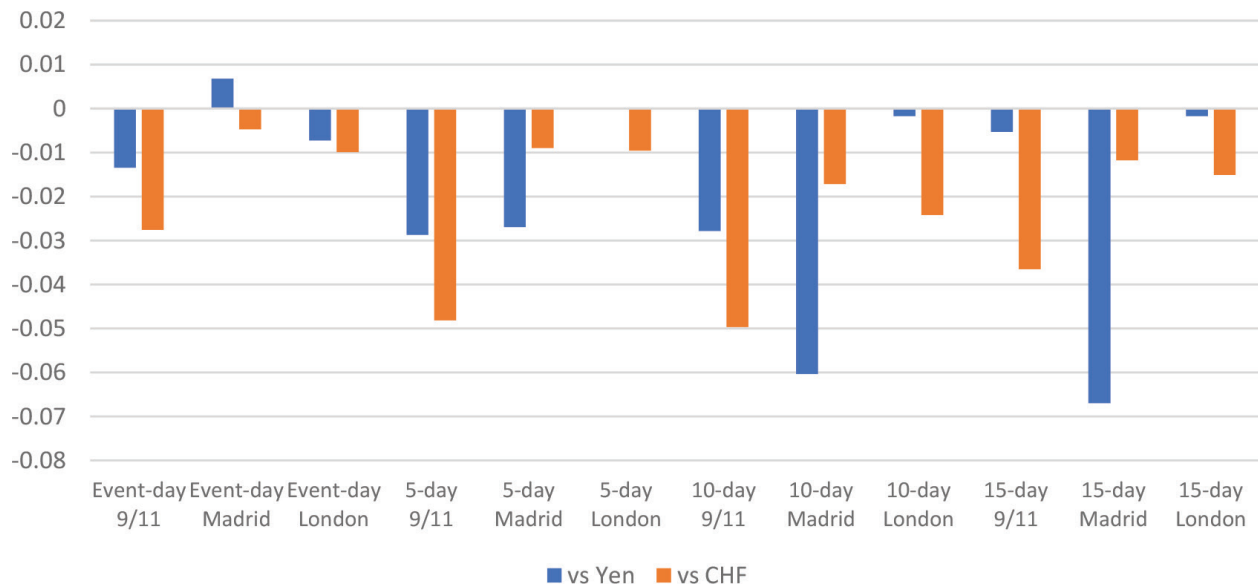


Figure 1. 'Event-day' AR and 'event-window' CAR for 9/11, Madrid 2004 and London 2005 (vs. the yen and the CHF).

The first event refers to the series of attacks that took place in Paris in November 2015, at cafés, restaurants and the Bataclan theatre, which resulted in 136 people losing their lives and 413 being injured. The Islamic State of Iraq and the Levant (ISIL) claimed responsibility for this, stating that it was carried out in retaliation for France's participation in the US-led coalition that carried out airstrikes in Iraq and Syria. France had experienced terror attacks before (e.g. by the Armed Islamic Group in 1995), but this was by far the deadliest one in terms of casualties. Due to this series of attacks, France was put under a state of emergency, borders were closed, and 1500 soldiers were deployed to help the police maintain order in Paris. The second event occurred a few months later and refers to the three suicide bombings which took place in Belgium in March 2016 (two at Brussels Airport and one at Maalbeek metro station), which resulted in 32 deaths and more than 300 injuries. The perpetrators were again members of ISIL, and the attacks were the worst terror incident Belgium ever faced. The targets chosen

	Event-day AR	5-day CAR	10-day CAR	15-day CAR
USD/euro	0.004970	0.004575	0.007089	0.001415
T-statistic	1.028086	0.423194	0.463755	0.075561
USD/yen	-0.016076**	-0.000347	-0.024752	-0.025447
T-statistic	-1.994523	-0.019276	-0.971109	-0.815156
USD/GBP	0.004084	0.005616	-0.013483	-0.020936
T-statistic	0.932575	0.573420	-0.973542	-1.234284
USD/CHF	0.003836	0.006165	0.016123	0.008819
T-statistic	0.850135	0.610931	1.129785	0.504570

Note 1: ***significance at the 1%, **significance at the 5% level and *significance at the 10% level.

Note 2: Table presents t-tests for the 'event day' and 'event windows' of 5, 10 and 15 days (H_0 , CAR = 0; H_1 , CAR \neq 0); t-statistics in italics.

Table 5. 'Event-day' AR and 'event-window' CAR for the USD after the Boston bombings in 2013.

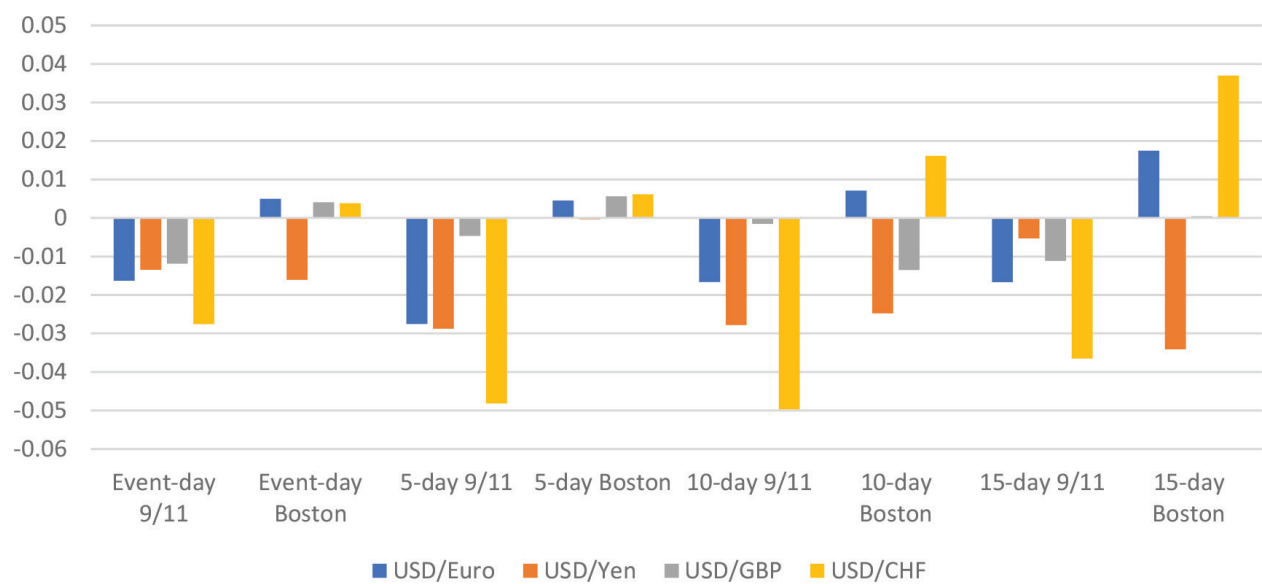


Figure 2. ‘Event-day’ AR and ‘event-window’ CAR for the USD; 9/11 vs. Boston Bombings.

this time were among the most sensitive in Europe, as Brussels is home to the EU, NATO and several international agencies.

The third event took place in France again and is the attack that took place in Nice in July 2016, when a large truck was driven into crowds celebrating Bastille Day. The attack resulted in 86 deaths and 434 injuries and once again, the ISIL claimed responsibility for it. The fourth event examined is the attack on a Christmas market in Berlin in December 2016, which cost the life to 12 people and left 56 injured. The perpetrator was a Tunisian failed asylum seeker, and ISIL yet again claimed responsibility for the attack. Germany had experienced terror attacks in the past (e.g. by PKK in Ulm in 1995), but this was the most severe in terms of casualties since the attack at Oktoberfest in Munich in 1980.

The fifth event is the London attack in March 2017 when a rental car was driven into pedestrians on London’s Westminster Bridge; as a result of the attack, 4 people died and 50 more were injured. According to police sources, the perpetrator may have acted alone but could have been inspired by ISIL. The next event took place in the UK again, 2 months later, this time in Manchester, when a suicide-bomb exploded just outside Britain’s Manchester Arena, as people were leaving a concert. Twenty-three people were killed in this attack and about five hundred were injured. It was the deadliest attack in the UK since the 2005 London bombings. The perpetrator was a British national of Libyan origin, and yet again, ISIL claimed responsibility for the attack.

The final event examined in this paper is the attack in Barcelona in August 2017 when a van was driven into pedestrians on the popular La Ramblas Avenue. As a result of the attack, 12 people lost their lives and another 130 were injured. A few hours after this incident, five men thought to be members of the same terrorist group drove into pedestrians in nearby tourist resort Cambrils, killing one person and injuring six others. The attacks were the deadliest in Spain since the 2004 Madrid train bombings, and it is believed that the ISIL was once again behind them.

With the exception of the attack in Berlin, where there is evidence of negative abnormal returns on the euro/yen pair on the day of the event only, all other recent events share one important characteristic; neither their ‘event-day’ abnormal returns nor their CAR over the 5-, 10- and

15-day 'event windows' are statistically significant, for all currency pairs examined. This finding is particularly interesting and potentially important, as it clearly contrasts the findings related to earlier events, where, on the day of the event, there was clear evidence of statistically significant negative abnormal returns, which very often persisted for some currency pairs (especially those involving the yen and the CHF) in the subsequent event windows. **Table 6** depicts the 'event-day' abnormal returns for these seven events; results regarding subsequent event windows are not reported to preserve space but are available upon request.

The analysis carried out in this section provides important insights regarding the research questions addressed in this paper. The first question was whether specific terror attacks affect the value of the currency of the country attacked versus other major currencies. Our results seem to suggest that the former events appear to cause negative abnormal returns on the day of the event, i.e. a negative initial effect, on the currency of the affected country. This effect varies across currency pairs, for example, 9/11 resulted in a negative effect on the USD for all currency pairs analysed; the Madrid bombings in 2004 resulted in a negative effect on the euro only versus the Swiss franc; the London bombings in 2005 resulted in a negative effect on the GBP for all currency pairs analysed except the GBP/USD; the Boston bombings in 2013 resulted in a negative effect only on the USD/yen currency pair. These findings seem to be aligned, to some extent, with other work, which has focused on the effect of terror attacks on the stock market and which documents 'event-day' abnormal returns (e.g. see [23, 24]). It should be noted though that these studies do not cover more recent events, i.e. those that have occurred in 2015, 2016 and 2017. Our results regarding such events seem to suggest that the clear majority of these events do not seem to exert any significant negative effect on the value of the currency of the country affected, and this holds across all currency pairs analysed. Overall, it seems that financial markets have become less and less reactive to terrorist incidents in recent time.

The second question was whether the aforementioned effect on the currency was permanent or transitory. Again, there is a distinct difference between former and latter events; in the case of the former events, the effect, as highlighted by negative CAR, seems to persist for some days, at least for some currency pairs. In the case of 9/11, the most persistent effect appears to be for the USD/Swiss franc pair, which exhibits negative CAR in the 10-day event window. In the case of the Madrid bombings in 2004, the most persistent negative effect on the euro is related to the euro/yen pair (persists in the 15-day event window) and the euro/Swiss franc (persists in the 10-day event window), while in the case of the London bombings in 2005, the British Pound seems to exhibit negative CAR versus the euro and the Swiss franc in the 10-day event window. These results suggest that following the aforementioned terror attacks, demand for the so-called 'safe heaven' currencies, such as the yen and the CHF, increased versus the currency of the country that suffered the attack. As far as the latter events are concerned, in line with our finding related to the first question, there does not appear to be any persistent effect for any of the currency pairs analysed.

The third question addressed was whether the market response to such events has changed over time and more specifically whether more recent attacks affect currency markets in the same way as earlier ones. Results regarding this question seem quite interesting as they clearly indicate that recent events such as the Manchester bombing in May 2017 or the attack in Barcelona in August 2017, among others, did not seem to have any significant effect on the value of the currency of the country suffering the attack. This is clearly in contrast to earlier events, such as 9/11 or the Madrid and London bombings. One possible explanation for this is that some of the

Paris attack		Brussels attack		Nice attack		Berlin attack	
15/11/2017		22/03/2017		14/07/2017		19/12/2017	
Euro/USD	-0.00531	Euro/USD	-0.00328	Euro/USD	0.00217	Euro/USD	-0.00220
<i>T-statistic</i>	-0.78455	<i>T-statistic</i>	-0.50166	<i>T-statistic</i>	-0.50166	<i>T-statistic</i>	-0.48742
Euro/yen	-0.00093	Euro/yen	0.00229	Euro/yen	0.01282	Euro/yen	-0.01185**
<i>T-statistic</i>	-0.18734	<i>T-statistic</i>	0.38239	<i>T-statistic</i>	1.34960	<i>T-statistic</i>	-2.42692
Euro/GBP	-0.00399	Euro/GBP	0.00822	Euro/GBP	-0.01421	Euro/GBP	0.00380
<i>T-statistic</i>	-0.62518	<i>T-statistic</i>	1.29038	<i>T-statistic</i>	-1.44827	<i>T-statistic</i>	0.66318
Euro/CHF	-0.00349	Euro/CHF	0.00089	Euro/CHF	-0.00155	Euro/CHF	-0.00302
<i>T-statistic</i>	-0.88635	<i>T-statistic</i>	0.29429	<i>T-statistic</i>	-0.52182	<i>T-statistic</i>	-1.25728
London attack		Manchester attack		Barcelona attack			
22/03/2017		22/05/2017		17/08/2017			
GBP/USD	0.00036	GBP/USD	-0.00375	Euro/USD	-0.00392		
<i>T-statistic</i>	0.05823	<i>T-statistic</i>	-0.61341	<i>T-statistic</i>	-0.86712		
GBP/yen	-0.00753	GBP/yen	-0.00301	Euro/yen	-0.00623		
<i>T-statistic</i>	-1.03914	<i>T-statistic</i>	-0.45512	<i>T-statistic</i>	-1.18227		
GBP/euro	0.00149	GBP/euro	-0.00570	Euro/GBP	-0.00343		
<i>T-statistic</i>	0.27798	<i>T-statistic</i>	-1.08205	<i>T-statistic</i>	-0.70862		
GBP/CHF	-0.00209	GBP/CHF	-0.00296	Euro/CHF	-0.00473		
<i>T-statistic</i>	-0.40796	<i>T-statistic</i>	-0.57692	<i>T-statistic</i>	-1.33436		

Note 1: ***significance at the 1%, **significance at the 5% level and *significance at the 10% level.

Note 2: Table presents t-tests for the 'event-day' abnormal returns (H_0 , $CAR = 0$; H_1 , $CAR \neq 0$); t-statistics in italics.

Table 6. Event-day abnormal returns for events that took place in 2015, 2016 and 2017.

earlier events, for example, 9/11, were much bigger in magnitude (e.g. many more casualties, higher direct and indirect costs, etc.) and, as such, naturally had a more profound effect on the foreign exchange market. Nonetheless, our results indicate that this is not always the case, for example, the attack in Paris in November 2015 and in Nice in July 2016 caused more deaths than the attack in London in 2005, yet the market reaction was distinctly different.

There may also be two further explanations regarding the above finding; the first one has to do with market participants, who seem to have overcome their initial behaviour of 'overreacting' and are now evaluating the 'true' economic and financial consequences of a terror attack. Sadly, market participants have seen several terror attacks, and they know that markets tend to 'bounce back' rather quickly, and this holds even for attacks as big as 9/11. The second explanation could be that, because market participants have become more used to the risk of terrorism, they are 'pricing' it in asset and currency prices much better; remember, the theory of market efficiency argues that unexpected events only affect markets. For example, consider the recent attack in Manchester (23/05/2017); it is possible that people in the UK, and that includes market participants, were expecting an attack to happen sometime. After all, we need to keep in mind that at the time of the attack, the threat level in the UK was classified as 'severe', which means that an attack was highly likely.

There is probably a different dimension to the above discussion, which is related to the theory developed in Ref.s [10, 28], which points out that it is the persistence of the terrorist phenomenon and no single attacks, no matter how big they are, that are likely to have a long-lasting effect on markets. Our results seem to suggest that market participants could be viewing the latter events as 'one-off' events, which are not likely to reoccur frequently. Nonetheless, given the unfortunate fact that lately we are seeing increasingly more and more terror attacks, it is possible that market participants may, at some point in time, re-evaluate their reaction to such events. This would most certainly be a very interesting field for future research, if and when more data is available (we most certainly hope it will not).

Turning now to the fourth and final question addressed in this paper, which was whether the above results regarding the effect of terror attacks on foreign exchange markets may influence national and global classes. This can potentially be done through the channel of the economy of the country suffering the attack, i.e. the effect to be transmitted from the foreign exchange market to the broader economy and potentially then to class dynamics. Our results indicate that earlier events have indeed affected the currency of the country attacked by causing it to depreciate against other currencies, especially those considered to be 'safe heaven' currencies (Yen and Swiss franc); our results, however, also indicate that latter events did not have any effect on the currency of the country attacked.

Typically, currency depreciation leads to imports becoming more expensive and exports becoming cheaper, thus more attractive; this usually results in an improvement in the balance of payments of the country. It moreover might lead to higher inflation (imported goods become more expensive), which in turn is likely to result in lower 'real wages'. Furthermore, a depreciation in the local currency is also likely to make the specific country a less attractive destination for foreign workers, but a more attractive one for tourists. Of course, when the currency of one country depreciates, the currency of another one (or more) appreciates; naturally, the economic consequences of a currency appreciation are the opposite to the ones mentioned above.

So, given the above, one might wonder what the effects of terror attacks, through the foreign exchange market, and its connection with the economy, might be on the class dynamics of nations, e.g. a permanent reduction in real wages could have serious implications for class dynamics. Nonetheless, an event such as a terror attack is likely to cause economic effects that will affect class dynamics, at the national and global levels, only if its effects on the currency – and hence the economy – are persistent, i.e. of a long-term nature. Our results clearly indicate that such events exhibit a transitory and not a persistent effect on currencies, for example, even an event of the proportions of 9/11 does not appear to have any negative effect on the US dollar for more than 10 days. Consequently, it appears that our results indicate that terror attacks are not likely to affect class dynamics, at least not through the foreign exchange market channel, which seems to be particularly efficient in absorbing short-term shocks, due to terror attacks, and continuing to function effectively, thus preserving economic stability.

5. Conclusion

This paper has employed the ‘event-study’ methodology to examine the effect that major terrorist attacks may have on the currency of the country, or economic union, which suffered the attack. It moreover provides an initial discussion regarding the possible effect that terror attacks might have, through the foreign exchange market and its link to the economy, on national and global class dynamics. More specifically, 11 major terrorist attacks that occurred in the twenty-first century were selected; two from US, two from France, two from Spain, three from Britain and one from each of Germany and Belgium, and an assessment was made to see whether these events resulted in significant negative abnormal returns for the currencies of these countries (versus other major currencies), on the day of the event and on the days that followed (we used ‘event windows’ of 5, 10 and 15 days).

Our results provide interesting insights regarding the way currency markets react to terror attacks over time. More specifically, except for the most recent attacks, i.e. those that occurred in 2015, 2016 and 2017, all others appear to cause substantial negative abnormal returns on the day of the attack. Moreover, in the case of earlier attacks (e.g. 9/11, Madrid and London bombings in 2004 and 2005, respectively), these abnormal returns seem to persist for some time after the event. This finding is especially evident in currency pairs involving the currency of the country that suffered the attack and ‘safe heaven’ currencies, such as the yen and the CHF, where the former depreciates and the latter appreciates, thus suggesting that after such an event, there might be a ‘flight’ of investors’ money to these currencies. However, for most of the terror attacks analysed, even the earlier ones, negative CAR do not seem to persist for more than 15 days. As such, we may conclude that the nature of these events is transitory and not permanent.

Probably the most striking finding of our paper is that the terror attacks that occurred in 2015, 2016 and 2017 appear to have very little or, in most cases, no significant influence on any of the currency pairs examined. This finding is particularly interesting as it suggests that, over time, market participants have probably learnt to better assess such events and hence react more calmly and rationally to them. They moreover appear not to treat them as unexpected events likely to significantly affect the foreign exchange market anymore.

The results of this paper connect well with those of earlier studies, which have mostly focused on the effect of terror attacks on stock markets and which have documented that such events seem to negatively affect stock prices on the day of the event and, in some cases, in the next few days (e.g. see [7, 23]), but the effect is not permanent. Our results appear to also be aligned with the finding that stock markets seem to have become more resilient to terror attacks over time (e.g. see [23]).

To sum up, it appears that currency markets have learned that, unlike the human toll, the financial ramifications of a terrorist attack can be short-lived and are not likely to affect economies in the same way as, for example, a recession would. As such, markets and market participants have become more efficient in absorbing the shocks or disruptions caused upon them by such events, learnt from them and continue to perform their functions effectively. This has potential repercussions for the potential effect of terror attacks on national and global class dynamics, through the foreign exchange market. It is our belief that for such an event to influence the dynamics of class formation, it must first have a permanent effect on the economy of the country attacked, which, in turn, must be caused by a permanent effect on the foreign exchange market; our results seem to clearly suggest the opposite, thus indicating that terror attacks are not likely to affect class formation, at least not through the channel of the foreign exchange market.

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