

Economic Impact of Potential MANPADS Attacks on Commercial Airliner

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Abstract

The purpose of this study is to estimate the economic consequences of potential MANPADS terrorist attacks on a commercial airliner in Europe. Using secondary research approach, we assess the short-term impacts on capital stocks, short-term economic activity and financial markets as well as the most important long-term impacts on economic growth, foreign direct investment, trade and tourism. However, we find that the impact of a single MANPADS attack on economic growth (as its most important negative effect) could be quite modest and short-lived. We estimate that the growth would be reduced by between 0 and 0.2 percentage points annually and the effect would be dissipated within one year. On the other hand, we find that small and open economies and economies where tourism is an important economic sector would suffer the greatest impact due to the expected stronger effect on tourism and related sectors such as airlines, hotels and restaurants, and trade sector. We estimate that the single attack could reduce trade by between 2 % and 10 % and tourist arrivals by between 3 % and 10 %. For both cases, the temporal effect is estimated to last from 1 to 2 years. The results also suggest that the attack with higher level of magnitude or simultaneous attacks would have a higher and more persistent effect than a single MANPADS attack. Furthermore, the most serious, persistent and the greatest impact we could expect from the serial MANPADS attacks at high frequency spread over a few weeks or months.

1. Introduction

MANPADS or Man Portable Air Defense Systems are cheap, mobile and widely available weapon which over 700.000 are estimated to have been produced since 1970's (Rand, 2005). By using from the ground, they could be one of the most serious dangers to commercial airliners. Around 6.000 MANPADS are outside the control of any government and many of them could be controlled by between 25 and 30 terrorist groups (Pena, 2005; Bolkom and Elias, 2006). It is estimated that over the past 26 years, 24 of 35 possibly MANPADS attacks against civilian aircrafts were shot down resulting in more than 500 deaths (Rand, 2005; Bolkom and Elias, 2006). For only six incidents are suspected that large civilian aircrafts have been attacked by MANPADS and only two of them resulted in catastrophic losses (Bolkom and Elias, 2006). Meanwhile, none of the 35 possibly MANPADS attacks have occurred in Europe or the USA.

The macroeconomic consequences of MANPADS attacks on commercial airliner firstly depend on the type of those attacks. A potential scenario could range from only a single unsuccessful attempt without any direct costs to simultaneous attacks across the country and countries or serial attacks spread over a few weeks or months. Well-coordinate or "high-cost" attack (e.g. aircraft crashes in metropolitan area) could cause massive property and personal damage and reduced short term economic activity such as complete closure of airports and related activity.

However, in both extreme cases, the most important cost would accrue due to increased terrorist threat which affects consumer, business and government behavior. There could be increases in transaction and business costs such as transport delays, tighter security and customs control, higher insurance costs, higher construction costs, increased inventory holdings. Consequently, such increases in transaction costs and risk premiums would induce reductions in investment and trade transactions. Moreover, there could be also a reduction in terrorism risk coverage which could have another negative impact on trade and investment. On the other hand, higher risk premiums would

increase required rates of returns on investments as well as reduced equity prices. This would have a dampening effect on long-term investment which could have a large impact on the re-allocation of capital. The cumulative effect would reduce overall investment (including FDI) and trade flows, and thereby the growth.

By the impact on consumer confidence, the terrorist attack and increased threat of terrorism could also result in lower spending, notably on tourism and related industries such as airlines, hotels and restaurants. The main consequences of the economic impact on tourism and airline sector would be a substitution effect and contagion effect; the substitution effect could accrue between affected and safe countries, between tourism or airline sector and other sectors, and between foreign and domestic destinations. Meanwhile, a large decline in tourist arrivals could spread rapidly over the neighboring countries or complete region with quick spillover, or contagion, effects.

Economic growth could be also affected through many channels by increased government spending for security and defense uses; there could be a reallocation of economic activity from productive uses toward security uses, a “spin-off effect” which can affect a short-term boost to domestic demand, and “resource mobilization effect” on savings and investment due to the higher security measures in country. In the end, terrorist attacks could also have an indirect impact on economic growth through income channel.

To estimate the macroeconomic effect of MANPADS attacks on commercial airliner in Europe, many empirical and simulated-scenario studies related to macroeconomic and microeconomic impact of terrorist attacks as well as many estimates related to the consequences of the attacks of September 11 (thereafter 9/11) are surveyed. The impacts are divided into short- and long-term consequences strictly on the basis of available literature although some empirical results do not consistently support such classification. It is also necessary to note that the long-term consequences could be underestimated since they do not capture psychological costs associated with the stress and other mental disorders.

However, the results seem to suggest that the effect of sporadic terrorist attacks on economic growth is quite modest and short-lived. The impact on growth depends on many factors such as kinds of terrorist threats, level of political and economical development, size and degree of diversification of economy. For this reasons, we could expect that the impact of a MANPADS attack in Europe of the magnitude such as the destruction of aircraft by bombs (like bombing attacks on Pan Am in 1988) is likely to have a very limited and temporary economic effect. On the basis of previous empirical results, we estimate that the growth would be reduced by between 0 and 0.2 percentage points annually and the effect would be dissipated within one year. A major reason for such limited effect is due to a substitution effect which is expected to occur between many sectors and countries. Because of the “negative” substitution effect, the impact on tourism and related sectors such as airlines, hotels and restaurants, and trade sector could be the greatest and also long-lived. We estimate that the attack could reduce trade by between 2 % and 10 % and tourist arrivals by between 3 % and 10 %. For both cases, the temporal effect is estimated to last from 1 to 2 years. For this reasons we could expect that the small and open economies and economies where tourism is an important sector would suffer the greatest impact. For the impact on foreign direct investment, the results are ambiguous. We estimate that the effect could reduce FDI stocks by between 0 % and 5 %. In the end, we estimate that the short-term impact on financial markets and especially on stock exchanges could be significant, but very temporary, lasting just a

few days. However, both effects depend on the effectiveness of government response by monetary and fiscal policies. Meanwhile, only for some major bond markets, we could expect decline in yields and higher volatility. Also, these effects are expected to be stronger in the USA than Europe, due to the differences in financial markets structures.

On the other hand, the attack with higher level of magnitude such as simultaneous attack resulting in 2 aircrafts shot down could have a stronger effect on economic growth at between 0 and 0.3 percentage points, which is also expected to last longer up to 1.5 years. And finally, serial MANPADS attacks at high frequency would have the most serious, persistent and the greatest impact. Once may be an accident, but twice or more makes a pattern.

The remainder of this paper is organized as follows. Chapter 2 introduces the short-term consequences of terrorist attacks and estimates the impact on capital stock, most vulnerable sectors and financial markets. Chapter 3 discusses the long-term impacts which include impact on economic growth, foreign direct investment, trade and tourism. Chapter 4 concludes the paper.

2. Methodology

This paper uses secondary research methodology to estimate the economic effects of potential MANPADS attacks on commercial airliner in Europe. We start with critical assessment of publicly available research papers dealing with macroeconomic and microeconomic consequences of terrorism in general, including studies related to the 9/11 terrorist attacks and continue with studies dealing directly with potential MANPADS attack. On the basis of these literature, short-term impacts on capital stocks, on short-term economic activity and on financial markets as well as the most important long-term impacts on economic growth, foreign direct investment, trade and tourism are estimated.

Secondary analysis was chosen as an appropriate robust tool due to the fact, that fortunately there have been no such incidents – MANPADS attacks on civil airliners in Europe, yet, so we do not have a methodologically necessary sample for primary statistical analysis.

Nevertheless, we are strongly aware of several limitations and shortcomings of this approach, some of which are listed below:

- A MANPADS attack on civil airliner has not occurred in Europe or USA, yet. For this reason, secondary data could be too general and its applicability for our needs, somewhat limited.
- It is hard to estimate economic consequences correctly since a wide range of potential MANPADS attacks may have many different consequences. A potential scenario could range from only a single unsuccessful attempt or the attack with the magnitude such as the destruction of aircraft by bombs to simultaneous, “high-cost” or serial attacks.
- A wide range of different countries in Europe also makes the analysis complex. Namely, economic consequences depend on many countries specific factors such as level of political and economical development, size of economy and degree of diversification of economy.
- The data used in available studies may be out-dated and might not be reflective of current-day terrorism. Namely, studies report that economies become more resilient and experienced from past-terrorist attacks.

- Some results are hard to interpret and many conclusions of different studies are inconsistent with each other.
- Samples used in some studies are relatively small.

3. Short-term impacts

3.1. Impact on capital stock and short-term economic activity

A MANPADS attack would have a short-term economic impact on a country's capital stock, both physical and human, as well as on short-term economic activity. The immediate short-term economic costs of such attack could result from the loss of life, the costs associated with injuries, the loss of airplanes (one or more), and the possible destruction of property on the ground. The latter costs are associated with the increased threat of terrorism and reduced short-term economic activity. A study by the RAND Corporation (2005) estimates that the cost of each 300 passenger aircraft shot down would be around \$1 billion or \$200-250 million per airplane and \$2-2.5 million per passenger.¹ In Europe, it seems that the loss of life is less costly. Namely, for the victims of the London terrorist bombings (July 7, 2005), Criminal Injuries Compensation Authority paid the basic compensation of only £11.000 per victim (CICA, 2005). However, the Regulation (EC) No. 785/2004 requires air carries to be insured at minimum 250.000 SDRs (around \$388.000) per passenger to cover liability in respect of passengers due to a number of risks including also terrorism.

On the other hand, the potential destruction of buildings and infrastructures could incur significant cost. However, if an economy is sufficiently large, the destruction of capital stock would be relatively small even from a catastrophic event, since it represents a smaller share of GDP. For example, Becker and Murphy (2001) estimate that the 9/11 terrorist attacks destroyed just 0.06 % of the total productive assets or 0.02 % of physical assets in the USA (\$60 billion as an upper bound for the damage). Another study (Navarro and Spencer, 2001) estimates the loss of capital stock to be around \$50 billion (or around 0.5 % of GDP).

However, while the loss of lives and destruction of property are likely to have a limited macroeconomic impact, the short-term losses from increased threat of terrorism could be significant. The most important channel through which the attack and continuing threat of terrorism immediately affects country's economic activity is through its impact on consumer and business confidence.² For example, in the aftermath of the 9/11 attacks, the index of consumer confidence in the USA declined by around 15 % in October 2001 (Penm et al., 2004; Virgo, 2001). A reduction in confidence could affect the economic activity through Keynesian multiplier and trade channels which can reduce aggregate demand and output (IMF, 2001). A negative impact can result in lower spending especially in the airline and tourism sectors. Furthermore, these industries could also suffer most economic losses as inventories of service output cannot be accumulated in times of declined demand (Straub, 2001). For example, one month after the bombings in Bali (October, 2002), tourist arrivals in Bali declined by 60 % while in Indonesia they declined by 21 % (Australian Government, 2004). Or another example, immediate after the 9/11 attacks (third and

¹ The average compensation payment for the victims of the 9/11 attacks was around \$2.1 million.

² Consumption could be also increased due to the expectations of future uncertainty (Persitz, 2007; Rand, 2007).

fourth quarter of 2001), domestic and Japanese tourist arrivals to Hawaii declined by 8.8 % and 30.6 %, respectively (Bonham et al., 2006).

Navarro and Spencer (2001) estimate the overall short-term costs of the 9/11 attacks to be around \$47 billion or around 0.5 % of GDP. These costs include the lost revenues in airline (for September 2001), hotel (for first weekend), retail (for 2 days) and advertising (for the first days) industry, and the loss of productivity (for 2 days).

3.1.1. Impact on airline sector

The short-term impact on airline sector could also be significant, perhaps the greatest. The potential closure of all airports, tighter security and customs control, transport delays, sharp decline in tourist arrivals, increased insurance costs, and increased insecurity could seriously reduce airline revenues. For example, Ito and Lee (2004) estimate the impact of 9/11 terrorist attacks on USA airline sector. They find that a temporary demand declined by more than 30 % measured in RPMs (revenue passenger miles) or 7.3 % measured in yields (prices).³ Moreover, they also find a long-term demand shock.⁴ Another study by Navarro and Spencer (2001) estimates the short-term revenues losses in USA airline sector to around \$4.7 billion for September 2001.

The immediate economic impact could also be dependent on the duration of potential interruption in air travel. For example, Rand (2005) estimates that the consumer and producer (welfare) losses for USA airline industry would be \$0.5 billion for a day shutdown, \$3.4 billion for a one week shutdown, and \$14.1 billion for a one month shutdown. Rand also assumes additional short-term costs from future demand decline for air travel at \$0.9 billion (measured in RPMs) for a one day shutdown, \$12.4 billion for a one week shutdown, and \$56.6 billion for a one month shutdown. A one day airline shutdown would reduce demand by 10 % for two weeks, a one week shutdown would reduce it by 15 % for six months, and one month shutdown would reduce it by 25 % for eighteen months.

Another study by Balvanyos and Lave (2005) also includes the costs from other sectors (airline suppliers) and estimate a larger effect than Rand (2005): a consumer surplus loss from an air travel shutdown is estimated to around \$2 billion per day. Additionally, the costs from reduced total spending (including airline) in the economy (USA) are estimated to \$0.64 billion per day.

Finally, additional costs for potential installation of anti-missile defense system on aircrafts could also be significant. For the USA airliners of around 6.800 aircrafts, Rand (2005) estimate the overall costs of installing laser jammers for ten years period to around \$40 billion.

To summarize, the macroeconomic impacts of MANPADS terrorist attacks on capital and human capital stocks in Europe could have significant effect especially on smaller countries, such as e.g. Malta, Estonia, Cyprus or Latvia. However, the effect on larger countries in Europe, such as Germany, the U.K. or France, and the USA would be smaller, since the loss of life, airplane(s) and the potential destruction of property on the ground would represent a smaller share of country's productive assets or GDP. Furthermore, many of policies for cover physical and human stocks

³ The decline in yield is smaller because a large number of airline tickets are purchased in advance (Ito and Lee, 2004).

⁴ See Chapter 3.4.

could be also reinsured abroad. On the other hand, short-term impact from reduced economic activity could have a substantial effect especially on tourism and airline sectors. The tighter security and customs control, transport delays, increased insurance costs and increased uncertainty could result in large loss of tourism and airline revenues. Moreover, airline sector could suffer additional costs from the potential investments in anti-missile defense systems or closed airports. The latter costs could be also associated with the duration of potential airports closures.

3.2. Impact on financial markets

Increased uncertainty from terrorist attack has also negative impact on a number of financial markets. Such attack makes financial assets riskier, which would work to lower prices, increase volatility and boost risk premiums. Higher risk premiums increase required rate of returns on investments and reduce assets prices (IMF, 2001; Mejia, 2004). This induces investors to sell riskier and especially “affected” assets such as stocks of airlines, aircraft manufactures or tourism, or long-term assets, and buy safer, liquid and short-term financial instruments. For these reason, airline and tourism shares are more vulnerable to the attacks than others and consequently suffer a sharper drop in prices. For example, on the first day of trading after the 11/9 attacks, United Airlines and American Airlines shares dropped by 43 % and 39 %, respectively (Karolyi and Martell (2006). On the other hand, some stock prices such as defense or security shares could also respond with positive price reaction, if investors expect increased economic activity in those sectors (Berrebi and Klor, 2006).

A large decline in stock prices could reflect investor’s decision that terrorist attack reduces the expected return to investment for higher risk exposures as well as reduces the potential economic activity in the future. But there could be also a contagion effect which is unrelated to any economic fundamentals and reflects only psychological over-reaction of investors (Karolyi, 2006). This is due to the experience that individual investor’s behavior is likely to be associated with the behavior of other investors (Frey et al., 2004). For this reason, even a small attack could affect investors’ behavior, which would affect financial asset prices (Gulley and Sultan, 2006). At the same time, the media could also adversely affect investors’ psychology and could have effect on stronger contagion behavior since (especially bad) news spread quickly over the world (Chen and Siems, 2004; Gulley and Sultan, 2006). This is another reason, why financial markets vulnerability could be larger than the changes in economic fundamentals. On the other hand, it seems that financial markets become more resilient and experienced from past-terrorist attacks (Chen and Siems, 2004; Gulley and Sultan, 2006). For example, the response of financial markets to the 9/11 attacks was much more muted than to prior attacks with smaller magnitude (Gulley and Sultan, 2006; Chen and Siems, 2004). Or another example, the day after the London terrorist bombings, London’s stock market actually responded with increased share prices (Luskin, 2005).

Further, to the extent that terrorist attacks affect investment as business confidence deteriorates or cost of capital increases, there could also be an impact on consumption through negative wealth effect (Saxton, 2002; Gulley and Sultan, 2006). Finally, exchange rate depreciation and volatility or only the threat of depreciation and inflation can also decline investment.

However, macroeconomic policy response is a key determinant of whether capital markets are able to withstand and quickly absorb such shocks (Sandler and Enders, 2005; Bruck and Wickstrom, 2004; IMF, 2001; Chen and Siems, 2004). Monetary policy should quickly respond to increased

uncertainty by lowering interest rates and providing liquidity to the market. This could provide resources to deal with the consequences of the attacks and help safeguard the integrity of the financial system (OECD, 2002). On the other hand, fiscal policy will be involved in defense spending to boost aggregate supply. However, the effectiveness of this policy in stimulating the economy over time is doubtful.⁵ Other fiscal policies may include additional unemployment insurance benefits and the tax cuts (OECD, 2002).

Empirical results show that the influence of terrorist events on major stock exchanges is very temporary and the impacts are not associated with additional risk (volatility) or increased risk premium. Only for the some major bond markets, the results show higher volatility, but no increase in risk premium. Interestingly, for foreign exchange markets, the results show that some currencies may appreciate. However, for more recent terrorist incidents and even such catastrophic attack as the 9/11 attack, the results show that none of the worldwide currencies responded with appreciation (or depreciation) or additional volatility. Moreover, the similar effect is also estimated for Israel which is persistently subject to terrorist attacks.

Gulley and Sultan (2006) estimate the impact of terrorist attacks on global financial markets from 1983 to 2005. They examine changes in prices and risk premiums, and the increased volatility in financial markets which is proxy for higher risk of terrorism exposures.

For the bond markets, they find that terrorist attacks reduce yields in Germany and the U.K., and increase volatility in France, Germany, Italy, and the USA For the stock markets, they find that only Germany, Italy, and the World index experience negative price reactions due to terrorist incidents. Moreover, no increased volatility is estimated in any of the stock market indices. Risk premium is increased only for World index. Interestingly, for foreign exchange markets, they find appreciations of the Euro, French frank and Italian lira against the British pound. Additionally, no increased volatility or risk premium is estimated.

They also find that the response to 9/11 attacks is much more muted than to the Cole attack (October 12, 2000). Moreover, for the 9/11 attacks they find that global stock markets actually responded with positive price reaction. Additional volatility is estimated only in France and Japan. No price reaction or additional volatility is found in all foreign exchange markets and nearly all bond markets (except in France and Japan). They conclude from this that financial markets have become more resilient and experienced in the recent years.

Chen and Siems (2004) investigate changes in average returns of stock exchange indices to 14 terrorist and military attacks. The authors find that just two (the 9/11 attacks and the bombing attacks on Air India in 1985) of the eight terrorist incidents had significant negative abnormal returns of DOW index on the day of the attacks. No abnormal returns were found for other terrorist attacks such as bombing attacks on Pan Am (1988), the World Trade Center (1993), Oklahoma City (1995) or the USA Embassy in Kenya (1998).

More surprisingly, the 9/11 attacks were the only ones that had significant negative six-day cumulative abnormal returns (the markets dropped around 9 % over a 6-day period), but none of the USA equity indices displayed negative 11- day cumulative returns (see Table 1). In Europe,

⁵ See Chapter 3.1.

only Italy, Belgium and Norway experienced negative six-day cumulative abnormal returns. These markets also required a longer period to return to pre-attacks level. However, of the 18 global stock markets (or indices) in Europe or the USA, just one (Norway) had significant negative abnormal returns over the 11-day period.

Table 1: The impact of the 9/11 terrorist attacks on stock markets in Europe and the USA

Stock market (or index)	Event-day AR (%)	6-day CAR (%)	11-day CAR (%)	Days to return to pre-attack level
LONDON	-5.29*	-4.77	-9.04	22
FRANKFURT	-7.61*	-7.98	-10.64	23
EUROPE - BLOOMBERG	-6.23*	-6.82	-8.30	23
FRANCE	-7.07*	-9.8	-10.82	31
SPAIN	-4.79*	-7.64	-8.83	23
SWITZERLAND	-7.03*	-5.97	-7.29	30
AUSTRIA	-0.96	-4.36	-7.76	97
ITALY	-7.71*	-13.51*	-14.19	31
BELGIUM	-5.41*	-8.51*	-9.22	76
NETHERLANDS	-6.94*	-8.52	-10.83	42
PORTUGAL	-3.82*	-6.70	0.67	14
NORWAY	-4.53*	-9.89*	-12.39*	78
SWEDEN	-7.65*	-4.96	-4.69	23
FINLAND	-3.30	7.49	15.26	2
S&P 500	-4.84*	-7.72	-3.83	19
DOW INDUSTRIALS	-7.14*	-10.57*	-7.90	40
NYSE	-4.55*	-8.09*	-3.98	37
NASDAQ	-6.56*	-10.14	-9.99	12

Notes:

- Statistically significant at the 0.05 level.
- AR – abnormal returns; CAR – cumulative abnormal returns.

Source: Chen and Siems (2004)

The authors show that the influence of terrorist events on major stock exchanges is very temporary, lasting just a few days for most major incidents. They conclude in the same way as Gulley and Sultan (2006) that financial markets have become more resilient, mainly because of effective government response. They also show that the stock exchanges in Jakarta, Kuala Lumpur, and Johannesburg took longer to rebound from the 9/11 attacks. This could be indicated that stock markets in developing countries are more vulnerable to terrorism shocks, since they are more dependent on trade flows. Furthermore, developing countries could also use less efficiently monetary policies to offset adverse economic impacts due to their budget constraint.

Karolyi and Martell (2006) investigate 75 different terrorist attacks against firms around the World and examine the impact on their stock prices for a period between 1995 and 2002. They find that terrorist incidents have a negative effect on stock prices of -0.83 % around the day of a terrorist attack. Nevertheless, such effect around the day of a terrorist attack is quite modest. In contrast with the previous studies, they find that the attacks have larger effect on stock prices in more wealthier and democratic countries. Interestingly, they also show that the effect depends on the kinds of terrorist incidents; for example, kidnappings of company executives have a larger negative effect on stock prices than property damage, such as bombings on buildings.

Overall, the results seem to suggest that the impact of potential MANPADS attack or even the attack of the magnitude of 9/11 attacks could be significant, but very short-lived. For these reasons, we estimate that the impact of a single or simultaneous MANPADS attack in the USA or Europe may reduce domestic (and also global) stock prices by between 0 % and 10 %, but very temporary, from 0 to 11 days. However, we could also expect no price reaction since the financial markets have become more experienced from the terrorist attacks with such or higher magnitude (the 9/11 attacks).⁶ On the other hand, both effects depend on the effectiveness of government response. Besides, we could not expect any increased volatility or risk premium. For foreign exchange markets, we could also not expect any appreciation (or depreciation) or additional volatility. On the other hand, it seems that bond markets are more sensitive to terrorist attacks. We could expect decline in yields and increased volatility in some bond markets.

The previous studies examine the effect of sporadic terrorist attacks on the financial markets. However, we could keep in mind that two or more serial MANPADS attacks spread over a few weeks or months are likely to higher increase uncertainty and magnitude of economic impact. For this reason, we have to examine the effect for countries which are persistently subject to terrorist attacks and which could be proxy for such threat. However, the Basque and the Israeli cases should be treated with caution since the terrorist attacks could have greater potential economic impact in a country with a smaller GDP. Furthermore, such terrorism is a local threat and has only a regional effect which could be also stronger, most notably due to a stronger substitution effect.

Abadie and Gardeazabal (2002) examine the impact of terrorist activity on stock prices in the Basque region of Spain in 1998 and 1999. For the “good news” period when the truce began (22 trading sessions), they find a positive compounded abnormal return of 10.14 % for the Basque portfolio relative to the non-Basque portfolio, and -11.21 % negative compounded abnormal return during the 66 trading sessions of the “bad news” period when the truce ended.

Another study, Eldor and Melnick (2004), analyze how Israel’s stock markets (and also foreign exchange markets) reacted to 639 terror attacks for a period between 1990 and 2003. They find that intensified terror attacks after September 2000 (during the second Palestinian uprising) had a permanent negative effect on the stock market, but, interestingly, not on the foreign exchange market. Furthermore, the negative effect is quite large. They estimate for a period 2000-2003 that the value of the TA100 index (relative to the S&P500 index) on June 2003 was 30 % lower. Interestingly, they also find that only suicide attacks have a permanent effect on both markets.

⁶ Moreover, for the 9/11 attacks, Gulley and Sultan (2006) find positive stock price reaction. Or another example, after the London bombings, London’s stock market also responded with positive stock price reaction.

Contrary, Berrebi and Klor (2006) find that terrorism has no negative impact on the Israel's stock markets. But the results indicate that this is due to a positive effect on defense and security stocks that offsets a negative effect on the rest of the companies stocks. They find that intensified terrorist attacks after September 2000 caused a significant decrease of 5 % on non-defense stocks and a significant increase of 7 % on defense and security stocks. These coefficients correspond to an average loss of \$65 million in the market capitalization of non defense-related companies, and an average gain of \$53 million in the market capitalization of defense related companies. The authors conclude that terrorism has a positive impact on these companies due to their specialization in defense manufacturing which is driven by an increased local and particularly global demand.

In the end, the impacts on financial markets are expected to be stronger in the USA than Europe, due to the differences in their structures. Namely, the European financial system is bank based since European countries have small stock markets and large bank loans (except the U.K with a large both, stock market and bank loans). On the other hand, the USA financial system is market based where stock and bond markets have the most important role in the financial system. Furthermore, households in European countries without the U.K. hold significantly fewer financial assets (and also stocks) than in the USA. For example, in the period 1995-2002, the EMU area's ratio of financial assets of households to GDP was only 192 %, about a third the U.S. of 327 % or the U.K. of 306 % (Allen et al., 2004). Due to the small holding of stocks and other equity, European countries (and also households) without the U.K. are significantly less exposed to financial risks than the USA and the U.K. Moreover, for these reasons, we could also expect larger contagion effect (through negative wealth effect) in the USA or the U.K. than the rest of Europe.⁷

To summarize, studies report that the impact of persistent terrorist threat could be substantially larger and also long-lived. For these reason, we estimate that serial MANPADS attacks would reduce domestic stock prices by around 10 % and could have more persistent effect. The results also show that the impact on security and defense stock prices could be positive.

⁷ Only in this case, we talk about contagion effect which spreads from the financial sector to the real sector through the wealth effect: lower stock prices reduce consumer spending, and weaker consumer spending decreases production, and thereby stock prices. Otherwise, we talk about psychological contagion effect which occurs when decreased demand spreads to other sectors, countries or region not affected by terrorism.

Table 2: Selected empirical studies, used to estimate the impact of MANPADS terrorist attacks on financial markets

Study	Countries	Time period	Key findings	Relevance to our analysis	Our conclusions and estimates	Level of relevance
Gulley and Sultan (2006)	Western Europe, the USA, Japan, Canada, Australia	1983-2005	<p>Bond markets:</p> <ul style="list-style-type: none"> - Reduced yields in Germany and the U.K., increased volatility in France, Germany, Italy and the USA, no increased risk premiums. <p>Stock markets:</p> <ul style="list-style-type: none"> - Prices declined in Germany and Italy, no increased volatility, increased risk premium only for World index. <p>Foreign exchange markets:</p> <ul style="list-style-type: none"> - The Euro, French frank and Italian lira appreciated against the British pound, no increased volatility or risk premium. <p>The response to 9/11 attacks:</p> <p>Bond markets:</p> <ul style="list-style-type: none"> - No price reaction in Western Europe and the USA, increased volatility only in France. <p>Stock markets:</p> <ul style="list-style-type: none"> - Increased prices in France, Germany, Italy and the U.K., no increased volatility. <p>Foreign exchange markets:</p> <ul style="list-style-type: none"> - No price reaction or additional volatility. <p>Main conclusion:</p> <ul style="list-style-type: none"> - Financial markets have become more resilient and experienced. 	<ul style="list-style-type: none"> - The impact of sporadic terrorist attacks could be appropriate proxy for a single or simultaneous MANPADS attack. - The study investigated the impact on countries in Western Europe and the USA. - The study estimated the impact on bond, stock and foreign exchange markets. - The response of financial markets to 9/11 attacks is also estimated. 	<p>Expectations for a single or simultaneous MANPADS attack:</p> <ul style="list-style-type: none"> - For some major bond markets, we could expect decline in yields and higher volatility. - For stock markets, the results are mixed. We could expect either increase in prices either negative price reaction. - For foreign exchange markets, we could expect no reaction in prices, volatility or risk premiums. 	4
Chen and Siems (2004)	Global stock markets	1915-2002	<p>The response to 9/11 attacks:</p> <ul style="list-style-type: none"> - Significant negative abnormal returns of nearly all global stock markets on the day of the attacks. For Europe and the USA markets, average abnormal returns were between -3 and -8 %. - For some markets, significant 6- day negative cumulative abnormal returns were between -8 and -13 %. - Only Norway had significant 11- day negative abnormal returns. <p>Main conclusion:</p> <ul style="list-style-type: none"> - Financial markets have become more experienced from the terrorist attacks with higher level of magnitude. - The effects depend on the effectiveness of government response by monetary and fiscal policies. 	<ul style="list-style-type: none"> - The impact of sporadic terrorist attacks could be appropriate proxy for a single or simultaneous MANPADS attack. - The response of Europe and the USA stock markets to 9/11 attacks is estimated. 	<p>Expectations for a single or simultaneous MANPADS attack:</p> <ul style="list-style-type: none"> - For nearly all stock markets, we could expect negative price reaction between -3 and -10 %. - The effect would be very temporary, lasting just a few days. 	4

(Continued)

Karolyi and Martell (2006)	Global shares	1995-2002	Terrorist incidents against firms have a negative effect on their stock prices of -0.83 % around the day of a terrorist attack. The effect could be permanent.	<ul style="list-style-type: none"> - The study investigated the impact of sporadic terrorist attacks on stock prices. The results could be proxy for the impact on airline shares. - The study also investigated the impact on firms in Europe and the USA. 	The effect is too modest. We expect larger effect on airline shares. For example, on the first day of trading after the 11/9 attacks, United Airlines and American Airlines shares dropped by 43 % and 39 %, respectively.	2
Abadie and Gardeazabal (2002)	Spain, Basque region	1998-1999	Stock prices in the Basque region declined by 11.21 % relative to the non-Basque portfolio when the truce ended.	The impact of persistent terrorist attacks could be appropriate proxy as an upper bound for serial MANPADS attacks. However, the Basque and the Israeli cases should be treated with caution since the terrorist attacks could have greater potential economic impact in a country with a smaller GDP. Furthermore, such terrorism is a local threat and has only a regional effect which could be also stronger, most notably due to a stronger substitution effect.	Serial MANPADS attacks could reduce domestic stock prices by around 10 % and could have more persistent effect.	3
Eldor and Melnick (2004)	Israel	1990-2003	The value of the TA100 index was around 30 % lower over the period 2000-2003 (during the second Intifada). Terrorist attacks had not a permanent negative effect on the foreign exchange market.	The impact of persistent terrorist attacks could be appropriate proxy for serial MANPADS attacks.	Serial MANPADS attacks could have stronger and more persistent effect on stock markets. However, the impact is too strong.	2
Berrebi and Klor (2006)	Israel	1998-2001	Terrorist attacks have no negative impact on the Israel's stock markets. However, they caused a significant decrease of 5 % on non-defense stocks and a significant increase of 7 % on defense and security stocks.	The impact of persistent terrorist attacks could be appropriate proxy for serial MANPADS attacks.	Serial MANPADS attacks could cause a reallocation of capital to defense and security stocks.	4

Note: levels of relevance of individual studies to our analysis are graded from 1 (lowest relevance) to 5 (very high relevance).

Source: Author

4. Long-term impacts

4.1. Impact on economic growth

In addition to the short term effects, MANPADS attacks and especially increased threat of terrorism may have significant long-term impacts. One major impact on economic growth is that there would be significant increases in transaction (or frictional) costs and inefficiencies: transport delays, tighter security and customs control, higher insurance costs, higher construction costs, boosting intelligence activities, increased inventory holdings (due to potential delivery disruptions) (Saxton, 2002). These measures constitute a negative supply-side shock or added “tax” (“security” or “terrorist tax”) on the economy (Saxton, 2002; Navarro and Spencer, 2001). An increased transaction costs and increased risk of possible terrorist attacks are likely to induce reductions in investment and trade transactions. Higher risk premiums increase required rates of returns on investments as well as reduce equity prices (IMF, 2001; Mejia, 2004). The cumulative effect is to reduce overall investment (including FDI) and trade flows. Furthermore, increased transaction costs and substitutions in favor of domestic markets could also imply a shift away from globalization (IMF, 2001). Moreover, insurers could also respond to the increased risk by reducing terrorism risk coverage (OECD, 2002). This could have a strong negative impact on investment and thus on growth. For example, after the 9/11 terrorist attacks, insurance costs for USA airlines were increased by 233 % in the fourth quarter of 2001, compared to the same period of 2000. Insurers introduced additional premium of \$1.25 per passenger and raised premium by 0.05 % ad valorem. Risk cover caused by terrorist actions is also decreased from \$1.5 billion to \$50 million (OECD, 2002).

Economic growth could be also affected through many channels by increased government spending for security and defense uses.⁸ First, increased military spending could “crowd-out” investment and cause a reallocation of economic activity from productive uses toward security uses (Blomberg, Hess, Orphanides, 2004; Eckstein and Tsiddon, 2003; Becker and Murphy, 2001; Gupta et al., 2002; OECD, 2002; Penm et al., 2004; McKibbin and Stoeckel, 2001; Persitz, 2007; IMF, 2001; Smith and Dunne, 2001; Saxton, 2002). To the extent that terrorist threat diverts investment to government spending the growth in labor and capital productivity would decline, and thereby also economic growth (OECD, 2002; Penm et al., 2004; McKibbin and Stoeckel, 2001). For these reasons, the benefits associated with the “peace dividend” may be reduced. Second, there could be also a “spin-off effect” which can affect a short-term boost to domestic demand (OECD, 2002; Gupta et al., 2002; Hodgson, 2004; Cosgrove, 2003; IMF, 2001; Smith and Dunne, 2001). On the other hand, increased security spending and decreased tax revenue could affect fiscal position through higher fiscal deficits or higher taxes (Hodgson, 2004; Sandler and Enders, 2005; Gupta et al., 2002; Mejia, 2004, Penm et al., 2004).⁹ Finally, increased defense spending could have a positive effect on savings and investment due to the higher security measures in country (Gupta et al., 2002).

⁸ For instance, after 9/11 attacks, USA government spending for homeland security increased from \$15 billion in 2001 prior to 9/11 to about \$32 billion in 2003 (Mirza and Verdier, 2006a).

⁹ For example, USA Government Accountability Office (2005) reports that 9/11 attacks reduced the tax revenues by between \$2.5 and \$3 billion in 2002 and 2003.

In the end, terrorism could also have an indirect impact on economic growth through income channel (Gupta et al., 2002; Blomberg et al., 2003; Li and Schaub, 2004; Blomberg and Hess, 2005; Blomberg, Hess, Orphanides, 2004). Government spending on social goods and more productive uses could be affected by reduced real economic activity. Meanwhile, economical (and also political) development as well as economical condition could reduce terrorism. And finally, developed countries could also suffer less intensive effects.

However, the empirical evidence seems to suggest that the effect of sporadic terrorist attacks on economic growth or GDP level is quite modest and less persistent.

For example, Blomberg, Hess, Orphanides (2004) examine the impact of various forms of conflict on economic growth for large sample of 177 countries for the period 1968-2000. They find that terrorism has a small negative and statistically significant effect on growth rates: a terrorist attack in a given year reduces per capita GDP growth by around 0.4 percentage points. However, their results are inconsistent and mixed. For example, they also find that one standard deviation of the incidence of terrorism per capita in a given year (1.2 incidents per-million of population per year) reduces per capita GDP growth by only 0.25 percentage points. For OECD countries in the same specification it is estimated that the growth is reduced by 0.5 percentage points. This means that, for example, in France with a population at around 60 million, the growth would be reduced by only 0.008 percentage points annually. Furthermore, for cross-section specification it is estimated that the growth is reduced by only 0.047 percentage points annually per attack. However, and most importantly, they find that the effect of terrorism is quickly dissipated within one year. In contrast, the external and internal conflicts have much larger and more persistent impact than terrorist attacks. The internal and external conflict in a given year reduces growth by around 1.3 and 4.3 percentage points, respectively. The effect of external war is significant and negative for up to 3 years, while the effect of internal conflict is negative and significant still after 6 years.

However, they also find that the impact of terrorism on developed economies is smaller than on developing countries. Moreover, for the sample of OECD countries which are also the most affected by terrorism in their sample, the impact of a terrorist attack on economic growth is small (0.2 percentage points) and, most importantly, statistically insignificant. It is significant only for African sample. Furthermore, the impact of internal and external conflict on the growth of OECD countries is also insignificant (0.95 and 0.75 percentage points, respectively).

Interestingly, they also find a “crowding out effect”. The rise in the government spending around 0.4 percentage points offsets the decline in the investment around -0.4 percentage points. It seems that this reallocation of economic activity affects GDP growth.

This result is confirmed by Gupta et al. (2002) who investigate the effects of terrorism in the developing country on government spending and revenue. The empirical results show that terrorism conflicts (and also armed conflict) have impact on lower growth by diverting resources from more productive sectors to defense spending. Furthermore, tax revenues and government spending on education and health are also affected through income channel by reduced real economic activity. This is an additional impact on economic growth. However, in contrast, Smith and Dunne (2001) find no relationship between military expenditure, investment and growth for a sample of 28 countries (including OECD) over the period 1960-1997. An intuitive explanation for this finding could be that investment is crowded out only due to terrorist threat.

Tavares (2004)¹⁰ examines the impact of terrorist attacks on economic growth for the shorter period 1987-2001 and find a smaller effect than Blomberg et al. (2004). He finds that a terrorist attack reduces per capita GDP growth by only 0.029 percentage points in a given year. It seems that terrorism had a smaller impact in the recently years, during the 1990s.¹¹ But, he also finds that one standard deviation of the incidence of terrorism per capita reduces GDP growth by 0.2 percentage points. This result may be consistent with that of Blomberg et al. (2004). But, when he applies other determinants of growth in basic specification, such as exports, openness, government, inflation rate, he finds that terrorism has no longer a significant negative impact on growth.

Tavares also finds that terrorist attacks could have higher negative impact on non-democratic than democratic countries. Therefore, the higher is degree of democracy the smaller is effect of terrorist attacks. Furthermore, Li (2005) show that the increased degree of democracy tend to reduce the number of terrorist attacks. Furthermore, Blomberg and Hess (2005) partly confirm his result and finds that the democratic and richer country significantly reduces terrorism, but only in source countries. In contrast, in targeted countries (democratic and richer country) it actually increases terrorism.

And finally, the reverse causality is also possible: terrorist attacks may not only be a cause but also an effect of economic condition (contraction). However, the empirical evidence is ambiguous. While Blomberg et al. (2003) confirms a positive relation between terrorism and economic recessions (for richer democratic countries) other studies do not support theoretical argument (e.g., Krueger and Maleckova, 2003).¹²

A third cross-sectional study by Barth et al. (2006) examined the cost of terrorism in terms of reduced per capita GDP growth and investment to GDP ratio for sample of 149 countries and more than 20.000 terrorism incidents for the period 1972-2005. Their results show that terrorism has a negative and significant (at only 10 % level) impact on economic growth. However, it seems that the impact is also quite modest. For example, the impact of 0.97 terrorist attacks per million of population in Russia (2003) is estimated to reduce GDP per capita growth by 0.08 percentage points. This means that the growth would be reduced by only 0.0005 percentage points annually, if we estimate the population at 143 million. Their results are also consistent with Tavares (2004); they indicate that the lower degree of democracy and political stability tend to increase the number of terrorist attacks. And finally, they also find that investment is negatively affected by terrorist attacks.

The studies below examine the effect of persistent terrorism on economic growth. Such kind of terrorist threat could have much larger and persistent impact than sporadic terrorist attacks. For example, Barth et al. (2006) evaluate the impact of 47 terrorist incidents per million people on the Israel economy in 2001. Only in this year, the attacks reduced GDP per capita growth by 4 percentage points.

¹⁰ See Sandler and Enders (2005), Barth et al. (2006), Mirza and Verdier (2006a).

¹¹ However, for cross-section estimation, Blomberg et al. (2004) got to similar result.

¹² See Frey et al. (2004), Li and Schaub (2004).

Abadie and Gardeazabal (2002) evaluate the impact of terrorism on the Basque economy by using a counterfactual region displaying the hypothetical behavior of the Basque economy in the absence of terrorism. They find that GDP per capita declined about 12 % over the period from 1975 to 1983 and it was around 10 % lower over the period 1975-1997.

Eckstein and Tsiddon (2003) estimate the impact of terrorism on the Israel economy during the second Intifada (2000-2003). They find that terrorism has a significant and negative impact on output, consumption, investment and exports. During three years, GNP per-capita declined by over 5 %. Furthermore, they also find an increase in government defense expenditure from around 9 % of GNP to 12 % of GNP. They also predict that if terror in Israel continued at its average rate in period 2002 – 2003 for a one and half more year, by the end of 2004 annual GNP per capita would be 3 % lower and investment would be 10 % lower.

Similarly, a study by Persitz (2007) also examines relatively large macroeconomic costs of the Palestinian-Israeli conflict for the Israeli economy from 1994 to 2003. He finds that increased Palestinian terror reduced real GDP per-capita by 8.6 % over the period 1994-2003. Furthermore, only during the second Intifada 2000-2003, GDP per capita is estimated to be reduced by around 12 %. Therefore, an Intifada quarter of terror reduces GDP per capita by around 1.4 % on average. Finally, they also find that Palestinian terror increased government expenditures and decreased the shares of investment in GDP.

Overall, it seems that the effect of sporadic terrorist attacks on economic growth is, if any for developed countries, quite modest, especially in the recent years. The effect is also very short-lived; it seems that the growth is fully recovered within one year. One reason that terrorist attacks have a small macroeconomic impact is that they boost demand in a number of sectors, most notably construction and defense spending (“spin-off effect”) (IMF, 2001). There could be also a substitution effect between individual sectors, e.g. consumer spending on tourism could be replaced with spending on other services or goods (Rand, 2007). Furthermore, economic impact of terrorism threat is likely to increase the home bias of international travel or international trade (Bonham et al., 2006; Fratianni and Kang, 2006). Finally, in the case of a passenger airliner shutdown, there could be a substitution effect with passengers moving to alternative mode of travel (RAND, 2007; Ito and Lee, 2004).

Another reason could be also that the insurance claims are only a transfer among person and hence do not reduce overall incomes (Sandler and Enders, 2005). Furthermore, terrorism could have a positive impact on FDI inflows to affected countries if many of the policies are reinsured abroad. For example, it is estimated that FDI inflows in the USA after the 9/11 terrorist attacks could increase by \$11 billion or 0.1 % of GDP (IMF, 2001).

The results also suggest that the effect of terrorist attacks on developed countries is smaller than on developing countries. One reason that terrorism attacks have a smaller macroeconomic impact on developed countries is that they have larger (in terms of GDP) and more diversified economy. In more diversified economies, resources could be temporary reallocated from sectors affected by terrorism to other more safe sectors and hence, such substitution effects do not largely reduce overall incomes (Sandler and Enders, 2005).¹³ The positive changes with respect to some sectors

¹³ See also Bonham et al. (2006), Fratianni and Kang (2006) and Rand (2007).

will be offset by negative changes with respect to others; as demand for some increases, the demand for others decreases. For example, Yemen suffered greatly after the terrorist attacks on the USS Cole (USA Navy) and the French supertanker Limburg (October 6, 2002) due to their specialized economy. The attacks diverted half of Yemen's port activities to competitive ports in Djibouti and Oman due to a 300 % increase in insurance premiums (Sandler and Enders, 2005). On the other hand, in large economies, the destruction of capital stock by even a catastrophic terrorist attack would be relatively small. Another reason could be also that most developing countries depend more heavily on trade flows and FDI inflows, which is an important source of savings, and thereby growth (Penm et al., 2004; McKibbin and Stoeckel, 2001; Walkenhorst and Dihel, 2002). And finally, developed countries could use more efficiently monetary and fiscal policies due to their larger government budget. Increased military spending may create a larger fiscal pressure on developing countries (Sandler and Enders, 2005).

The results also confirm that the effect of terrorist attacks on non-democratic countries could be larger than on democratic countries. On the other hand, the increased degree of democracy and economic expansion could reduce the number of terrorist attacks.

However, the results also suggest that the terrorism may divert resources from more productive activities to security which could adversely affect GDP growth. Furthermore, terrorism could also force governments to divert national resources away from resources that create education and health.

On the other hand, we could assume that a catastrophic attack such as 9/11 could have greater and more persistent impact.¹⁴ However, we could also assume that the effects have to be much smaller and less persistent than the effects of internal or external conflicts which are more serious than sporadic terrorist attacks. Meanwhile, we should keep in mind that the impact of internal or external conflicts is still insignificant for OECD countries (Blomberg, Hess, Orphanides, 2004). For these reasons, we could expect that the impact of a single or simultaneous MANPADS attack may reduce the growth by between 0 and 0.2 percentage points, and 0 and 0.3 percentage points in a given year and last up to 1 to 1.5 years, respectively.¹⁵ Serial attacks could reduce the growth by up to 0.8

¹⁴ For example, Kunreuther, Michel-Kerjan and Porter (2003) estimate the overall costs of the 9/11 attacks to between \$80 and \$90 billion or around 0.9 % of GDP (Sandler and Enders, 2005). On the other hand, in extreme, Navarro and Spencer (2001) estimate costs to \$2 trillion or around 20 % of GDP for the 10 years period. For example, only psychological cost is estimated to be at least \$100 billion.

¹⁵ In contrast with the empirical studies, the potential long-term costs of terrorist threats to national economies could be also larger and more persistence. Two studies use CGE modeling to assess global effects of the 9/11 attacks on the world economy. However, initial assumptions of these studies are unrealistic and inconsistent with empirical results. Penm et al. (2004) assume that the total factor productivity in the world economy has been 0.5 % lower over the next five years (Namely, OECD (2002) estimated that if military and security spending are increased by around 1.5 % of GDP over the medium term, than the level of labor productivity in the USA would be lower by around 0.5 %). The simulation results suggest that the world economy would be around 0.7 % lower after 5 years. Economic activity (measured by GDP) in the USA would be around 0.6 % lower, in Japan 0.4 % and in the European Union 0.5 %. The effect on developing countries would be much larger due to of their heavy reliance on both exports and foreign direct investment. For the ASEAN region and East Asia, economic activity would be around 1.4 % and 1.1 % lower. Another study, McKibbin and Stoeckel (2001) assumed that permanent threat of terrorism caused a worldwide increase of equity risk by 5 percentage points. The risk premium reappraisal returns to normal after 5 years (it declined by 1 percentage point per year). The results show that the real GDP does not fully recover in the US, Japan and the rest of the OECD until 10 years later. Full recovery in Asia and Australia, does not occur until 15 years later. McKibbin and Stoeckel also simulate a scenario where terrorism causes both a permanent 0.3 % decline in total factor productivity

percentage points annually and could have more persistent effect lasting up to 2 years. These estimations are used to quantify the impact on particular countries in Table 3.¹⁶

Table 4 displays the data corresponding to previous discussion. We estimate the potential magnitude of the impact on economic activity for the EU-27 countries and the USA on the basis of their level of political and economic development, size and degree of diversification of economy. For Germany, the U.K., France, Italy and the USA, we could expect that the attack would have the least impact on the economic activity. On the other hand, those countries (and also Spain, Netherlands and Belgium) have also the highest risk of terrorism or political violence, and thereby the highest probability of MANPADS attacks. However, for the USA, we could also expect the stronger and more persistent effect since the probability of reprisal attack on source country is very high. The smaller, poorer and specialized countries, such as Bulgaria, Lithuania and Latvia, would suffer the greatest impact.

and a 1 percentage points decline per year in global equity risk premium (from 5 %). The combined shocks of a permanent decline in productivity and rise in equity risk are predicted to cause a much stronger decline in real GDP. After five years, USA and Australian real GDP are predicted to fall by around 2 %, Japan's real GDP falls by over 2.75 % and East Asian real GDP falls by 3 %. After 10 years the impact would be larger. USA, Australia and Japan real GDP fall by over 3 %, Other East Asia GDP fall by 5 % and, China and ASEAN-4 are predicted to fall by around 6 %. Consistent with the earlier findings, the results suggest the impacts on East Asian economies would be much stronger.

¹⁶ We use the share of GDP as a proxy for reduced growth.

Table 3: Estimation of the impact on economic activity for 2006

Countries	1 aircraft shot down – single attack (0-0.2 % of GDP; mio EUR)	2 aircrafts shot down – simultaneous attack (0-0.3 % of GDP; mio EUR)	2 aircrafts shot down – serial attacks spread over a few weeks or months (up to 0.8 % of GDP; mio EUR)
GERMANY	0 – 4618	0 – 6927	18473
U.K.	0 – 3813	0 – 5719	15251
FRANCE	0 – 3584	0 – 5376	14336
ITALY	0 – 2951	0 – 4426	11803
SPAIN	0 – 1952	0 – 2929	7809
NETHERLANDS	0 – 1056	0 – 1584	4223
BELGIUM	0 – 628	0 – 942	2513
SWEDEN	0 – 612	0 – 918	2448
POLAND	0 – 543	0 – 815	2172
AUSTRIA	0 – 516	0 – 774	2063
DENMARK	0 – 439	0 – 659	1756
GREECE	0 – 390	0 – 586	1562
IRELAND	0 – 352	0 – 527	1406
FINLAND	0 – 336	0 – 504	1343
PORTUGAL	0 – 310	0 – 466	1242
CZECH REPUBLIC	0 – 226	0 – 339	904
ROMANIA	0 – 194	0 – 291	777
HUNGARY	0 – 180	0 – 270	719
SLOVAKIA	0 – 88	0 – 132	351
LUXEMBOURG	0 – 66	0 – 99	264
SLOVENIA	0 – 59	0 – 89	238
BULGARIA	0 – 50	0 – 75	200
LITHUANIA	0 – 47	0 – 71	190
LATVIA	0 – 32	0 – 48	129
CYPRUS	0 – 29	0 – 43	116
ESTONIA	0 – 26	0 – 39	104
MALTA	0 – 10	0 – 15	41
USA	0 – 21100	0 – 31650	84400

Source: Author, Eurostat

Table 4: Terrorism risk and main criteria for estimation of the magnitude of the impact on economic activity

Countries	Risk of terrorism or political violence (2005)	GDP (2006)	GDP per capita (2006)	Diversification of economy (2003)	Level of democracy (2003)
GERMANY	7.0	2309100	109.2	28.85	10
U.K.	7.5	1906359	114.8	22.02	10
FRANCE	7.5	1791953	109	25.21	9
ITALY	7.0	1475401	100.2	25.32	10
SPAIN	7.5	976189	98.4	20.32	10
NETHERLANDS	7.5	527916	126.1	20.46	10
BELGIUM	7.0	314084	118.1	24.80	10
SWEDEN	6.5	305989	116.2	26.52	10
POLAND	5.5	271530	51.1	29.05	10
AUSTRIA	5.0	257897	124.4	25.13	10
DENMARK	6.5	219544	122	21.70	10
GREECE	6.5	195213	85.4	/	10
IRELAND	5.0	175794	138.8	15.14	10
FINLAND	2.5	167911	113	29.50	10
PORTUGAL	5.5	155216	71.9	24.57	10
CZECH REPUBLIC	5.5	113051	76.1	28.22	10
ROMANIA	5.5	97118	36.4	26.65	8
HUNGARY	5.0	89884	63.1	30.07	10
SLOVAKIA	5.5	43945	60.6	21.12	9
LUXEMBOURG	3.0	33055	268.8	16.96	/
SLOVENIA	5.0	29742	83.8	28.37	10
BULGARIA	5.5	25100	35.8	24.15	9
LITHUANIA	4.5	23746	55.8	21.69	10
LATVIA	4.5	16180	53.9	19.73	8
CYPRUS	/	14522	90	13.48	10
ESTONIA	5.0	13073	64.8	25.80	6
MALTA	4.0	5096	74	28.85	/
USA	7.5	10550016	148.2	/	10

Notes:

- GDP is measured by GDP at market current prices in mio EUR.
- GDP per capita is measured by GDP per capita in PPS (EU25 = 100).
- Diversification of economy is measured by Herfindahl and spread index. The calculations are based on the two-digit NACE (C-K) classification for the value added at factor cost. The higher the index the more diverse the economic structure is.
- The measure of democratic institutions ranges from -10 to +10 (strongly democratic).
- The measure of terrorist and political violence risk ranges from 0 (very low risk) to 10.

Source: Eurostat, MIG, WRI, author's calculations

Table 5: Selected empirical studies, used to estimate the impact of MANPADS terrorist attacks on economic growth

Study	Countries	Time period	Key findings	Relevance to our analysis	Our conclusions and estimates	Level of relevance
Blomberg, Hess, Orphanides (2004)	177 countries	1968-2000	<p>Mixed results. Cross sectional regression:</p> <ul style="list-style-type: none"> - The growth is reduced by 0.047 percentage points annually per attack. <p>Panel regression:</p> <ul style="list-style-type: none"> - For full sample, the growth is reduced by around 0.4 percentage points annually per attack (statistically significant at only 10 % level). The internal and external conflicts in a given year reduce growth by around 1.2 and 3.7 percentage points, respectively. One standard deviation of the incidence of terrorism per capita in a given year (1.2 incidents per-million of population per year) reduces per capita GDP growth by 0.25 percentage points. - For OECD countries, the effect of terrorism, internal and external conflict on growth is 0.18, 0.94 and 0.75 percentage points, respectively, and statistically insignificant. One standard deviation of the incidence of terrorism per capita in a given year reduces per capita GDP growth by 0.5 percentage points. - The rise in the government spending around 0.4 percentage points offsets the decline in the investment around -0.4 percentage points. <p>Structural VAR:</p> <ul style="list-style-type: none"> - For full sample, the effect of terrorism, internal and external conflict on growth is 0.47, 1.26 and 4.31 percentage points, respectively. The effect of terrorism, internal and external conflicts are significant for up to 1, 3 and 6 years. - For OECD countries, the effect of terrorism, internal and external conflict on growth is 0.17, 3.23 and 1.24 percentage points, respectively. The effect of terrorism and external conflicts is statistically insignificant. 	<ul style="list-style-type: none"> - The impact of sporadic terrorist attacks could be appropriate proxy for a single or simultaneous MANPADS attack. - The impact of internal or external conflicts could be appropriate proxy as an upper bound for serial MANPADS attacks. - The study also investigated the impact on OECD countries. 	<ul style="list-style-type: none"> - The impact of a single MANPADS attack may reduce the growth by between 0 and 0.2 percentage points and last up to 1 year. For stronger magnitude of attack such as simultaneous MANPADS attack, we could expect stronger effect by between 0 and 0.3 percentage points in a given year. The attack could have also more persistent effect lasting up to 1.5 years - Serial attacks could reduce the growth by up to 0.8 percentage points annually and could have more persistent effect lasting up to 2 years. - The impact on developed economies could be smaller. - The attack may divert spending from investment to government expenditures. 	4
Tavares (2004)	Large unspecified sample of countries	1987-2001	<ul style="list-style-type: none"> - A terrorist attack reduces per capita GDP growth by 0.029 percentage points in a given year. Terrorism has no longer a significant negative impact on growth by including other determinants of growth. - One standard deviation of the incidence of terrorism per capita reduces GDP growth by 0.2 percentage points. - Terrorist attacks have higher negative impact on non-democratic than democratic countries. 	<ul style="list-style-type: none"> - The impact of sporadic terrorist attacks could be appropriate proxy for a single or simultaneous MANPADS attack. - The study also investigated the impact on democratic countries. 	<ul style="list-style-type: none"> - Single or simultaneous MANPADS attack could have no impact on economic growth. -The impact on more democratic countries could be smaller. - Serial MANPADS attacks could have stronger effect. 	4

(Continued)

Barth et al. (2006)	149 countries	1972-2005	<ul style="list-style-type: none"> - Terrorism has a negative impact on economic growth. However, it is statistically significant at only 10 % level. - For example, the impact of 0.97 terrorist attacks per million of population in Russia (2003) is estimated to reduce GDP per capita growth by 0.08 percentage points. In 2001, terrorist attacks in Israel reduced GDP per capita growth by 4 percentage points. 	<ul style="list-style-type: none"> - The impact of sporadic terrorist attacks could be appropriate proxy for a single or simultaneous MANPADS attack. - The study investigated the impact on countries in Europe and the USA. - The impact of persistent terrorist attacks in Israel could be appropriate proxy for serial MANPADS attacks. 	<ul style="list-style-type: none"> -Single or simultaneous MANPADS attack could have small impact on economic growth. -Serial MANPADS attacks could have stronger effect on economic growth. However, the impact is too strong. 	3
Abadie and Gardeazabal (2002)	Spain, Basque region	1975-1997	<ul style="list-style-type: none"> - GDP per capita declined about 12 % over the period from 1975 to 1983. - GDP per capita was around 10 % lower over the period 1975-1997. 	<ul style="list-style-type: none"> The impact of persistent terrorist attacks could be appropriate proxy for serial MANPADS attacks. 	<ul style="list-style-type: none"> Serial MANPADS attacks could have stronger and more persistent effect on economic growth. 	3
Eckstein and Tsiddon (2003)	Israel	2000-2003	<ul style="list-style-type: none"> GNP per-capita declined over 5 % during the period 2000-2003. 	<ul style="list-style-type: none"> The impact of persistent terrorist attacks could be appropriate proxy for serial MANPADS attacks. 	<ul style="list-style-type: none"> Serial MANPADS attacks could have stronger and more persistent effect on economic growth. 	3
Persitz (2007)	Israel	1994-2003	<ul style="list-style-type: none"> - Terrorism reduced real GDP per-capita by 8.6 % over the period 1994-2003. - GDP per capita declined around 12 % over the period 2000-2003. - Terrorism increased government expenditures and decreased investment. 	<ul style="list-style-type: none"> The impact of persistent terrorist attacks could be appropriate proxy for serial MANPADS attacks. 	<ul style="list-style-type: none"> - The attacks with higher level of magnitude and frequency could have stronger and more persistent effect on economic growth. -Serial MANPADS attacks could cause a reallocation of resources from more productive uses to defense and security. 	3

Note: Levels of relevance of individual studies to our analysis are graded from 1 (lowest relevance) to 5 (very high relevance).

Source: Author

4.1.1. How the shock could spill-over to other countries?

In this chapter we investigate how the (potential) shocks (decreased demand or productivity) could be spilled-over to other countries, and how these shocks could affect economic growth in other countries, if the MANPADS attack would occur in Europe. To answer this question, first we have to assume that the country's vulnerability of output depends on the shocks which could be spilled-over only through trade channel. Namely, several authors note that closer trade links allow shocks to more easily spread across the trading partners, and lead to more correlated business cycles. They also mention that policy shocks will become more correlated. Therefore, increased trade could lead to business cycle synchronization or, equivalently, increase the symmetry of shocks. If countries would be more affected by symmetric shocks (through trade channel) then also their correlation of outputs would be more symmetric.¹⁷

Furthermore, on the basis of the studied literature, more diversified countries and countries with similar production structures would also be more affected by symmetric shocks and thereby, their correlation of outputs would be more symmetric. The same is valid also for trade indicators, since the structure of trade and the openness to trade can be also seen as a proxy for the output structure of a country and the openness of economy (excepting USA and some transition countries).

However, Živkovič (2006) finds that increased intra-industry trade and decreased level of diversification of trade (smaller effect) actually induce higher business cycle correlation among developed countries, while for transition countries increased inter-industry trade, trade intensity (openness to trade) and diversified trade are the main determinants of the synchronicity of the business cycles correlation between them and developed countries.¹⁸

For these reasons, we estimate the magnitude of spill-over effect for industrial countries on the basis of their degree of business cycles correlation with the EMU countries since the shocks could be also transmitted through other channels, and the level of intra-industry trade intensity between them and the EMU.¹⁹ For transition countries, we estimate it on the basis of the degree of business cycles correlation, inter-industry trade intensity, trade intensity and diversified trade intensity.²⁰

Table 6 shows that Germany, France and the U.K. would suffer the greatest spill-over effects among industrial countries. However, since those countries have large, diverse and developed economy, the effect would be smaller (see Table 4). Transition countries like Hungary, the Czech Republic and Slovenia could be the most affected countries.

¹⁷ Studies usually use correlation of real GDP growth as a measure for business cycles (or shocks) symmetry across countries. Industrial production, employment or unemployment could also be used. However, the results should be interpreted with caution, since such an approach does not distinguish between the shocks themselves and the reactions to them.

¹⁸ Business cycles synchronization is measured by correlation of real GDP growth.

¹⁹ We assume that the attack would occur in the EMU.

²⁰ The intra-industry trade could have also positive effect on business cycles correlation, but the inter-industry trade is more important in explaining business cycles synchronization.

Table 6: Business cycle correlation, trade intensity, inter-industry trade, intra-industry trade and diversification of trade of selected countries with the EMU for a period 1995-2004 – Estimation of the magnitude of spill-over effect for selected countries

Developed countries	Business cycle correlation (GDP)	Intra-industry trade	Diversification of trade
GERMANY	0.60	-4.3	27.61
SPAIN	0.53	-5.30	25.15
GREECE	-0.16	-7.57	32.05
ITALY	0.53	-5.06	36.84
NETHERLANDS	0.59	-5.11	32.56
PORTUGAL	0.43	-6.32	28.20
FINLAND	0.45	-7.09	15.59
IRELAND	0.52	-6.92	16.39
FRANCE	0.63	-4.64	27.89
BELGIUM	0.55	-5.27	24.91
AUSTRIA	0.56	-5.84	30.67
DENMARK	0.48	-6.08	36.31
U.K.	0.55	-4.67	26.19
SWEDEN	0.55	-5.75	28.36
NORVAY	0.26	-7.27	13.01
USA	0.42	-6.03	24.90

Transition countries	Business cycle correlation (GDP) (1999-2004)	Trade intensity (openness to trade)	Inter-industry trade	Intra-industry trade	Diversification of trade
SLOVENIA	0.53	-6.50	-6.97	-7.73	28.09
SLOVAKIA	-0.60	-6.22	-6.61	-7.55	18.55
POLAND	0.34	-5.08	-5.48	-6.34	29.49
LITHUANIA	-0.52	-7.27	-7.56	-9.05	25.57
LATVIA	-0.05	-7.86	-7.96	-10.30	28.43
HUNGARY	0.76	-5.26	-5.80	-6.29	19.30
ESTONIA	0.29	-7.66	-7.86	-9.60	26.64
CZECH REPUBLIC	0.42	-5.36	-6.03	-6.33	27.15

Source: Živković (2006)

4.2. Impact on foreign direct investment

Terrorist attacks and especially increased uncertainty could have a dampening effect on long-term investment and may have a large impact on the re-allocation of capital. Furthermore, terrorism also reduces the expected return to investment due to a higher risk premium. For this reason, international investors have to re-diversify their investment which may cause a large capital outflow from affected countries. As FDI is an important source of savings and investment, the effects on growth would be much stronger in developing countries due to their higher dependence on FDI (McKibbin and Stoeckel, 2001; Australian Government, 2004; Sandler and Enders, 2005). Moreover, decreased FDI could also reduce the transfer of technological spillovers in these countries (Frey et al., 2004; Abadie and Gardeazabal, 2005). In Europe, Netherlands, Belgium, Ireland, Luxembourg, Estonia and Malta could suffer the greatest impact since their economies have the highest degree of openness to FDI (see Table 7). On the other hand, FDI flows could also indirectly reduce the effect of terrorist attacks by their positive impact on economic development (Li and Schaub, 2004). Moreover, terrorist attacks could also have a positive impact on FDI due to a substitution effect between FDI and an increased cost of trade (Cosgrove, 2003).

However, the behavior of long-term investors does not depend only on increased uncertainty from terrorist attacks (as may be valid for portfolio investors), but also on many other factors, including conventional wisdom, prior experience, corporate and government relationships and “a long time horizon” (ex ante and ex post risk-adjusted) (Wagner, 2006; Li, 2006). The latter is particularly important as badly anticipated terrorism risk could enhance the negative effects on FDI flows. These characteristics could make FDI less vulnerable to sporadic terrorist attacks (Li, 2006). Related to this, some earlier studies concluded that political and terrorist risk are the most important factors which drive investors’ decisions (Wagner, 2006; Li, 2006). Furthermore, the effect of political instability on FDI stocks or flows is particularly found by earlier empirical evidence (Schneider and Frey, 1985; Nigh, 1985; Woodward and Rolfe, 1993; Loree and Guisinger, 1995).²¹ However, recent studies do not confirm previous results. According to A.T. Kearney (2004), only 26 % of global investors (among the world’s 1000 largest corporations) indicated that terrorism has influence on their investment decision.²² Furthermore, Li and Resnick (2003) do not find any relationship between political instability and FDI inflows for a sample of 53 developing countries for the period 1982-1995. Another recent study by Sethi et al. (2003) also does not find that political (and economic) instability has negative effect on USA FDI flows to 28 countries from 1981 to 2000. On the other hand, Globerman and Shapiro (2002) find that political instability and violence (including terrorism) reduce USA FDI flows to 143 countries from 1994 to 1997. However, the probability that a country will receive USA FDI does not depend on increased political instability and violence.

²¹ See Li (2006).

²² Terrorism is ranked at seventh place out of 15 FDI decisions.

Table 7: Degree of openness to FDI of European countries and the USA

Countries	FDI stock – mio USD (2005)	FDI stock / GDP (2005)
GERMANY	502790	0.18
U.K.	816716	0.37
FRANCE	600821	0.28
ITALY	219868	0.12
SPAIN	367656	0.33
NETHERLANDS	463416	0.74
BELGIUM	492330	1.33
SWEDEN	171517	0.48
POLAND	93329	0.32
AUSTRIA	61344	0.20
DENMARK	101568	0.39
GREECE	29312	0.13
IRELAND	211190	1.05
FINLAND	52821	0.27
PORTUGAL	64517	0.35
CZECH REPUBLIC	59459	0.49
ROMANIA	23818	0.24
HUNGARY	61221	0.56
SLOVAKIA	15324	0.33
LUXEMBOURG	69383	1.90
SLOVENIA	8064	0.24
BULGARIA	9173	0.35
LITHUANIA	6461	0.26
LATVIA	4783	0.31
CYPRUS	8768	0.52
ESTONIA	12274	0.96
MALTA	4195	0.75
USA	1625749	0.13

Source: UNCTAD

Only a few studies have considered the effect of sporadic terrorist attacks on FDI. Li (2006) estimates the impact of terrorist attacks on FDI inflows and the amount of FDI for a sample of 129 countries from 1976 to 1996. Terrorism is measured by a number of terrorist attacks. He finds that terrorism has no negative impact on FDI flows or on FDI stocks. He also finds that anticipated terrorist incidents have no effect on ex post investment decision over destination or the amount of FDI. Moreover, unanticipated terrorist incidents also do not affect FDI inflows or the amount of FDI.

Another study by Abadie and Gardeazabal (2005) examine the impact of sporadic terrorism on FDI stocks in the year 2003 for 196 countries and territories. Contrary to Li (2006), they find a negative relationship between terrorism and FDI stocks. Furthermore, the effect of terrorist risk is quite large. A standard deviation of terrorist risk (around the difference in terrorist risk between Italy and the USA) reduces net FDI stocks of about 5 % of GDP. However, an important difference between Li (2006) and their study is that the latter authors use the terrorist risk index as a measure for terrorism.²³ On the other hand, the measure for anticipated terrorist incidents using by Li could not be quite differentiated from the terrorist risk index. Another reason could be also that the post-period of the 9/11 attacks have made FDI more vulnerable to terrorism.

The next study examines the effect of persistent terrorism on FDI flows in two European countries. Enders and Sandler (1996)²⁴ estimate the impact of terrorism on Spain and Greece during the 1968-91 when both countries were affected by persistent terrorism. Again, the effect of terrorism is not insubstantial. For Spain, they find that terrorism reduced FDI stock by on average 13.5 % annually for the period 1975–1991. For Greece, the results are similar. For the period 1976-1991, they find that terrorism reduced annual net FDI of 11.9 % on average. The results show that persistent terrorist attacks could have a greater adverse impact on FDI than sporadic terrorist attacks.²⁵

Studies also address the problem of reverse causality when FDI flows have a negative effect on terrorism. Li and Schaub (2004) investigate the effects of economic globalization on the number of transnational terrorist incidents for a sample of 112 countries from 1975 to 1997. They find that the level of development (measured by GDP per capita) in countries decreases the number of transnational terrorist incidents; a 1 % increase in the GDP per capita of a country decreases the expected number of transnational terrorist incident by 19.3 %. Furthermore, they also find that FDI (and also trade) has a positive effect on economic development. They conclude that FDI does not have a direct negative effect on transnational terrorism, but only an indirect negative effect by promoting economic development in countries. Furthermore, the effect of terrorist attacks on developed countries could be also less intensive (Blomberg, Hess, Orphanides, 2004).

In the end, the effect of sporadic terrorist attacks on FDI is hard to estimate correctly. While Li (2006) finds no impact of terrorism on FDI, Abadie and Gardeazabal (2005) find FDI stocks to be quite largely affected by terrorist incidents. Furthermore, the results of the effect of political instability on FDI flows are also inconsistent across empirical studies. Meanwhile, FDI flows could indirectly reduce the possibility and also the effect of terrorist attacks by their impact on economic development. For these reasons, we estimate that the impact of a single or simultaneous MANPADS attack in Europe may reduce FDI stocks by between 0 % and 5 %. On the other hand, the impact of terrorism certainly depends on the kinds of terrorist threat. Therefore, the terrorist attacks may have a significant negative effect on FDI flows in economies which would be subject to persistent terrorism for longer periods of time. In this case, it is estimated that FDI stocks could be reduced by between 0 % and 10 %. On the basis of these estimations, Table 8 quantifies the impact on particular countries.

²³ For this reason, the result of A.T Kearney's (2004) survey study is also questionable.

²⁴ See Sandler and Enders (2005), Frey et al. (2004), Barth et al. (2006), Abadie and Gardeazabal (2005).

²⁵ Meanwhile, for France, Germany and Italy, terrorism had no effect on FDI flows (Frey et al., 2004).

Table 8: Estimation of the impact on FDI for 2005

Countries	1 aircraft shot down – single attack	2 aircrafts shot down – simultaneous attack	2 aircrafts shot down – serial attacks spread over a few weeks or months
	(FDI decline 0-5 %; mio USD)	(FDI decline 0-5 %; mio USD)	(FDI decline 0-10 %; mio USD)
GERMANY	0 – 25139	0 – 25139	0 – 50279
U.K.	0 – 40836	0 – 40836	0 – 81672
FRANCE	0 – 30041	0 – 30041	0 – 60082
ITALY	0 – 10993	0 – 10993	0 – 21987
SPAIN	0 – 18383	0 – 18383	0 – 36766
NETHERLANDS	0 – 23171	0 – 23171	0 – 46342
BELGIUM	0 – 24616	0 – 24616	0 – 49233
SWEDEN	0 – 8576	0 – 8576	0 – 17152
POLAND	0 – 4666	0 – 4666	0 – 9333
AUSTRIA	0 – 3067	0 – 3067	0 – 6134
DENMARK	0 – 5078	0 – 5078	0 – 10157
GREECE	0 – 1466	0 – 1466	0 – 2931
IRELAND	0 – 10559	0 – 10559	0 – 21119
FINLAND	0 – 2641	0 – 2641	0 – 5282
PORTUGAL	0 – 3226	0 – 3226	0 – 6452
CZECH REPUBLIC	0 – 2973	0 – 2973	0 – 5946
ROMANIA	0 – 1191	0 – 1191	0 – 2382
HUNGARY	0 – 3061	0 – 3061	0 – 6122
SLOVAKIA	0 – 766	0 – 766	0 – 1532
LUXEMBOURG	0 – 3469	0 – 3469	0 – 6938
SLOVENIA	0 – 403	0 – 403	0 – 806
BULGARIA	0 – 459	0 – 459	0 – 917
LITHUANIA	0 – 323	0 – 323	0 – 646
LATVIA	0 – 239	0 – 239	0 – 478
CYPRUS	0 – 438	0 – 438	0 – 877
ESTONIA	0 – 614	0 – 614	0 – 1227
MALTA	0 – 210	0 – 210	0 – 419
USA	0 – 81287	0 – 81287	0 – 162575

Source: Author, UNCTAD

Table 9: Selected empirical studies, used to estimate the impact of MANPADS terrorist attacks on foreign direct investment

Study	Countries	Time period	Key findings	Relevance to our analysis	Our conclusions and estimates	Level of relevance
Li (2006)	129	1976- 1996	<ul style="list-style-type: none"> - Terrorism has no negative impact on FDI flows, or on the amount of FDI. - Anticipated or unanticipated terrorist incidents have no effect on FDI flows, or on the amount of FDI. 	<ul style="list-style-type: none"> - The impact of sporadic terrorist attacks could be appropriate proxy for a single or simultaneous MANPADS attack. - The study investigated the impact on countries in Europe and the USA. 	Single or simultaneous MANPADS attack could have no impact on FDI.	4
Abadie and Gardeazabal (2005)	196	2003	A standard deviation of terrorist risk reduces net FDI stocks of about 5 % of GDP.	<ul style="list-style-type: none"> - The impact of sporadic terrorist attacks could be appropriate proxy for a single or simultaneous MANPADS attack. - The study also investigated the impact on countries in Europe and the USA. 	<ul style="list-style-type: none"> - Single or simultaneous MANPADS attack could reduce net FDI stocks by around 5 % of GDP annually. However, for the countries with a smaller share of FDI stock in GDP, the impact is too strong. - Serial MANPADS attacks could have stronger effect. 	4
Enders and Sandler (1996)	Spain, Greece	1968-1991	<ul style="list-style-type: none"> - Terrorism in Spain reduced FDI stock by on average 13.5 % annually for the period 1975–1991. - Terrorism in Greece reduced FDI stock by on average 11.9 % annually for the period 1975–1991. - Terrorism not affected FDI flows in France, Germany and Italy. 	<ul style="list-style-type: none"> - The impact of persistent terrorist attacks could be appropriate proxy for serial MANPADS attacks. - The study investigated the impact on countries in Europe. 	Serial MANPADS attacks could have stronger and more persistent effect on FDI flows, especially in smaller countries. It could reduce FDI flows by around 10 % annually.	4
Li and Resnick (2003)	53 developing countries	1982-1995	Political instability has no impact on FDI inflows.	The impact of political instability could be appropriate proxy as an upper bound for serial MANPADS attacks.	Serial MANPADS attacks could have no effect on FDI flows.	3
Li and Schaub (2004)	112	1975-1997	<ul style="list-style-type: none"> - A 1 % increase in the GDP per capita of a country decreases the expected number of transnational terrorist incident by 19.3 %. - FDI has a positive effect on economic development. 	FDI flows could indirect reduce the terrorist risk and also the effect of terrorist attacks by their impact on economic development.	MANPADS attack could have smaller effect on countries with a large stock of FDI.	4

Note: levels of relevance of individual studies to our analysis are graded from 1 (lowest relevance) to 5 (very high relevance).

Source: Author

4.3. Impact on trade

One major impact of terrorist attacks on trade flows is through an increase in trading costs due to higher insurance costs, counter terrorist policy and increased insecurity. Tighter security and customs control increase the transport costs, especially when a time is an important factor. For instance, Hummels (2001) estimates the daily cost in shipping time to 0.5 % ad-valorem on average. The costs for time sensitive products such as fresh products or products that relied on just-in-time manufacturing processes are certainly higher (Mirza and Verdier, 2006b; Walkenhorst and Dihel, 2002). Furthermore, an increased transport and insurance costs could have stronger effect on commodities with a high ratio of weight and volume relative to their value (Walkenhorst and Dihel, 2002). Finally, the effect could be much stronger in the developing countries due to their heavy reliance on trade (Walkenhorst and Dihel, 2002; Penm et al., 2004; McKibbin and Stoeckel, 2001). In Europe, we could expect the strongest impact on the economies with the highest openness ratio, such as Netherlands, Belgium, the Czech Republic, Hungary, Slovakia, Luxembourg, Slovenia, Estonia and Malta (see Table 10).

The effect of increased transport costs on trade could be quite large. Limao and Venables (1999) estimate an elasticity of trade flows with respect to transport costs of about -2.5, which means that an increase in transport costs of 1 % lead to a decline in trade flows of 2.5 %. Another study, Walkenhorst and Dihel (2002), estimates the global welfare losses to about \$75 billion resulting from a 1 % ad-valorem increase in trading costs.

Transaction costs could be also affected by an increase in uncertainty. The risk of a loss of traded goods affects the willingness to trade with countries affected by terrorism. Furthermore, increased uncertainty in investment returns and transactions could lead to reductions in investment and demand. Such reductions could have an additional effect on trade flows.

By the increased government spending on security, international trade flows could be negatively affected through income channel (Mirza and Verdier, 2006a). Namely, increased expenditures on security could divert labor and capital resources away from more productive uses. This could have a negative effect on investment and productivity, and thereby on trade and growth. The magnitude of this effect on trade depends on the growth impact of security spending and on the relationship between income effect and trade. We have already found out that the impact on growth depends on many factors such as kinds of terrorist threats, level of political and economical development, size of economy and degree of diversification (Blomberg, Hess, Orphanides, 2004; Tavares, 2004; Abadie and Gardeazabal, 2002; Eckstein and Tsiddon, 2003; Persitz, 2007; Sandler and Enders, 2005; Penm et al., 2004; McKibbin and Stoeckel, 2001; Walkenhorst and Dihel, 2002).

Another channel, through which increased security spending could affect trade are security restrictions on the international mobility of business people such as lower issuing of visas and tighter visa controls at the borders (Mirza and Verdier, 2006b; OECD, 2002). For this reason, time sensitive and network-based products could be much more affected.²⁶

²⁶ Products could be classified into products in organized exchange, referenced prices products and differentiated or network-based products (Mirza and Verdier, 2006b).

Table 10: Degree of openness to trade of European countries and the USA

Countries	Total trade – mio EUR (2004)	Total trade / GDP (2004)
GERMANY	1306880	0.58
U.K.	657710	0.36
FRANCE	742060	0.43
ITALY	570040	0.40
SPAIN	354490	0.39
NETHERLANDS	544330	1.08
BELGIUM	476320	1.60
SWEDEN	179840	0.63
POLAND	132440	0.54
AUSTRIA	191550	0.78
DENMARK	116760	0.56
GREECE	54720	0.30
IRELAND	133930	0.83
FINLAND	90820	0.58
PORTUGAL	72940	0.49
CZECH REPUBLIC	111710	1.12
ROMANIA	45210	0.57
HUNGARY	93340	1.05
SLOVAKIA	46140	1.21
LUXEMBOURG	29180	0.99
SLOVENIA	27430	0.99
BULGARIA	19600	0.90
LITHUANIA	17440	0.85
LATVIA	8920	0.69
CYPRUS	5180	0.38
ESTONIA	11470	1.04
MALTA	4950	1.04
USA	1955740	0.20

Source: Eurostat

On the other hand, the reverse causality is also possible; trade could also affect the government spending (Mirza and Verdier, 2006a). There could be a trade-off effect between security or cost of cross-border transactions and trade intensity (OECD, 2002). This is due to the reason that the higher security spending (or restrictions) could negatively affect the benefits from trade. For instance, an important trading partner could reduce security spending in a country affected by terrorism (Mirza and Verdier, 2006b). Therefore, the relationship between terrorism and trade could be also positive; higher trade intensity could reduce security spending which in turn increases terrorism.

By the increases in transport and insurance costs, terrorist incidents could have also an adverse effect on globalization process. On the other hand, the reverse impact is also possible; globalization

could reduce terrorist attacks and also their effects by promoting economic development in countries (Li and Schaub, 2004; Blomberg, Hess, Orphanides; 2004). However, the effect of globalization on terrorism is ambiguous since economic development could also increase terrorism in targeted countries (Blomberg and Hess, 2005). In contrast, in source richer countries, it could decrease terrorism (Blomberg and Hess, 2005; Li and Schaub, 2004).²⁷ Moreover, this could imply that richer host countries as well as poorer source countries are more strongly affected by terrorism. Therefore, larger differences in economic development could also lead to increased terrorism.

Nitsch and Schumacher (2004) study is the first one to assess the impact of terrorism on bilateral trade flows. Using an annual data covering 217 countries from 1968 to 1979, they find that terrorist attacks have a large effect on trade: a 100 % increase in the number of terrorist incidents in a year reduces bilateral trade by about 4 % in the same year. Furthermore, they also find that the first terrorist attack in a one trading partner is associated with a decrease in bilateral trade by almost 10 %.

However, an important problem with these results is the fact that the historical data may not adequately represent the effect of present-day terrorism. For this reason, Nitsch (2006) explores a new data set between more than 180 countries over the period from 1968 to 2003. The results seem to suggest that the effect on trade is less significant. He finds that a terrorist incident with injuries in a year is associated with a decrease in bilateral trade by about 2 % in the same year. Interestingly, for overall terrorist incidents and terrorist incidents with fatalities, he does not find any effect on trade (in contrast to Nitsch and Schumacher, 2004). More interestingly, he also finds that terrorism reduces only exports by between 4 % and 9 % while imports tend to be increased, probably as a result of higher inventory holdings. Furthermore, he also finds that the effect of a terrorist attack on trade (or exports) is dissipated after two years. For more violent and frequent attacks, it could be larger and more persistent. On the other hand, the effect of increased imports seems to be temporary.

Fратиanni and Kang (2006) criticize Nitsch and Schumacher (2004) in pointing that their result could be sample specific. They apply a more recent time period from 1980 to 1999 and find that terrorism has not effect on trade. On the other hand, they find that the impact of terrorism on trade depends on distance and common land borders between trading partners. These combined factors reduce potential impact: as distance increases between trading partners, the effect of terrorism declines, most notably due to a smaller substitution effect. But the effect is very strong. For example, trading partners sharing a common land border and suffering from terrorism trade 62 % less than other neighbor countries which are not affected by terrorism. If only one country is affected by terrorism than trade declines by 41 %. On average, terrorism reduces trade by 25 % if both countries are affected by terrorism and by 32 % if only one country is affected by terrorism. Furthermore, these effects could be much higher for small and open economies due to a trade-off effect which could occur between security and trade.

Blomberg and Hess (2004) also investigate the impact of terrorism on bilateral trade for a sample of 177 countries in the period 1968-1999. It seems that they find a greater impact than Nitsch and Schumacher (2004) and Nitsch (2006); a terrorist attack reduces bilateral trade by between 8 and

²⁷ However, Li and Schaub (2004) find that economic development reduces terrorism for entire sample of countries; they do not separate the host and the source countries.

10 percentage points in a given year. Furthermore, the impact of internal conflict and revolution on trade is much stronger. It is estimated at around 18 and 21 (up to 30) percentage points, respectively. The authors also split the sample in 1983 and find that the impact on trade is 4 times larger for the second half of the sample. For this reason, the critic of Fratianni and Kang (2006) becomes questionable. However, they also find that the impact on high income countries is less intensive. In the end, they also estimate that the tariff equivalent cost of terrorism is between 1 % and 3 %. Interestingly, if we assume an elasticity of trade flows with respect to transport costs of about -2.5, as estimated by Limao and Venables (1999), and the higher bound of tariff costs (3 %), than the result is approximately equal to that of Blomberg and Hess (2004).

Mirza and Verdier (2006b) investigate interaction between terrorism, government spending and trade in the case of USA imports. They find that frequency of terrorist attacks reduces trade, but the effect seems to be small; a 1 % increase in the number of terrorist attacks from a source country, decreases their exports to the USA by 0.01 %. This may imply that a doubling (100 % increase) the number of terrorist attacks reduces exports by 1 %. They also find that for countries which are related to more violent and frequent attacks (such as Columbia, Pakistan and Saudi Arabia), the effect could be larger, by between 0.5 % and 1 %. Furthermore, they also find that the impact on USA imports could be stronger (more than double) in the case when the trading partner is small in size of GDP. Therefore, there could be another case of a trade-off effect between security and trade. Finally, they also find that the time sensitive and network-based products are much more affected by terrorism incidents and security restrictions at the borders. The latter is related to the lower number of issuing business-type visas.

To sum up the empirical results, it seems that the impact of terrorist attacks on trade could be significant and also long-lived, especially in the small and open economies due to their heavy dependence on trade and the higher impacts of security restrictions. Furthermore, the effect on exports could be much stronger than on imports. And finally, the time sensitive and network-based products could be much more affected.

The economic consequences also imply that terrorist attacks could divert trade from close to distant partners, and/or from international trade to home trade, and/or towards countries with smaller border restrictions (or which are not affected by terrorism).

And finally, the results also suggest that a trade-off between security spending and an important trading partner is also possible. More important trading partners are likely to limit security restrictions.

On the basis of the previous empirical results, we estimate that the impact of a single or simultaneous MANPADS attack could reduce trade flows by between 2 % and 12 % and last up to 2.5 years. For a serial MANPADS attacks, the impact is estimated to reduce trade flows by between 8 % and 20 %. We could also expect much longer temporal effect lasting up to 3 years. Table 11 quantifies the impact on particular countries.

Table 11: Estimation of the impact on trade for 2004

Countries	1 aircraft shot down – single attack	2 aircrafts shot down – simultaneous attack	2 aircrafts shot down – serial attacks spread over a few weeks or months
	(Trade decline 2-10 %; mio EUR)	(Trade decline 3-12 %; mio EUR)	(Trade decline 8-20 %; mio EUR)
GERMANY	26138 – 130688	39206 – 156826	104550 – 261376
U.K.	13154 – 65771	19731 – 78925	52617 – 131542
FRANCE	14841 – 74206	22262 – 89047	59365 – 148412
ITALY	11401 – 57004	17101 – 68405	45603 – 114008
SPAIN	7090 – 35449	10635 – 42539	28359 – 70898
NETHERLANDS	10887 – 54433	16330 – 65320	43546 – 108866
BELGIUM	9526 – 47632	14290 – 57158	38106 – 95264
SWEDEN	3597 – 17984	5395 – 21581	14387 – 35968
POLAND	2649 – 13244	3973 – 15893	10595 – 26488
AUSTRIA	3831 – 19155	5746 – 22986	15324 – 38310
DENMARK	2335 – 11676	3503 – 14011	9341 – 23352
GREECE	1094 – 5472	1642 – 6566	4378 – 10944
IRELAND	2679 – 13393	4018 – 16072	10714 – 26786
FINLAND	1816 – 9082	2725 – 10898	7266 – 18164
PORTUGAL	1459 – 7294	2188 – 8753	5835 – 14588
CZECH REPUBLIC	2234 – 11171	3351 – 13405	8937 – 22342
ROMANIA	904 – 4521	1356 – 5425	3617 – 9042
HUNGARY	1867 – 9334	2800 – 11201	7467 – 18668
SLOVAKIA	923 – 4614	1384 – 5537	3691 – 9228
LUXEMBOURG	584 – 2918	875 – 3502	2334 – 5836
SLOVENIA	549 – 2743	823 – 3292	2194 – 5486
BULGARIA	392 – 1960	588 – 2352	1568 – 3920
LITHUANIA	349 – 1744	523 – 2093	1395 – 3488
LATVIA	178 – 892	268 – 1070	714 – 1784
CYPRUS	104 – 518	155 – 622	414 – 1036
ESTONIA	229 – 1147	344 – 1376	918 – 2294
MALTA	99 – 495	148 – 594	396 – 990
USA	39115 – 195574	58672 – 234689	156459 – 391148

Source: Author, Eurostat

Table 12: Selected empirical studies, used to estimate the impact of MANPADS terrorist attacks on trade

Study	Countries	Time period	Key findings	Relevance to our analysis	Our conclusions and estimates	Level of relevance
Nitsch and Schumacher (2004)	217	1968-1979	<ul style="list-style-type: none"> - A 100 % increase in the number of terrorist incidents in a year reduces bilateral trade by about 4 % in the same year. - First terrorist attack in a one trading partner is associated with a decrease in bilateral trade by almost 10 %. 	<ul style="list-style-type: none"> - The impact of sporadic terrorist attacks could be appropriate proxy for a single or simultaneous MANPADS attack. - The study also investigated the impact on countries in Europe and the USA. 	<ul style="list-style-type: none"> - Single or simultaneous MANPADS attack could reduce FDI flows by between 4 and 14 % annually. - Serial MANPADS attacks could have stronger effect. 	4
Nitsch (2006)	180	1968-2003	<ul style="list-style-type: none"> - A terrorist incident with injuries reduces bilateral trade by about 2 % in the same year. - Terrorism reduces only exports by between 4 % and 9 %. The effect on imports could be positive. - The effect is dissipated after two years. - For more violent and frequent attacks, the effect could be larger and more persistent. 	<ul style="list-style-type: none"> - The impact of sporadic terrorist attacks could be appropriate proxy for a single or simultaneous MANPADS attack. - The study also investigated the impact on countries in Europe and the USA. 	<ul style="list-style-type: none"> - Single MANPADS attack could reduce FDI flows by between 2 and 9 % annually. - The impact on exports could be stronger. - The effect could last 2 years. - Simultaneous or serial MANPADS attacks could have larger and more persistent effect. 	4
Fratianni and Kang (2006)	Large unspecified sample of countries	1980-1999	<ul style="list-style-type: none"> - Terrorism reduces trade by 25 % if both countries are affected by terrorism and by 32 % if only one country is affected by terrorism. - Trading partners sharing a common land border and suffering from terrorism trade 62 % less than other neighbor countries which are not affected by terrorism. If only one country is affected by terrorism than trade declines by 41 %. - The effect of terrorism declines as distance increases between trading partners. - The effect could be stronger for small and open economies. 	<ul style="list-style-type: none"> - The impact of sporadic terrorist attacks could be appropriate proxy for a single or simultaneous MANPADS attack. - The study also investigated the impact on countries in Europe and the USA. 	<ul style="list-style-type: none"> - Single or simultaneous MANPADS attack could have a huge effect on trade. However, the impact is too strong. - The attack could have stronger effect on trade between neighbor countries. - The impact on small and open economies could be stronger. - The attack could divert trade from close to distant partners, and/or from international trade to home trade, and/or towards countries which are not affected by terrorism. 	3

(Continued)

Blomberg and Hess (2004)	177	1968-1999	<ul style="list-style-type: none"> - A terrorist attack reduces bilateral trade by between 8 and 10 percentage points in a given year. - Internal conflict and revolution reduces trade by around 18 and 21 (up to 30) percentage points, respectively. - The impact on high income countries is less intensive. 	<ul style="list-style-type: none"> - The impact of sporadic terrorist attacks could be appropriate proxy for a single or simultaneous MANPADS attack. - The impact of internal conflicts or revolution could be appropriate proxy as an upper bound for serial MANPADS attacks. - The study also investigated the impact on countries in Europe and the USA. 	<ul style="list-style-type: none"> - Single MANPADS attack could reduce FDI flows by between 8 and 10 % annually. - Simultaneous and especially serial MANPADS attacks could have stronger effect. - The impact on high income countries could be less intensive. 	4
Mirza and Verdier (2006)	USA imports	1968-2002	<ul style="list-style-type: none"> - A 1 % increase in the number of terrorist attacks from a source country decreases their exports to the USA by 0.01 %. - For countries which are related to more violent and frequent attacks, the effect could be larger. - The effect on small countries is stronger. - Time sensitive and network-based products are much more affected by terrorism incidents and security restrictions at the borders. 	The impact of sporadic terrorist attacks could be appropriate proxy for a single or simultaneous MANPADS attack.	<ul style="list-style-type: none"> - The impact of MANPADS attack on time sensitive and network-based products could be stronger. - The impact on small countries could be stronger. - The effect is too modest. 	2

Note: levels of relevance of individual studies to our analysis are graded from 1 (lowest relevance) to 5 (very high relevance).

Source: Author

4.4. Impact on tourism

By the impact on consumer confidence, the terrorist attack and increased threat of terrorism would result in lower spending, notably on tourism and related industries such as airlines, hotels and restaurants. Region, economies and especially developing countries where tourism is an important economic sector would suffer the greatest impact on economic activity. For example, it is estimated that the bombings in Bali reduced tourism revenues in 2003 by \$1 billion and it may have reduced Indonesian GDP by up to 0.56 % (Australian Government, 2004; Hodgson, 2004). This is approximately 20 % in lost tourism revenues, if we estimate Indonesian tourism revenues in 2003 at around \$4 billion (UNESCAP, 2005). In Europe, we could also expect the greatest impact on developing countries, such as Hungary, Bulgaria, Lithuania, Latvia, Cyprus, Estonia and Malta (see Table 13). However, the effect on countries which are heavy dependent on tourism could be also smaller, due to a smaller substitution effect for attractive tourist destinations (Neumayer, 2004).

The main consequences of the economic impact on tourism could be a substitution effect and contagion effect. The substitution effect may affect tourism sector in many different ways: first, people could substitute affected country to safer tourist destination (Drakos and Kutan; 2001; Frey et al. 2004; Sandler and Enders, 2005; Neumayer, 2004). Second, they could also substitute spending on tourism to other services and goods (Rand, 2007). And finally, the economic consequences of terrorism threat are likely to increase the home bias of international travel which means that people substitute foreign destinations to domestic destinations (Bonham et al., 2006). Furthermore, a large decline in tourist arrivals to the neighboring countries or complete region could reflect a spillover, or contagion (or negative externality), effects (Drakos and Kutan; 2001; Frey et al. 2004; Neumayer, 2004; Sandler and Enders, 2005; Barth et al., 2006).

Some studies also investigate the problem of reverse causality that terrorism could be a result of increased tourism development (Frey et al., 2004). However, Enders and Sandler's (1991)²⁸ empirical results do not support this theoretical argument.

²⁸ See Frey et al. (2004).

Table 13: Tourist arrivals to GDP ratio of European countries and the USA

Countries	Tourist arrivals (2005)	Tourist arrivals / GDP (mio EUR) (2005)
GERMANY	21500000	9.7
U.K.	29970000	17.2
FRANCE	75910000	45.7
ITALY	36513000	26.3
SPAIN	55916000	66.6
NETHERLANDS	10012000	20.4
BELGIUM	6747000	23.3
SWEDEN	3133000	11.1
POLAND	15200000	74.4
AUSTRIA	19952000	84.5
DENMARK	4562000	23.3
GREECE	14276000	84.8
IRELAND	7333000	49.7
FINLAND	3140000	20.6
PORTUGAL	/	/
CZECH REPUBLIC	6336000	72.7
ROMANIA	1430000	23.5
HUNGARY	10048000	122.1
SLOVAKIA	1515000	44.7
LUXEMBOURG	/	/
SLOVENIA	1555000	59.3
BULGARIA	4837000	243.4
LITHUANIA	2000000	110.3
LATVIA	1116000	99.9
CYPRUS	2470000	194.5
ESTONIA	1917000	204.5
MALTA	1171000	261.2
USA	49206000	5.2

Source: UNWTO, Eurostat

Empirical evidence seems to suggest that long-term impact of terrorist attacks on tourism and airlines sector could be substantial. On the other hand, the temporal effect is ambiguous and depends on the magnitude or frequency of the terrorist attacks (Frey et al., 2004; Pizam and Fleischer, 2001).

Enders and Sandler (1991)²⁹ estimate the effect of terrorist attacks on tourism in Spain for the period 1970 to 1991. They find that a terrorist attack decreases the number of tourists by around

²⁹ See Frey et al. (2004), Sandler and Enders (2005), Barth et al. (2006).

140.000. For example, given that in 1988 Spain had 5.4 million tourist arrivals and 18 terrorist attacks, then the loss was around 2.5 million or around 30 % (2.5 % per attack) in tourist arrivals (Frey et al., 2004).

Enders, Sandler and Parise (1992)³⁰ investigate the impact on tourism revenues for a sample of Austria, Greece, and Italy which have been highly affected by terrorism during the period 1974-1988. They find that Austria, Italy and Greece lost \$4.5 billion, \$1.1 billion and \$0.8 billion tourism revenues, respectively, between 1974 and 1988, while Europe lost around \$16.1 billion. For example, total revenues in Austria, Italy and Greece in 1988 are estimated to \$11.1 billion, \$19.3 billion and \$3.3 billion, respectively (Frey et al., 2004). For Europe, total tourism revenues in 1988 are estimated at \$74.4 billion (Frey et al., 2004). Furthermore, they also find a contagion effect which reflects the differences between the aggregate losses in tourism revenues for Austria, Greece and Italy (\$6.4 billion) and Europe (\$16.1) and the fact that for other European countries are not estimated any significant effects of terrorist attacks. The authors also find a substitution effect since some of the lost revenues in Europe are substituted to North America (Sandler and Enders, 2005).

Another study by Drakos and Kutan (2001) also finds both, the substitution and contagion effect. They estimate the effect of terrorism attacks on tourism for Greece, Israel and Turkey for the period 1996 to 1999. First, they find that a terrorist attack in Turkey reduces its relative market share (to Israel, Greece and Italy) on average by 0.78 %. For 1999, this is approximately 5.7 % in lost tourist arrivals, if we estimate Turkey's tourist arrivals at around \$7.5 million (Morand, 2007). For Israel, the impact is estimated to 0.44 % in lost relative market share while for Greece no significant impact is found. However, for Greece the contagion effect is found. In particular, a terrorist incident in Greece is associated with an increase in the relative market share of Israel by around 1 %. For 1999, this translates into 580.000 or around 4.6 % in lost tourist arrivals or \$424 million or 4.8 % in lost tourist revenues (Drakos and Kutan, 2001).

Second, they also find a substitution effect; a terrorist incident in Israel increases Turkey's market share by on average 0.7 %. For a higher magnitude of the terrorist attacks, they find a greater impact in terms of market share lost and a higher substitution effect. For example, a terrorist incident in Turkey is associated with an increase in the relative market share of Greece by 1.81%. Finally, the effect could also depend on the location (urban vs. rural location) and the intensity of terrorist attacks.

Neumayer (2004) is the first who uses a large sample of countries to investigate the impact of terrorist attacks on tourism. For the period 1984-1995, he finds the contemporaneous, short-term and long-term effects. For a contemporaneous effect it is estimated that a one standard deviation ("substantial") increase in the terrorist incidents reduces tourist arrivals by 8.8 %. Similarly, for the short- and long-term effect it is estimated at 7.1 % and 14.8 %, respectively. The short- and long-term effect of more serious political violence is much stronger at around 10 % and 27 %, respectively. He also finds that the impact on larger countries and countries, which are heavily dependent on tourism, is smaller. The latter effect is occurred most notably due to countries' attractive characteristic that is not easily substituted for.

³⁰ See Frey et al. (2004), Sandler and Enders (2005), Barth et al. (2006), Drakos and Kutan (2003).

Ito and Lee (2004) assess the impact of the 9/11 attacks on the USA airline industry. They find quite large temporary and long-term effects. The temporary demand shock is estimated by over 30 % measured in RPMs (revenue passenger miles) and 7.3 % measured in yields (prices); the permanent demand shock is estimated by around 7.4 % measured in RPMs and 10 % measured in yields. Furthermore, in the period November 2002-2003, the long-term shock was still persistent. It explained around 94 % of lower domestic RPMs from historical peak during the period August 2000-2001 (7.9 % lower). Meanwhile, the temporary shock was gradually declined after 12 months for yields and after 5 months for RPMs. Interestingly, they also find a substitution effect between the shorter flight distances (less than 500 miles) and alternative mode of travel.

Bonham et al. (2006) investigate the impact of the 9/11 attacks on the American and Japanese tourist arrivals in Hawaii. They find that in the third and fourth quarter of 2001, immediately after the 9/11 attacks, domestic arrivals to Hawaii declined by 8.8 % while Japanese arrivals fell by 30.6 %. In 2002, American and Japanese arrivals were still 1.5 % and 17 % below predicted arrivals, respectively. On the annual basis, this translates approximately into 5 % and 24 % in lost tourist arrivals, respectively, and 14 % in lost overall (both American and Japanese) tourist arrivals. American tourist arrivals to Hawaii had fully recovered by the end of 2003, notably due to the substitution effect between domestic and foreign destinations by American tourists. For this reason, overall tourist arrivals in Hawaii were recovered in 2004. Meanwhile, by the end 2004, Japanese arrivals in Hawaii were still 15.8 % lower.

In contrast with the previous studies, many other studies found that the impact of terrorism on tourism is quite shorter. The effect can occur up to three months after the terrorist attack and last for 6 to 9 months after the terrorist attacks (Pizam and Fleischer, 2001). For example, Fielding and Shortland (2004) find that the numbers of tourist arrivals swiftly recover after 3 months of terrorist attack in Israel. However, an increase in monthly fatalities up to 10 reduced American and European tourist arrivals by around 30 % in the next month and 45 % in the second month. On the annual basis, this approximately translates into 6 % in lost tourist arrivals. Another example, an equivalent increase in monthly fatalities in the West Bank and Gaza is estimated to reduce American and European tourist numbers by around 15-20 % in the second and third months following. Furthermore, Pizam and Fleischer (2001) show that the temporal effect of the impact of terrorism on tourism in Israel depends only on the frequency of the terrorist attacks and not on their level of magnitude.

Some studies report that the effect of the terrorist attacks on tourism could also occur with a large lag. Enders, Sandler and Parise (1992)³¹ find that the effect on tourism in Austria and the rest of Europe (without Italy and Greece) has occurred not earlier than 18-21 months after the terrorist attacks.

To summarize, it seems that the impact of terrorist attacks on tourism is not insubstantial. For a single MANPADS attack, we estimate that the impact could reduce the number of tourist arrivals by between 3 % and 10 %. For a higher level of magnitude and serial MANPADS attacks, we expect that the tourist arrivals would be lower by between 5 % and 15 %, and between 10 % and 25 %, respectively. While the economic effect of terrorism would be significant for all countries, the greatest impact would be suffered by the economies where tourism is an important economic

³¹ See Frey et al. (2004), Sandler and Enders (2005).

sector. The main reason that terrorist attacks have such a strong effect is due to a substitution and contagion effect which occur between affected countries and safer tourist destinations. On the other hand, the results seem to suggest that the temporal effect of a terrorist attack is ambiguous; it could be a quite short and also long-lived. Furthermore, it could be also lagged since a large number of tourist engagements are bookings in advance. For these reasons, we estimate that the impact of a single or simultaneous MANPADS attack could last up to 3 years. Moreover, higher frequency of terrorist attacks spread over a short time, could obviously require a longer recovery period for up to 4 years due to larger substitution and contagion effects. Table 14 quantifies the impact on tourist arrivals for particular countries.

Table 14: Estimation of the impact on number of tourist arrivals for 2005

Countries	1 aircraft shot down – single attack (Number of tourist arrivals fall 3-10 %)	2 aircrafts shot down – simultaneous attack (Number of tourist arrivals fall 5-15 %)	2 aircrafts shot down – serial attacks spread over a few weeks or months (Number of tourist arrivals fall 10-25 %)
GERMANY	645000 – 2150000	1075000 – 3225000	2150000 – 5375000
U.K.	899100 – 2997000	1498500 – 4495500	2997000 – 7492500
FRANCE	2277300 – 7591000	3795500 – 11386500	7591000 – 18977500
ITALY	1095390 – 3651300	1825650 – 5476950	3651300 – 9128250
SPAIN	1677480 – 5591600	2795800 – 8387400	5591600 – 13979000
NETHERLANDS	300360 – 1001200	500600 – 1501800	1001200 – 2503000
BELGIUM	202410 – 674700	337350 – 1012050	674700 – 1686750
SWEDEN	93990 – 313300	156650 – 469950	313300 – 783250
POLAND	456000 – 1520000	760000 – 2280000	1520000 – 3800000
AUSTRIA	598560 – 1995200	997600 – 2992800	1995200 – 4988000
DENMARK	136860 – 456200	228100 – 684300	456200 – 1140500
GREECE	428280 – 1427600	713800 – 2141400	1427600 – 3569000
IRELAND	219990 – 733300	366650 – 1099950	733300 – 1833250
FINLAND	94200 – 314000	157000 – 471000	314000 – 785000
PORTUGAL	/	/	/
CZECH REPUBLIC	190080 – 633600	316800 – 950400	633600 – 1584000
ROMANIA	42900 – 143000	71500 – 214500	143000 – 357500
HUNGARY	301440 – 1004800	502400 – 1507200	1004800 – 2512000
SLOVAKIA	45450 – 151500	75750 – 227250	151500 – 378750
LUXEMBOURG	/	/	/
SLOVENIA	46650 – 155500	77750 – 233250	155500 – 388750
BULGARIA	145110 – 483700	241850 – 725550	483700 – 1209250
LITHUANIA	60000 – 200000	100000 – 300000	200000 – 500000
LATVIA	33480 – 111600	55800 – 167400	111600 – 279000
CYPRUS	74100 – 247000	123500 – 370500	247000 – 617500
ESTONIA	57510 – 191700	95850 – 287550	191700 – 479250
MALTA	35130 – 117100	58550 – 175650	117100 – 292750
USA	1476180 – 4920600	1075000 – 7380900	4920600 – 12301500

Source: Author, UNWTO

Table 15: Selected empirical studies, used to estimate the impact of MANPADS terrorist attacks on tourism

Study	Countries	Time period	Key findings	Relevance to our analysis	Our conclusions and estimates	Level of relevance
Enders and Sandler (1991)	Spain	1970-1991	A terrorist attack decreases the number of tourists by around 140.000. For example, in 1988, the loss was around 2.5 million or around 30 % (2.5 % per attack) in tourist arrivals.	- The impact of persistent terrorist attacks could be appropriate proxy for serial MANPADS attacks.	Serial MANPADS attacks could reduce tourist arrivals by up to 30 % annually.	3
Enders, Sandler and Parise (1992)	Austria, Greece, and Italy	1974-1988	<ul style="list-style-type: none"> - Austria, Italy and Greece lost \$4.5 billion, \$1.1 billion and \$0.8 billion tourism revenues, respectively, between 1974 and 1988, while Europe lost around \$16.1 billion. - Contagion and substitution effect. - The effect on tourism in Austria and the rest of Europe (without Italy and Greece) was occurred not earlier than 18-21 months after the terrorist attacks. 	<ul style="list-style-type: none"> - The impact of sporadic terrorist attacks could be appropriate proxy for a single or simultaneous MANPADS attack. - The study investigated the impact on countries in Europe. 	<ul style="list-style-type: none"> - Single or simultaneous MANPADS attack could have strong effect on tourism. - The effect could occur with a large lag. - The attack could cause a substitution and contagion effect. 	3
Drakos and Kutan (2001)	Greece, Israel and Turkey	1996-1999	<ul style="list-style-type: none"> - A terrorist attack in Turkey reduces its relative market share (to Israel, Greece and Italy) on average by 0.78 %. For 1999, this is approximately 5.7 % in lost tourist arrivals. - A terrorist incident in Greece is associated with an increase in the relative market share of Israel by around 1 %. For 1999, this translates into 4.8 % in lost tourist revenues. - Contagion and substitution effect. - Higher magnitude of the terrorist attack causes a greater impact in terms of market share lost and a higher substitution effect. 	<ul style="list-style-type: none"> - The impact of sporadic terrorist attacks could be appropriate proxy for a single or simultaneous MANPADS attack. - The study investigated the impact on countries in Europe. 	<ul style="list-style-type: none"> - Single or simultaneous MANPADS attack could reduce tourist arrivals by around 6 %. - The attack could cause a substitution and contagion effect. - Higher magnitude of the attack could have a greater impact and cause a higher substitution effect. 	3
Neumayer (2004)	Large unspecified sample of countries	1984-1995	<ul style="list-style-type: none"> - For contemporaneous effect is estimated that a one standard deviation (“substantial”) increase in the terrorist incidents reduces tourist arrivals by 8.8 %. Similarly, for the short- and long-term effect is estimated at 7.1 % and 14.8 %, respectively. The short- and long-term effect of more serious political violence is much stronger at around 10 % and 27 %, respectively. - The impact on large countries is smaller. - The effect on countries which are heavy dependent on tourism is smaller. - Contagion and substitution effect. 	<ul style="list-style-type: none"> - The impact of sporadic terrorist attacks could be appropriate proxy for a single or simultaneous MANPADS attack. - The study also investigated the impact on countries in Europe and the USA. - The impact of more serial political violence could be appropriate proxy as an upper bound for serial MANPADS attacks. 	<ul style="list-style-type: none"> - The short- and long-term effect of single or simultaneous MANPADS attack could reduce tourist arrivals by around 7 % and 15 %. The short- and long-term effect of serial MANPADS attacks could reduce tourist arrivals by around 10 % and 25 %. - The effect on large countries and on countries which are heavy dependent on tourism could be smaller. 	4

(Continued)

Ito and Lee (2004)	USA (airline industry)	2001	<p>The response to 9/11 attacks:</p> <ul style="list-style-type: none"> - Temporary demand shock is estimated by over 30 % measured in RPMs and 7.3 % measured in yields (prices); the permanent demand shock is estimated by around 7.4 % measured in RPMs and 10 % measured in yields. - The temporary shock was gradually declined after 12 months for yields and after 5 months for RPMs. In November 2003, the long-term shock was still persistent. - Substitution effect between the shorter flight distances and alternative mode of travel. 	<ul style="list-style-type: none"> - The impact of 9/11 terrorist attacks could be appropriate proxy for a single or simultaneous MANPADS attack. - The study investigated the impact on the USA airline industry. 	<ul style="list-style-type: none"> - The short- and long-term effect of single or simultaneous MANPADS attack could reduce tourist arrivals by around 30 % and 10 %, respectively. - The long-term effect could last at least 3 years. - The attack could cause a substitution effect between the shorter flight distances and alternative mode of travel. 	3
Bonham et al. (2006)	USA (Hawaii)	2001	<p>The response to 9/11 attacks:</p> <ul style="list-style-type: none"> - Immediate after the 9/11 attacks, domestic arrivals to Hawaii declined by 8.8 % while Japanese arrivals fell by 30.6 %. In 2002, American and Japanese arrivals were still 1.5 % and 17 % below predicted arrivals, respectively. By the end 2004, Japanese arrivals in Hawaii were still 15.8 % lower. - Substitution effect between domestic and foreign destinations. 	<ul style="list-style-type: none"> - The impact of 9/11 terrorist attacks could be appropriate proxy for a single or simultaneous MANPADS attack. - The study investigated the impact on tourism in the USA. 	<ul style="list-style-type: none"> - The short- term effect of single or simultaneous MANPADS attack could reduce tourist arrivals by between 10 % and 30 %. - The long-term effect could reduce tourist arrivals by around 15 %. - The attack could cause a substitution effect between domestic and foreign destinations. 	3

Note: levels of relevance of individual studies to our analysis are graded from 1 (lowest relevance) to 5 (very high relevance).

Source: Author

5. Conclusion

Using many empirical and simulated-scenario studies related to macroeconomic and microeconomic impacts of terrorist attacks as well as many estimates related to the consequences of the attacks of September 11, we have assessed the short- and long-term impacts of potential MANPADS terrorist attacks on a commercial airliner. We have estimated the short-term impacts on capital stocks, short-term economic activity and financial markets as well as the most important long-term impacts on economic growth, foreign direct investment, trade and tourism which would accrue due to changes in the consumer, business and government behavior.

We have found that the effect of a single MANPADS terrorist attack on economic growth would be quite modest and not very persistent. It is estimated that the growth would be reduced by between 0 and 0.2 percentage points, and the effect would be dissipated up to 1 year. A major reason for such small and temporary impact is due to a substitution effect which could occur between sectors and countries. Actually, the effect depends on many factors such as level of magnitude of the attack, level of political and economical development, size of economy and degree of diversification of economy. However, the empirical results also suggest that the terrorism may divert resources from more productive activities to defense uses. Moreover, in the case of negative impact on economic activity, tax revenues and government spending on education and social goods could be also negatively affected.

Since the effect depends on the magnitude and frequency of terrorist attacks, we could expect that the impact of a simultaneous or serial MANPADS attacks could have greater and more persistent effect, but smaller and less persistent than the impacts of internal or external conflicts. For a simultaneous attack resulting in 2 aircrafts shot down, we estimate that the growth could be reduced by between 0 and 0.3 percentage points in a given year. On the other hand, serial MANPADS attacks could reduce the growth by up to 0.8 percentage points annually and could have more persistent effect lasting up to 2 years. In this case, we could expect a larger substitution effect which could occur between countries.

However, small and open economies and economies where tourism is an important economic sector would suffer the greatest impact due to the expected stronger effect on tourism and related sectors such as airlines, hotels and restaurants, and trade sector. We estimate that the impact of a single MANPADS attack could reduce the number of tourist arrivals by between 3 % and 10 %. The main reason for such strong effect is due to a substitution and contagion effect which could occur between affected countries and safer destinations. People could substitute affected country to safer tourist destination and/or foreign destinations to domestic destinations and/or spending on tourism to other services and goods and/or air services to alternative mode of travel. On the other hand, the contagion effect could reduce the number of tourist arrivals to neighboring countries or complete region which is not affected by terrorism. The temporal effect of a terrorist attack on tourism is ambiguous; it could be both short and long-lived, and furthermore, it could be also lagged. For these reasons, we estimate that the impact of a single MANPADS attack could last from 1 to 2 years.

For a higher level of magnitude and frequency of MANPADS attacks, we expect stronger and more persistent effects. We estimate that a simultaneous MANPADS attack could reduce the number of

tourist arrivals by between 5 % and 15 % annually. The temporal effect is estimated to last up to 3 years. Furthermore, the most persistent and the greatest impact we could expect from the serial MANPADS attacks. In this case, the attacks could reduce tourist arrivals by between 10 % and 25 % and last up to 4 years.

The economic consequences of MANPADS terrorist attacks on trade flows could be also large and long-lived. We estimate that the impact of a single MANPADS attack could reduce trade flows by between 2 % and 10 % and last up to 2 years. The main reason for such strong effect is due to increased trading costs, uncertainty and security restrictions. In addition to the “damper” effect, trade could be also diverted from close to distant partners, and/or from international trade to home trade, and/or towards countries with smaller border restrictions. The impact would be also higher for commodities with a high ratio of weight and volume relative to their value, time sensitive products and network-based products. We could also expect stronger impact in the small and open economies due to their heavy dependence on trade and potential higher security restrictions. The latter is important as less important trading partners are likely to enhance security restrictions. On the other hand, globalization could also reduce the negative effects of terrorism by promoting economic development in countries. Finally, the results also suggest that the effect on exports could be much stronger than on imports.

The results also suggest that the severity and frequency of MANPADS attacks could have much stronger and more persistent effects on trade flows. We estimate that the impact of a simultaneous MANPADS attack would reduce trade by between 3 % and 12 % and last up to 2.5 years. For a serial MANPADS attacks, the impact is estimated to reduce trade flows by between 8 % and 20 % annually and last up to 3 years.

The empirical results of the effect of terrorist attacks (and also political violence) on FDI flows are inconsistent and ambiguous. For these reasons, we estimate that the impact of a single or simultaneous MANPADS attack may reduce FDI stocks by between 0 % and 5 %. On the other hand, it seems that terrorist attacks could have higher impact on FDI flows in smaller countries and especially in those countries which are affected by persistent terrorism, notably due to a larger substitution effect. Therefore, for economies which would be subject to serial MANPADS attacks, we estimate that FDI stocks could be reduced by between 0 % and 10 %. Since the impact of more serious violence (political) is also ambiguous, we have to take into account the possibility that the terrorist attacks have no effect on FDI flows. Furthermore, the results also suggest that FDI flows could indirectly reduce the effect and the possibility of terrorist attacks by their impact on economic development.

The immediate short-term impacts on financial markets firstly depend on the effectiveness of government response by monetary and fiscal policies, and on the kinds of terrorist threat. Since developed countries could use efficient monetary and fiscal policies, we estimate that the impact of a single or simultaneous MANPADS attack could reduce stock prices in major stock markets by between 0 % and 10 %. However, the effect would be very temporary, lasting just a few days. We also expect no additional volatility or increased risk premium. For foreign exchange markets, we do not expect any changes in prices or additional volatility or increased risk premiums. Furthermore, for some bond markets, we could expect decline in yields and increased volatility, but no increased risk premiums. On the other hand, the impact of serial MANPADS attacks on domestic financial markets could have larger and more persistent effect.

To summarize, we could expect that the attack with higher level of magnitude (e.g. aircraft crashes in metropolitan area) or simultaneous attack would have a higher and more persistent effect than a single MANPADS attack. However, the most serious, persistent and the greatest impact we could expect from the serial MANPADS attacks at high frequency spread over a few weeks or months.

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Table 16: Estimates of the long-term impacts of MANPADS terrorist attacks

Scenario	Economic growth		Foreign direct investment		Trade		Tourism	
	Annually decline in GDP per capita growth (percentage points)	Recovery period (years)	Annually decline in FDI stocks (percentages)	Recovery period (years)	Annually decline in trade flows (percentages)	Recovery period (years)	Annually decline in tourist arrivals (percentages)	Recovery period (years)
1 aircraft shot down – single attack	0 – -0.2	0 – 1	0 – -5	/	-2 – -10	1 – 2	-3 – -10	1 – 2
2 aircrafts shot down – simultaneous attack	0 – -0.3	0 – 1.5	0 – -5	/	-3 – -12	1.5 – 2.5	-5 – -15	1.5 – 3
2 aircrafts shot down – serial attacks spread over a few weeks or months	up to 0.8	1 – 2	0 – -10	/	-8 – -20	2 – 3	-10 – -25	2 – 4

Table 17: Estimates of the short-term impact of MANPADS terrorist attacks

Scenario	Financial markets	
	Average decline in stock prices (percentages)	Recovery period (days)
1 aircraft shot down – single attack	0 – -10	0 – 11
2 aircrafts shot down – simultaneous attack	0 – -10	0 – 11
2 aircrafts shot down – serial attacks spread over a few weeks or months	around -10	longer period

Note: Quantitative estimation of the short-term impacts on capital stock was not made since the possible destruction of capital stocks on the ground is impossible to estimate in advance. For the short-term impacts on economic activity, the quantitative estimations were not made for three reasons: firstly, the estimates are limited, they only exist for the USA (especially only for the airline sector), and some of them could be speculative since they were made soon after the 11/9 attacks; secondly, some factors are also impossible to estimate in advance, such as the duration of potential airports (and related activity) closures; and thirdly, some of the short-term impacts (e.g. on economic growth, tourism or trade) are included in the quantitative estimation of the long-term impacts.