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under the Shadow of Terrorism**

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## **Household Economic Decisions under the Shadow of Terrorism\***

Dimitris Christelis<sup>1</sup> and Dimitris Georgarakos<sup>2</sup>

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### **Abstract:**

We investigate, using the 2002 US Health and Retirement Study, the factors influencing individuals' insecurity and expectations about terrorism, and study the effects these last have on households' portfolio choices and spending patterns. We find that females, the religiously devout, those equipped with a better memory, the less educated, and those living close to where the events of September 2001 took place worry a lot about their safety. In addition, fear of terrorism discourages households from investing in stocks, mostly through the high levels of insecurity felt by females. Insecurity due to terrorism also makes single men less likely to own a business. Finally, we find evidence of expenditure shifting away from recreational activities that can potentially leave one exposed to a terrorist attack and towards goods that might help one cope with the consequences of terrorism materially (increased use of car and spending on the house) or psychologically (spending on personal care products by females in couples).

**JEL Classification:** D12, D14, D74, D84, G11

**Keywords:** Terrorism, Expectations, Household Finance, Demand Analysis.

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## **I. Introduction**

Terrorist attacks represent major shocks for a country's economy that are beyond the control of economic agents and can have severe consequences both at the macro and the micro level. While analysis of macroeconomic data can be useful in understanding the economic implications of terrorism, it can not shed light on the effect of the fear of terrorism on spending and portfolio choices at the household level. Yet, households' economic decisions under the threat of terrorism can have important implications for aggregate consumption, asset demands and asset pricing.

A common feature of most existing studies of the economic effects of terrorism is the use of aggregate data (Frey, Luechinger and Stutzer, 2004, provide an extensive review). For example, Enders and Sandler (1991) and Drakos and Kutan (2003) have found strong negative effects of terrorist attacks on tourism, Enders and Sandler (1996) on foreign direct investment and Nitsch and Schumacher (2004) on international trade. Furthermore, Eckstein and Tsiddon (2004), using quarterly data for Israel, find that periods of high terrorist activity have a negative impact on aggregate output, investment, consumption and exports. However, these periods may partly reflect the influence of related political developments that took place at the same time (see Cukierman, 2004), which could be a problem affecting any study of terrorism using aggregate data.

In this paper we use US household survey data from the Health and Retirement Study (HRS), which interviews those aged 50 and above and offers information on people's perceived sense of security in the aftermath of the events of September 11, 2001 and the anthrax attacks that took place in the US shortly thereafter. Moreover, respondents are asked about their expectation of future bioterrorism incidents and the possibility of being a victim of such attacks. This directly provided information may be very revealing, since different individuals can perceive the same event in a variety of ways depending on their personal traits and circumstances, and such heterogeneous perceptions can lead to quite disparate economic decisions. Furthermore, it is important to understand the consequences of such extreme events on the choices of the older segment of the population, given that it controls a large share of society's resources (and therefore their economic decisions can significantly affect the relevant markets). In addition, older households face challenges such as an increasingly difficult access to

credit, a relatively inflexible labor supply, adverse health shocks and the need to secure adequate resources for retirement.

There exist micro-data studies in the fields of political science, psychology and medicine, that have investigated the effects of terrorism on individuals (see Galea, Ahern, Resnick, Kilpatrick, Bucuvalas, Gold and Vlahov, 2002; Huddy, Feldman, Taber and Lahav, 2005; Silver, Holman, McIntosh, Poulin and Gil-Rivas, 2002; Boscarino, Adams, Figley, Galea and Foa, 2006; Lavanco, Romano and Milio, 2008). These studies have often relied on small-scale surveys that were conducted in areas immediately affected by the 9/11 attacks,<sup>1</sup> and they find that being younger, female, with lower education and living closer to the site of the events, all increase the anxious reactions to the 9/11 attacks and terrorism in general.<sup>2</sup> In the field of economics, Becker and Rubinstein (2004) have examined the labor supply and wages of Israeli workers who might be exposed to terrorism, using aggregate data on suicide attacks and their victims to proxy for the danger faced by individuals.

We build on these earlier studies by using the HRS, which is a nationally representative US household survey that provides much more extensive information on demographic, social and economic characteristics of the respondents (e.g. on depression, cognitive abilities, religious attachment, veteran status and economic resources) than the surveys used in those earlier studies. This wealth of information allows us to investigate more thoroughly the factors that shape individuals' perceptions about terrorism. More importantly, our paper is the first one, as far as we know, that uses information directly provided by survey respondents on such perceptions in order to examine their effect on a number of important household economic choices involving asset investment and expenditure.

Due to terrorism, households face a largely undiversifiable risk of loss of life and of severe economic damages, which has a very low probability. These damages can come, among other things, from job loss, destruction of property and increased expenditures needed to cope with the consequences of terrorism. As is known from Pratt

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<sup>1</sup> Huddy, Feldman and Cassese (2007) and Silver, Holman, McIntosh, Poulin and Gil-Rivas (2002) are exceptions, since they use nationally representative surveys.

<sup>2</sup> With respect to firms, Abadie and Gardeazabal (2003) found that the stock price of those that operated mostly in the Basque country in Spain exhibited higher returns in a period of truce with the Basque terrorist organization ETA.

(1964), a decrease in wealth will make an individual more risk averse if her preferences exhibit decreasing absolute risk aversion (DARA). Furthermore, Leland (1968) and Sandmo (1970) have shown that a positive third derivative of the utility function induces precautionary saving in response to background risk. Finally, the results of Gollier and Pratt (1996) indicate that increased exposure to an undiversifiable background risk should reduce the exposure to avoidable risks, even if the two risks are independent.<sup>3</sup> Guiso, Jappelli and Terlizzese (1996), based on Italian survey data, find that households with higher uncertainty about their future wages adopt a more conservative portfolio strategy, lending empirical support to the above premise. In our context, the above findings imply that terrorism can lead households to increase their saving and reduce their exposure to risky assets.

Households' economic response to terrorism may also be the outcome of deviations from the standard expected utility framework. According to prospect theory (Kahneman and Tversky, 1979), agents are more sensitive to gains than losses and tend to overweigh events occurring with very low probabilities.<sup>4</sup> In our context, these propositions would suggest that households may worry inordinately about losing their life and property due to terrorism. As a result, they might make very conservative economic choices, with a particular emphasis on avoiding losses.

In our study, we initially document the considerable heterogeneity of perceptions about terrorism in the population, and correlate them with various personal and economic characteristics of the survey respondents. We find that women feel much higher levels of insecurity and report a higher probability of becoming victims of a bioterrorist attack. The same holds for the less educated, those for whom religion is more important, those with worse numeracy skills, those with no military experience and those who live close to where the events of September 2001 took place. In contrast, the better educated, the veterans, the less religious and those with a higher income consider a bioterrorist attack in the US more likely to happen and worry less about their personal safety. In addition,

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<sup>3</sup> This holds for the class of preferences exhibiting risk vulnerability, which is a stronger notion than DARA and can be seen as a more general case of: i) proper risk aversion, i.e. the notion that a newly introduced risk has a negative impact on the attitude towards other independent risks (see Pratt and Zeckhauser, 1987); ii) standard risk aversion, under which any risk that makes a small reduction in wealth more painful - in the sense of decreased expected utility - also makes any independent risk more painful (see Kimball, 1993).

<sup>4</sup> Barberis and Huang (2005) provide a review of the implications of prospect theory and loss aversion on stock market participation and the equity premium.

we find evidence that the passage of time and a reduced memory capacity tend to alleviate the insecurity created by the 9/11 attacks, but they do not seem to influence the fear of being a victim of bioterrorism.

We then turn to household economic decisions and find that the fear of terrorism strongly discourages households from investing in stocks through the high levels of insecurity that females feel. This finding is net of a number of demographic and economic factors that are likely to be correlated with gender, like the general attitude towards risk, the level of depression, education and economic resources. When it comes to entrepreneurial risk, we observe that insecurity due to terrorism makes single men quite less likely to own a business. Finally, we find that fear of terrorism also induces females to buy life insurance.

As for households' spending decisions, insecurity and expectations about future terrorist attacks do not seem to influence either the total level of non-durable expenditure or the budget shares of some basic goods (food at home, clothing, medical services and utilities). However, we find strong evidence that households shift their expenditure away from items (e.g. travel, movie-going and gyms) that require more time spent in public places and a more frequent use of means of transportation such as airplanes and trains, which could be considered as likely targets of terrorist attacks. Moreover, given that spending on such recreational goods is typically elastic, they are more likely to be among those that will be negatively affected by an expected future reduction in economic resources. On the other hand, we find that households spend more on items that might help them better cope with the consequences of terrorism either materially (more intensive use of the car, increased spending on the house) or psychologically (spending on personal care products by females).

The rest of the paper is organized as follows. Section II provides details on the data and on the questions related to terrorism found therein. Section III presents results on the impact of various socio-economic characteristics on the insecurity due to and the expectations about terrorism. Section IV explores the link of the terrorism-related variables with household portfolio decisions while Section V with household spending. Section VI concludes.

## II. Data and questions on terrorism

We use data from the HRS, which is a longitudinal, nationally representative dataset interviewing those aged 50 and above in the US. The survey, conducted on a biannual basis since 1992, provides extensive information on households' socioeconomic characteristics, income and assets (for a detailed description of the survey see Hauser and Willis, 2004).<sup>5</sup> In the 6<sup>th</sup> wave of the HRS, which was conducted from April 2002 through January 2003 and during which 17,549 individuals belonging to 11,770 households were interviewed, respondents are asked three questions regarding their expectations about terrorism and the degree to which they have been affected by the 9/11 attacks.

The first question (Q1) is as follows: *“How much -if any- have the events of September 11 shaken your own personal sense of safety and security: have they shaken it a great deal, a good amount, not too much, or not at all?”*. Therefore, this question asks explicitly about the effect of the biggest terrorist attack in US territory on the respondents' sense of security, which is presumably influenced by terrorist threats of every kind. In our HRS sample, 17% of the respondents report feeling no insecurity whatsoever, 42% not too much insecurity, 24% a good amount of insecurity and 17% a great deal of insecurity.

Survey respondents were then asked: *“What do you think is the percent chance that there will be a major incident of bio-terrorism in the United States in the next five years, directly affecting 100 people or more?”*. This question (Q2) records the subjective probability of a future terrorist attack of a specific kind in the US in general, and thus should reflect less the respondents' fear for their wellbeing than the first question. The distribution of the answers to Q2 in the HRS sample is as follows: the 25<sup>th</sup> percentile is equal to 50 percentage points (pp), the 50<sup>th</sup> equal to 60 pp, the 75<sup>th</sup> equal to 80 pp, while the mean is equal to 61 pp.<sup>6</sup>

Finally, the third question (Q3) was: *“What do you think is the percent chance that you, yourself will be a victim of bio-terrorism in the next five years?”*. This question measures respondents' fear of dying from a specific type of terrorist attack and may be

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<sup>5</sup> For our analysis, we mostly rely on the HRS files created by the RAND Center for the Study of Aging.

<sup>6</sup> Khwaja, Sloan and Salm (2006) have examined this question when investigating the relationship between smoking and subjective beliefs about various future macroeconomic events.



seen as a special case of the Q1 since it asks about one possible aspect of the insecurity associated with terrorism.<sup>7</sup> The 25<sup>th</sup> percentile of the distribution of this expectation is equal to 0 pp, the 50<sup>th</sup> equal to 10 pp, the 75<sup>th</sup> equal to 30 pp and the mean equal to 19 pp.<sup>8</sup> A median value of 10 pp for this probability seems implausibly high, given what is known about the frequency and the extent of the damage caused by such attacks (see Tucker, 1999, for historical evidence on this issue). As already discussed, this overestimation of the probability of a catastrophic event is consistent with the tenets of prospect theory.

Since the three questions on terrorism are asked only in the 2002 HRS, we have to operate in a cross-sectional setting. However, given the panel nature of the survey, one has information on the 2002 respondents from previous waves, which we will use below in order to address issues arising in the estimation of our econometric models.

### **III. Factors influencing insecurity and expectations about terrorism**

In this section we explore the extent to which various demographic, social and economic factors influence the perceived level of insecurity, as well as the subjective expectations of a future bioterrorist attack in the US and of being a victim of such an attack. This exercise can shed light on what makes an individual more sensitive to terrorist threats and hence be informative to policy makers.

In our empirical specification, we first include standard demographic variables like age, marital status, labor force status and race. In addition, we account for income and wealth (typically not recorded in surveys used to study the reactions to the threat of terrorism), since they might have an independent role in shaping perceptions about terrorism. This could be possible because wealthier individuals may protect themselves better against terrorism incidents (e.g. by getting higher quality medical care or moving to a safer place). Economic resources are also very likely to be correlated with other

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<sup>7</sup> However, respondents' expectations about bioterrorism incidents could also reflect their views on other types of attacks. In a survey conducted in New York during the same period as the 2002 HRS, respondents were as concerned about biological attacks as they were about chemical ones or any future major terrorism incident. On the other hand, they found nuclear attacks less likely (Boscarino, Adams, Figley, Galea and Foa, 2006).

<sup>8</sup> Those who answer zero to Q2 or Q3 are asked a follow up question about the probability being less, equal or greater than a very small threshold (1/1,000 for Q2 and 1/1,000,000 for Q3). In both cases, the vast majority of respondents choose the "less than" option.

regressors like gender, education and cognitive abilities, and thus their inclusion is important for the consistency of our estimates.

Gender can be another important factor influencing perceptions about terrorism. The notion that women develop fears related to physical threats (both personal and national) in a different way than men is empirically supported by various earlier studies. For example, research on crime has shown that women are more afraid than men of being victims of crime, although they are less likely to experience a violent assault (see for example Warr, 1984 and Ferraro, 1996). In addition, women appear more concerned about national threats. Poikolainen, Kanerva and Lönnqvist (1998) find that Finnish women in the early nineties were more afraid of the likelihood of a nuclear war, while Arian and Gordon (1993) document significantly higher fear and anxiety among Israeli women during the Gulf war. With respect to fear caused by terrorism, Silver, Holman, McIntosh, Poulin and Gil-Rivas (2002) show that females have experienced much higher levels of posttraumatic stress symptoms in the aftermath of the 9/11 attacks. Solomon, Gelkopf and Bleich (2005) report similar findings for Israeli women and estimate the odds of developing posttraumatic stress symptoms after terrorist attacks to be six times higher than those of men. In a recent study, Huddy, Feldman and Cassese (2007), using US data from the National Terrorism and Threat survey, find that women are more concerned about the consequences of both terrorism and war. More generally, a range of studies have offered evidence on the links between gender and emotional reactions involving fear, worry, anxiety and depression (see for example Robichaud, Dugas and Conway, 2003).

In order to account for the influence of personal pessimism on perceptions about terrorist threats, we include a dummy for feeling depressed most of the time over the week prior to the interview. Political and religious beliefs can also be important for the study of the aforementioned perceptions, but unfortunately our data does not provide any information on the former. With respect to the latter, we have information on whether the respondents are Catholics, Protestants, Jewish, followers of other religions or have no

religious preference. Moreover, we control for the strength of religious beliefs by including a dummy for those who declare that religion is very important in their lives.<sup>9</sup>

We use as an additional regressor an objective health indicator, namely the number of activities of daily living (ADLs) that the respondent has difficulties with. Such functional limitations are likely to make an individual less able to protect herself in case of an emergency but also less mobile and therefore less exposed to a terrorism incident that may occur in a public venue. Moreover, our dataset provides information on respondents' cognitive abilities that is not typically available in most surveys. Such information can be very relevant since cognitive abilities may influence how individuals recall and process information and subsequently form their perceptions about terrorism. We use as a measure of respondents' mathematical skills the number of correct answers to a numeracy test (five successive subtractions of the same number), and as a measure of their memory capacity the number of words correctly recalled out of a list of ten that is read to them by the interviewer.

Education could also shape perceptions about terrorism, since more educated individuals typically have easier and wider access to information related to terrorism (e.g. experts' evaluations of terrorist threats), and they may also be able to process such information more efficiently. Moreover, we distinguish those who make regular use of the internet (another important source of information), from those who do not. We also use respondents' visits to their neighbors as an indicator of sociability and integration to the local community, and include a dummy for veteran status because those with military experience may evaluate terrorist threats differently than the rest of the population.

The place of a respondent's residence could influence her views and feelings about terrorist threats, especially if it is perceived as a likely target of a terrorist attack. Due to privacy concerns, the most disaggregated information about place of residence that we can use refers to the US Census divisions.<sup>10</sup> Finally, we examine how answers to the terrorism-related questions are affected by the time elapsed (measured as the logarithm of months) between the survey interview and September 2001. We would

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<sup>9</sup> One should note that having no religious preference is not equivalent to claiming that religion does not play an important role in one's life, since 21% of those with no religious preference state the opposite.

<sup>10</sup> These are: i) New England (used as the base category in our specifications); ii) Middle Atlantic (which includes New York); iii) South Atlantic (which includes the District of Columbia); iv) East North Central; v) East South Central; vi) West North Central; vii) West South Central; viii) Mountain; ix) Pacific.

expect that the longer this time distance is, the less intense the insecurity due to terrorism should be.

The distribution of the answers to the three terrorism-related questions across different values of the socio-economic variables just discussed can be seen in Table 1. Columns 1 and 2 record the proportions of those who feel not at all insecure and very insecure respectively. Column 3 denotes the mean expectation of a bioterrorist attack in the US and column 4 the mean expectation of becoming a victim of bioterrorism.<sup>11</sup> We see that the insecurity due to terrorism and the expectation of being a victim are greater for those aged less than 65<sup>12</sup>, females, the depressed, African Americans and other races, the less educated, the less well off, those who have not served in the military, those for whom religion is important, the Jewish, and those living in New England, in the Middle Atlantic and East South Central census divisions. There is less variability with respect to the expectation of a bioterrorist attack in the US in general, but it seems to be positively correlated with higher education, depression, regular use of the Internet, and larger economic resources.

When deciding which statistical models are appropriate for the three terrorism questions, the choice concerning Q1 is straightforward: since the answer can only be one of four ranked alternatives, we can use an ordered probit model. On the other hand, answers to Q2 and Q3 denote probabilities, and thus can take values ranging between zero and one.<sup>13</sup> These bounds imply that a statistical model of these probabilities should feature a conditional mean that is nonlinear in the regressors since as this mean gets closer to the bounds, changes in the regressors should influence it less and less. In contrast, a linear model produces a constant effect of the regressors across all ranges of the conditional mean, thus overestimating the effect for sample units with predicted means close to the bounds. In addition, nothing prevents a linear model from predicting out of range.

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<sup>11</sup> The median values for Q2 are close to the average ones, while the median value of Q3 is equal to 10 pp for all characteristics.

<sup>12</sup> Since we are using a cross-section, we cannot really distinguish age from cohort effects.

<sup>13</sup> Respondents give answers to Q2 and Q3 ranging from zero to one hundred, which we normalize to lie between zero and one. Given that these answers can equal zero, using a logarithmic transformation of the two expectation variables is not advisable (Papke and Wooldridge, 1996).

In order to address the aforementioned issues affecting Q2 and Q3, we use the fractional variable model of Papke and Wooldridge (1996, henceforth PW), who assume that the mean of the variable of interest conditional on the regressors  $\mathbf{x}$  is equal to  $G(\mathbf{x}\boldsymbol{\beta})$ , where  $G$  is the cumulative standard normal distribution and  $\boldsymbol{\beta}$  a vector of parameters. PW use a quasi-maximum likelihood estimation strategy that, under this assumption, results in consistent estimates (Gourieroux, Monfort and Trognon, 1984). The quasi ML estimation needs to be performed by using a member of the linear exponential family of distributions, and we follow PW in choosing the Bernoulli distribution. Hence, the log likelihood of an individual  $i$  reporting an answer  $y_i$  to Q2 or Q3 is given by:

$$l(y_i) = y_i \ln G(\mathbf{x}_i\boldsymbol{\beta}) + (1 - y_i) \ln(1 - G(\mathbf{x}_i\boldsymbol{\beta}))$$

The quasi ML approach proposed by PW has been found to perform very well in estimation problems involving fractional variables (Kieschnick and McCullough, 2003) and requires no additional assumptions about other features of the data generating process (e.g. about the variance of the errors, which are heteroskedastic as the conditional mean approaches zero or one). Therefore, standard errors of the estimates need to be corrected for possible misspecifications of the likelihood, and hence we obtain them by using 500 bootstrap replications.

Marginal effects from our estimation are shown in Table 2 (more details on the calculation of marginal effects can be found in Appendix A.1).<sup>14</sup> In columns 1 and 2 we display the effects and their standard errors on the probability of not feeling insecure at all due to terrorism, while in columns 3 and 4 we display the corresponding magnitudes for the probability of feeling very insecure. Columns 5 and 6 show the results corresponding to the expectation asked in Q2 and columns 7 and 8 those for Q3. For age, numeracy and recall scores, number of ADLs and number of months since 9/11, the marginal effects show the change in the relevant magnitude when the variable changes by one unit.

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<sup>14</sup> We do not show any regression coefficients since in the case of nonlinear models they contain little quantitative information (they are available from the authors upon request).

Women's sense of security seems to have been greatly shaken as a result of the 9/11 attacks, since they are more likely by almost 10 pp to report that they feel very insecure. They also think that there is a higher chance (7 pp) of being a victim of a future bioterrorism incident, while there is no difference between them and males with respect to the expectation of a bioterrorist attack in the US in general. These results provide further support to the aforementioned existing findings about gender differences in insecurity, and show that such differences persist even after controlling for education, depression, cognitive abilities and economic resources.

Depression, which is likely to result in a pessimistic outlook on life, affects responses in all three questions. Those suffering from depression are more likely to feel very insecure (6.3 pp), to anticipate that a bioterrorist attack will take place the next five years in the US (3.9 pp) and to be victims of such attacks (2.4 pp).

Race also seems to have a large effect on the terrorism-related variables, given that African Americans assign a much lower probability than whites to a major bioterrorist attack taking place in the US in the next five years (8 pp). On the other hand, African Americans are more likely by 6.3 pp to feel insecure as a result of 9/11. However, they are as likely as whites to expect to be victims of bioterrorism. Other races differ from whites mainly on the general expectation about a bioterrorist attack in the US (its effect is smaller by 3.9 pp).

A college graduate exhibits a significantly lower probability (4.6 pp) to declare that her personal sense of security has been greatly shaken by the 9/11 attacks. The general expectation of a bioterrorist attack in the next five years is higher for high school graduates (1.9 pp) relative to their less than high school counterparts, while the effect is not statistically significant for those with a college degree. On the other hand, when asked about the expectation of being a victim of such an attack, college-educated individuals report a lower probability (1.3 pp, significant at 10%). The negative correlation between educational attainment and perceived level of security could be attributed to the increased capacity of the better educated to realize that terrorist attacks are very low probability events. Similar results are derived for those who make regular use of the internet, suggesting that access to more information is not translated into higher fear and insecurity.

Veterans find a major bioterrorism incident more likely to happen in the next five years by 2.6 pp, and their personal sense of security is less affected by the 9/11 attacks by 1.3 pp (significant at 10%). This result could mean that experience in the military makes one more attuned to the threats facing the country in general and also more likely to realize that being victimized from a terrorist attack is statistically not very probable.

Economic resources do not seem to have a significant influence on the personal sense of security. On the other hand, household income is positively correlated with the general expectation of a major bioterrorist attack in the next five years: individuals at the top income quartile assign a higher probability (4.4 pp) to this event. When it comes to the risk to the respondent's life, economic resources do not play any role. The above results point to the development of differing concerns about terrorist threats across population groups: on the one hand, the less educated and those without military experience appear more worried about their personal security while veterans, the better educated and the better off consider a bioterrorist attack in US territory as more likely to happen.<sup>15</sup>

The literature on the fear of crime has pointed out that frequent contacts with neighbors can reduce apprehension by strengthening the feelings of interpersonal trust (see Crawford, 1997). However, our results challenge those findings, since they suggest that those who have such contacts have a higher probability (2.7 pp) to declare that their personal sense of security has been greatly affected by the events of 9/11. This could be due to the fact that a terrorist attack is an event against which one can not be protected through good relationships with neighbors and integration to the local community. Instead, such contacts seem to intensify the perceived threat from terrorism, maybe by mutual reinforcement of fear.

The importance of religion has a large effect on the feeling of personal insecurity (3.4 pp) as well as on the expectations of a bioterrorist attack in the US (1.5 pp) and of being a victim of bioterrorism (2.9 pp). However, conditional on the importance of religion, we do not find any significant influence of particular religious faiths on the answers to any of the three terrorism questions, with the notable exception of Jewish

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<sup>15</sup> Various studies have found that people tend to separate their personal concerns from social or national issues (see for example Sears and Funk, 1991, and Funk, 2000).

respondents, who are much more likely than people of other faiths to feel both insecure due to terrorism (12.2 pp) and to expect to be victims of bioterrorist attacks (5 pp).

We do not find any significant relationship of our objective health indicator and the personal sense of security or the fear of being a victim of bioterrorism. This suggests that a decreased exposure to terrorist attacks due to mobility problems offsets the presumably higher vulnerability felt by those who suffer from such problems. On the other hand, we find that each additional limitation in ADLs, increases the expectation that a bioterrorist attack will take place in the next five years by 0.9 pp.

The time distance from the events of September 2001 seems to weaken the strong emotions that they created, given that each additional month since then makes respondents less likely to be insecure by 0.3 pp and reduces their expectation of a bioterrorist attack by a similar magnitude. However, the passage of time does not seem to lessen respondents' fear of being victims of a bioterrorist attack. Interestingly, better memory skills make respondents more likely to feel very insecure (one additional word recalled adds 0.3 pp to the probability) and increase their expectation about a future bioterrorist attack (one word by 0.5 pp), possibly because a better memory makes it easier to recall the horror of the 9/11 attacks. These results are consistent with the notion (see Loewenstein, 1996) that vividly recalled traumatic events affect, either through temporal proximity or better memory, both the subjective expectations about them (Tversky and Kahneman, 1973), as well as individuals' emotional response to them (Miller, Levin, Kozak, Cook, McLean and Lang, 1987). On the other hand, the ability to perform basic numerical operations, which may reflect a better understanding of the objectively low probabilities to be directly affected by a terrorism incident, reduces both the sense of personal insecurity (one additional score point by 0.6 pp) and the fear of being a victim of a bioterrorist attack (one point by 0.3 pp).

We find quite significant regional effects on the answers to all three questions on terrorism. In particular, we find that the personal sense of security has been significantly less affected for respondents living in the four census divisions that are most distant from where the 9/11 attacks took place, namely in the Pacific, Mountain, West North Central and West South Central divisions (we also derive significant negative effects for the East North Central division). In contrast, we do not find significant differences among



respondents living in New England (the base region) and Middle and South Atlantic (all three regions were connected in one way or another to either the 9/11 or the subsequent anthrax attacks). These results may also be due to differences in the population density in those regions, given that a terrorism incident can have multiplicative effects in populated areas.<sup>16</sup> The picture is quite different for the general expectation of a bio terrorist attack that is estimated to be lower in all census divisions but the Mountain, compared to the base region. As for the likelihood of being a victim of a bioterrorist attack, those living in the Middle Atlantic and East South Central regions are as likely as those living in New England to report a higher probability than those who live in the remaining regions. All in all, our results suggest that the region of residence strongly influence the respondents' perceptions about terrorism, with those living in the Northeast being generally more worried than the rest of the population.

We checked the robustness of the above results in a number of ways. First, it could be argued that depression is an endogenous variable, since it might be partly due to the fear of terrorism. Similarly, the importance of religion in the respondents' lives could be endogenous if fear and anxiety about terrorism make people more religiously observant.<sup>17</sup> Since both of these variables are binary indicators, we cannot use in the models for Q2 and Q3 the instrumental variable procedure proposed by Papke and Wooldridge (2008), which can be implemented only for endogenous continuous regressors in the context of fractional variable models. In addition, instrumental variable estimation in an ordered probit model for Q1 results in an extremely complicated likelihood function that is very difficult to make converge. Hence, in order to address this possible endogeneity issue and since we have information on depression and the importance of religion from the 2000 HRS, we reestimated our models after substituting the lagged values of those two variables for the contemporaneous ones. The only change in the results concerned the effect of the importance of religion on the expectation of a bioterrorist attack in the US, which was somewhat reduced in value (1.0 pp instead of 1.5

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<sup>16</sup> New England, Middle and South Atlantic represent the three most densely populated areas, while Mountain, West North Central and West South Central the least populated ones.

<sup>17</sup> According to a Gallup poll however, while weekly church attendance increased significantly in September 2001, it returned to pre-9/11 levels two months later (see <http://www.newsbatch.com/rel-9-11churchatt.html>).

pp) and in statistical significance (p-value: 0.088). All other marginal effects remained substantially unchanged.

In addition, we ran simple linear regressions for Q2 and Q3, using both the contemporaneous and lagged values of the two possibly endogenous variables as well as linear instrumental variable regressions (using the lagged variables as instruments). For all regressors, we find very similar or, in some cases, larger effects from the linear models.<sup>18</sup> As already discussed, it is to be expected that a linear model will produce these larger effects, and hence our results from the PW models are likely to be conservative estimates of the influence of the respondents' socio-economic characteristics on the two variables denoting expectations about terrorism.<sup>19</sup>

#### **IV. Household asset investment**

Households' portfolio decisions can have important implications for their economic welfare as well as for aggregate asset demands and asset pricing.<sup>20</sup> As a result, we find it worthwhile to examine whether the insecurity that terrorism generates and the expectations about future attacks affect household ownership of shares, bonds, business and life insurance.<sup>21</sup>

When modeling the ownership of each asset we use a probit specification that includes as regressors, in addition to the terrorism-related variables, a rich set of household attributes. More specifically, we control for age, gender, race, marital and labor force status, educational attainment, having children as well as income and wealth

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<sup>18</sup> As an example, the effect of depression on the probability of becoming a victim of bioterrorism becomes more than three times as large at 7.7 pp (significant at 1%), when estimated via the linear instrumental variables model.

<sup>19</sup> The results from these robustness checks as well as those from other checks discussed in subsequent sections are available upon request from the authors.

<sup>20</sup> Campbell (2006) provides an extensive discussion of recent developments in household finance. See also Hurd (2002), for an early analysis of the portfolios of elderly households using data from the AHEAD (Asset and Health Dynamics among the Oldest-Old) survey.

<sup>21</sup> It would be also interesting to study ownership transitions between 2000 and 2002, by estimating for example a two-stage Heckman selection model. However, this is infeasible in our case since the first stage would have to be estimated using data from the 2000 wave, while we do not have information on the terrorism-related variables in that year. Using instead only the relevant subsample in 2002 (e.g. the one consisting of owners in 2000, when studying transitions out of ownership) in order to estimate a probit for ownership would very likely lead to inconsistent estimates. This would happen because such a subsample would most probably not be representative of the population (due to selection on unobservables), which would make the error correlated with the characteristics of the sample.

quartiles.<sup>22</sup> These variables represent a standard set of regressors that has been used, in earlier studies of household asset investment (see for example the empirical contributions in Guiso, Haliassos and Jappelli, 2002). We also account for self-reported health and limitations in ADLs (an objective health indicator), since there is evidence that households facing health problems are less likely to invest in shares (Rosen and Wu, 2004). We include the sociability indicator of Hong, Kubik and Stein (2004), namely whether respondents visit their neighbors, because these authors found that social interactions encourage stockholding by lowering information-related costs.

Since attitudes towards risk are likely to influence asset investment decisions, we use information on risk aversion that can be gleaned from a series of income gamble questions with mean preserving spreads. In addition, the survey provides information on the time horizon each household has in mind when making investment decisions. Unfortunately, in the 2002 HRS questions on both risk aversion and investment horizon are asked only of those that are aged 65 and lower. Given that age is exogenous, the subsample in which there is information on those two variables is produced through stratification by an exogenous variable, which does not affect the consistency of our coefficient estimates (see for example Gourieroux and Jasiak, 2007).

Recent research has emphasized the role of cognitive abilities on stockholding (see Christelis, Jappelli and Padula, 2008), and thus we include the recall and arithmetic scores already discussed in Section III. In a related vein, we add a dummy for regular internet usage because there is evidence that it encourages stockholding by providing cheaper access to financial information (Bogan, 2006). In addition, we use an indicator of being depressed as a measure of pessimism. Since we have already showed that depression is positively associated with perceptions about terrorist threats, by controlling for it we can examine the effects of the terrorism-related variables on asset choices net of pessimism and of a negative psychological outlook. Finally, we include a set of dummies representing the aforementioned nine US Census divisions.

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<sup>22</sup> Controlling for economic resources is dictated both by theory, with its emphasis on ‘cash on hand’ as a key determinant of asset investment, and by the need to avoid confounding the role of other variables included in the specification with that of income and wealth. In each specification we exclude from total net wealth the value of the asset in question in order to avoid endogeneity problems.

It is important that our specification allow for different effects of terrorism across genders, since in Section III we have identified strong gender differences with respect to the perception of terrorist threats. These differences are consistent with existing evidence on the relationship between gender and emotional reactions involving fear, worry, anxiety and depression. In addition, a growing literature in behavioral finance has recently emphasized the asymmetric way with which men and women perceive financial risks and make decisions about their investments. For instance, Barber and Odean (2001) show that men trade stocks excessively, given the large cost of frequent transactions. Furthermore, a number of studies have found that females tend to be more risk averse and worry more than men about financial decisions.<sup>23</sup>

Due to the above considerations, and since information for stocks, bonds (both can be held directly and indirectly through mutual funds and retirement accounts) and own business is available only at the household level, we estimate separate probit models for couples and singles. In the case of couples we include one terrorism-related term for each partner, while for singles we include the term and its interaction with a dummy for females.<sup>24</sup> On the other hand, information on life insurance is available at the respondent level. As a result, we estimate a probit for life-insurance on individuals, while controlling for marital status. We again allow for gender-specific effects of the terrorism-related variables through appropriate interaction, and cluster standard errors at the household level.<sup>25</sup>

We use one terrorism-related variable at a time, due to their substantial conceptual overlap. Marginal effects for each of the three variables are shown in Table 3 (more details on the calculation of marginal effects are given in Appendix A.1). In order to keep our specification parsimonious, we use a binary indicator for the variable denoting

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<sup>23</sup> For women's propensity to assume lower risks see Jianakopoulos and Bernasek (1998) and Powell and Ansic (1997). For an overview of non-academic reports that highlight the differences in financial decision making across genders, see Table 1 in Ricciardi (2008), who also reviews the literature on gender behavioral biases.

<sup>24</sup> Given the richness of our specification, the remaining characteristics in the case of couples represent a combination of the information from the two partners. In particular we use average age, worse reported health status, total number of limitations in daily activities and the maximum of: educational level, recall abilities, willingness to assume risk, investment horizon, familiarity in using the internet, frequency in visiting neighbors and depression. Furthermore, the household is determined to be in the labor force if any of the two partners is working. We have also run our regressions with separate terms for each partner and the results remain essentially unchanged.

<sup>25</sup> We compute robust standard errors for all specifications.

insecurity due to terrorism, which is equal to one if the respondent feels very insecure and zero otherwise. If not for this, we would have four additional terms that represent different levels of insecurity, for both couples and singles. In the case of the two continuous terrorism expectation variables, marginal effects represent the change in the probability of the asset choice of interest when the expectation increases by 10 pp. In the case of stocks, bonds and own business, samples contain roughly (there are small differences across specifications) 1,400 and 1,220 observations for couples and singles respectively, while for life insurance the sample size is approximately equal to 5,600.

Women's perceived sense of security seems to have economically meaningful effects on the decision to invest in shares. In particular, we find that among couples the female partner's perceived insecurity can negatively influence the household's decision to invest in stocks by 7.3 pp. Given that the prevalence of stockholding among couples in the HRS is 56%, this effect is clearly economically significant, and it is estimated with precision as well. Furthermore, single women who are afraid of becoming victims of a bioterrorist attack exhibit a modestly lower probability (1.2 pp) to invest in stocks, though the effect is less precisely estimated (p-value: 0.06). On the other hand, the general anticipation of a bioterrorist attack seems to influence positively the decision of both men and women in a couple to hold stocks, but the estimated magnitude (roughly equal to 0.75 pp) is not economically relevant. We find no effect of this expectation on singles either.

We then examine whether the terrorism-related variables influence investments in bonds, which are considerably less risky financial instruments than shares, and owned by 61% of couples and 39% of singles in the HRS sample. However, just as an investor could switch from stocks to bonds to reduce her portfolio's riskiness, she could also switch from bonds to cash for the same purpose. Therefore, the effects of increased risk due to terrorism on bondholding could be of either sign. In our results, we find that for couples, the insecurity due to terrorism makes men more likely by 6.8 pp to hold bonds. This suggests that they view bonds as safer investment vehicles in times of increased uncertainty. As for singles, none of the terrorism-related variables we examine seems to have any effect on bond ownership.

Private business equity represents a risky and illiquid household investment that is not very prevalent among either couples or singles (ownership rates in the HRS sample are about 13% and 5% respectively). However, as Gentry and Hubbard (2004) point out, private business owners form a group that is particularly important for aggregate asset demands and asset pricing. In the case of couples, none of the three terrorism-related variables seem to influence business ownership. On the other hand, we find that single males are strongly less likely (9.5 pp) to own a business when feeling very insecure in the aftermath of the 9/11 attacks. This result suggests that they view their business as not adequately protected from the consequences of terrorism (e.g. due to insufficient commercial insurance coverage), and thus feel compelled to sell it or close it down.

When examining the effects of terrorism on ownership of life insurance (held by roughly 75% of males and 63% of females in the HRS sample), one needs to take into account the fact that life insurance policies typically do not contain terrorism exclusions, which also can not be added retrospectively. Hence, we would expect that the events of September 2001 would induce individuals to buy life insurance. Indeed, we find that the insecurity generated by terrorism makes females quite more likely (3.3 pp) to own a life insurance policy. Moreover, we find for males a statistically significant but economically unimportant (0.8 pp) positive effect of the general anticipation of a bioterrorist attack on having life insurance.

To check the robustness of our results, and in order to add to our sample those aged above 65, we also estimated probit regressions for the ownership of the aforementioned four assets excluding the variables denoting risk aversion and financial planning horizon.<sup>26</sup> We expect in any case to find some quantitative differences in the marginal effects with respect to those from the smaller sample. This may happen because in nonlinear models these effects depend on all characteristics of the sample units, and such characteristics can differ across the two samples (e.g. those above 65 have typically quite lower incomes and are in worse health than their younger counterparts). Our estimates about the negative influence of terrorism-induced insecurity on investment in risky assets remain very relevant economically, if a bit smaller in absolute value for

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<sup>26</sup> This increases our sample size to roughly 4,080 and 4,640 observations for couples and singles respectively (for stocks, bonds and own business), and to 14,420 observations for life insurance.

females in couples with respect to stockholding (3.2 pp, now less precisely estimated with a p-value equal to 0.059) and for single males with respect to business ownership (3.8 pp, p-value: 0.04). In addition, we now find quite strong and statistically significant negative effects of the aforementioned insecurity on stockholding for single females (3.3 pp), and on business ownership for females in a couple (2.6 pp). On the other hand, males in a couple do not seem to be affected any more with respect to their investment in bonds when feeling insecure, which suggests that the corresponding strong result from the smaller sample might not be very robust. Finally, the effects of the general expectation of a bioterrorist attack now become statistically insignificant for males in a couple, and even smaller (0.4 pp, p-value: 0.065) for their female partners.

All in all, our results concerning asset investments are consistent with the notion that terrorism makes households less disposed to assume economic risks, and this drives them away from stocks (through females) and business ownership (mostly through single males). As already discussed, this result is consistent with aspects of both traditional expected utility theory (and its extensions) and prospect theory. Furthermore, one way for individuals to protect to some extent their families from the economic consequences of terrorism is to buy life insurance, and we see in our sample that this indeed happens for females. All the above effects are due to the insecurity felt in the aftermath of the 9/11 attacks, while the two expectation variables corresponding to Q2 and Q3 seem to have very little relevance for household asset investment. Finally, it is important to note that the estimated effects of the terrorism-related variables are net of the influence of several powerful predictors of financial choices like education, gender, race, health, financial attitudes and economic resources, and thus should be conservative estimates of the impact of terrorism on household asset investments.

## **V. Household expenditure**

We now turn to the effect that the expectation and fear of terrorism have on the spending patterns of HRS households. Since 2001 the HRS has administered the Consumption and Activities Mail Survey (CAMS), a supplemental survey sent by mail to a random sub-sample of HRS respondents in the year following the main interview, and

in which households are asked to report expenditures over the previous 12 months.<sup>27</sup> We use data on expenditures from the 3,254 households that responded to the CAMS mailed out in the fall of 2003 and we combine it with the data from the 2002 HRS wave in order to examine the impact of perceptions about terrorism on household spending.

There could be a number of reasons why such an impact could be negative. First, as we have already pointed out, terrorism represents a potential negative shock to economic resources, and this could reduce household expenditure, especially on highly elastic goods. Second, terrorism represents a largely undiversifiable risk that increases the uncertainty regarding future earnings and asset income flows, and thus could induce saving for precautionary reasons. Third, households could reduce spending on goods or activities that could leave them potentially exposed to terrorist attacks (e.g. travel or use of public transportation). On the other hand, households might spend more on goods and services that could counter the effects of terrorism (e.g. medications), or help avoiding them (e.g. use of the car instead of public transportation). In addition, the prospect of living in a world struck by terrorism might make households more impatient, thus inducing them to decrease their saving.<sup>28</sup> Hence, the overall effect of the fear of terrorism on household expenditure is a priori ambiguous. In any case, it would be also interesting to examine whether there is any shift in spending among different items.

We first examine the effect of the terrorism-related variables on total non-durable expenditure, which includes spending on the following goods: i) food at home and alcohol; ii) food outside the home; iii) clothing; iv) personal care products;<sup>29</sup> v) recreation (consisting of the sub-categories of spending on travel, tickets to movies and sporting events, gyms and exercise equipment, and hobbies); vi) vehicle costs (gasoline, maintenance, insurance); vii) medical expenses (drugs, supplies, insurance, services); viii) housing expenses (supplies, dry cleaning and laundry services, gardening supplies, gardening services, repair materials, repair and maintenance services); ix) utility bills

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<sup>27</sup> For more details on the CAMS see Hurd and Rohwedder (2005).

<sup>28</sup> There is also evidence (see Lowenstein, 1996, 2000) that when individuals are under the influence of visceral factors, they often behave as if their discounting of the future has increased.

<sup>29</sup> These include hair care, shaving and skin products, as well as hair dresser and manicure services, but there are no separate questions on any of these items.



(heating fuel, electricity, water and telephone); x) transfers to other family members; xi) charitable contributions.

First, we ran a median regression of the logarithm of total non-durable expenditure on the terrorism-related variables and various demographics typically used in previous studies of household expenditure (family size, age, self-reported health, race and education).<sup>30</sup> We found no statistically significant effect for any of the terrorism-related variables, either for couples or for singles. This result suggests that the already discussed conflicting effects of terrorism perceptions on expenditure may be canceling each other out.

We then examine the expenditure share of the aforementioned eleven major non-durable categories, as well as the share of each item within them, by using the Quadratic Almost Ideal Demand System of Banks, Blundell and Lewbel (1997, henceforth BBL). BBL derive an estimating equation that relates the share of expenditure on each item to the logarithm of total non-durable expenditure and its square, plus demographics. Since the expenditure terms are likely to be endogenous, BBL instrument them with the logarithm of income and its square. We employ the same instruments as BBL in the context of the fractional variable model discussed in Section III, given that expenditure shares are bounded between zero and one. Since the total expenditure variables are continuous, we can use this time the instrumental variable procedure proposed by Papke and Wooldridge (2008).

Our specification includes the demographic variables used earlier when modeling total non-durable expenditure.<sup>31</sup> As with the asset participation equations of Section IV, we allow asymmetric effects of the terrorism-related variables across genders, and thus we estimate models independently for couples (with separate terms for the 2 partners) and singles (interacting the terrorism-related variables with gender). Marginal effects derived from our estimation are shown in Table 4 for nine of the major non-durables expenditure shares. We will also refer to the results from some of the various expenditure

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<sup>30</sup> See for example Banks, Blundell and Lewbel (1997) and Browning and Collado (2007).

<sup>31</sup> In order to make our results robust to outliers, we drop observations with values of the expenditure shares at the top two percentiles of the distribution.

sub-categories, but will not show them due to space constraints.<sup>32</sup> The estimation samples contain roughly 950 and 750 observations for couples and singles respectively. In order to facilitate the assessment of the economic significance of our results, we display in Table A.1 of the Appendix the median expenditure shares and amounts for each major expenditure item.

Expenditure on food at home and alcohol, food outside home, and medical expenses do not seem to be affected by the terrorism-related variables, neither for couples nor for singles. A very small (and significant at 10%) effect is found for the expectation of a bioterrorist attack in the US, which seems to induce the male in a couple to reduce clothing expenditure by 0.08 pp (3.7% of the median share (m.s.)). Quite stronger effects are found for vehicle costs for couples, where insecurity after 9/11 induces the male partner to increase the share of expenditure on vehicles by 2.5 pp (23.4% of the m.s.), mostly through additional spending on gasoline. Furthermore, the expectation of a bioterrorist attack in the US very slightly increases the share of expenditure on vehicles of both partners by 0.22 pp (2% of the m.s.), again through higher spending on gasoline. This evidence is consistent with a more intensive use of vehicles due to the potentially higher exposure to terrorism when traveling by public transportation.

Recreational activities are candidates for reduced expenditure because of terrorism, given that they involve being in public places and possibly using public transportation. In addition, they are largely discretionary expenditures with a high elasticity of demand, and thus more likely to be affected by an expected drop in economic resources. We indeed find that, when expecting a bioterrorist attack in the US, male partners in a couple cut their share of recreational spending by 0.23 pp (4.1% of the m.s.), mostly through a reduced expenditure share for travel and for tickets to movies and sporting events, while for the female partner the decline is by 0.18 pp (3.1% of the m.s. and significant at 10%) and is due to a reduced expenditure share for tickets. The fear of becoming a victim of a bioterrorist attack also makes female partners in a couple spend less on recreation by 0.37 pp (6.4% of the m.s.), again through decreased spending on travel and tickets.

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<sup>32</sup> The results for all expenditure categories not shown in Table 4 are available upon request from the authors.

The terrorism-induced insecurity that is felt by the female in a couple increases the couple's housing expenses by 2.8 pp (45.8% of the m.s.), mainly through the increase in the expenditure share of housing supplies and repairs. This result suggests that the female partner expects the couple to spend more time at home (possibly because it would feel more protected from terrorism therein) and hence wants the house to be in a good state.

Females in a couple who feel insecure because of terrorism increase their share of spending on personal care products by 0.4 pp (31.5% of the m.s.), which could reflect an attempt to feel better while living under the threat of terrorism.<sup>33</sup> On the other hand, single females decrease moderately their spending on these products by 0.11 pp (6.9% of the m.s., p-value: 0.078) when expecting to become victims of a bioterrorist attack, possibly because they have quite lower economic resources than couples and thus less margin to increase spending on discretionary items.

Finally, charitable contributions and expenses on utilities do not seem to be affected with any economic or statistical significance by expectations and the insecurity due to terrorism, neither for couples nor for singles. On the other hand, we find positive effects on family transfers given by single males due to the expectation of a bioterrorist attack in the US (0.55 pp, 29.9% of the m.s.) and the expectation of becoming a victim of a bioterrorist attack (0.85 pp, 45.7% of the m.s.).

As a robustness check, we also run linear instrumental variable models as in BBL and found that, for both couples and singles, the effects of the terrorism-related variables were mostly very similar and sometimes quite stronger in terms of economic significance than those estimated from the PW model.<sup>34</sup> As was discussed in Section III, these stronger results are probably due to the linearity of the model, which ignores the bounded nature of the expenditure share variables. Therefore, we prefer to err on the side of cautiousness and present the estimates from the PW model as more conservative estimates of the effect of the perceptions about terrorism on household expenditure.

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<sup>33</sup> We also find a negative but economically insignificant effect of the fear of becoming a victim on personal care spending by females in a couple.

<sup>34</sup> As an example, females in a couple were found in the linear model to reduce the share of expenditure on recreation by 3 pp (p-value: 0.035) when expecting to become a victim of a bioterrorist attack. This estimate is roughly eight times larger in absolute value than the one obtained from the PW model.

## VI. Conclusions

In this paper we have used micro data from the HRS in which respondents are asked questions on their insecurity and expectations about terrorism in the aftermath of 9/11 and the subsequent anthrax attacks that took place in the US. We use this person-level information in order to explore the factors that shape individuals' perceptions about terrorism and to quantify the effects that terrorism has on household portfolio choices and spending patterns.

We find that individuals who could be in a better position to acquire and process information about terrorist threats (due to higher education, better numeracy skills, previous military experience or large economic resources), tend to worry less about their personal security and more about the threat to the country as a whole. On the other hand, being a female, Jewish and having reduced numeracy skills, all make individuals fear about themselves but do not increase their expectation about a bioterrorist attack in the US in general. We also find that depression and religious devotion induce fear both at the personal level and for the nation. Finally, we show that the passage of time and reduced memory ability tend to alleviate the insecurity created by 9/11, but they do not seem to influence the fear of being a victim of bioterrorism. Our evidence could help to identify which population groups might be psychologically vulnerable to the threat of terrorist attacks and thus could be of use to policy makers.

Another result of our analysis is that insecurity due to terrorism has important negative effects on household stock investment. These effects are channeled through females, who also tend to buy life insurance when feeling insecure. In addition, fear of terrorism makes single men quite less likely to own a business. These results suggest that terrorism reduces households' appetite for economic risk, as predicted both by traditional and more recent behavioral models of financial decision-making. Hence, an appropriate policy response to this phenomenon would be to introduce measures that will make owners of those two assets feel more protected from the economic consequences of terrorism (e.g. cheaper and more extensive commercial insurance coverage), and therefore less hesitant to assume financial risk.

With regard to household non-durable expenditure, while we find no overall effect of the terrorism-related variables, we observe a shifting of spending from goods

that can potentially leave one exposed to a terrorist attack (travel and other recreational activities) towards goods that might help to cope with the consequences of terrorism materially (car and spending on the house) or psychologically (personal care products used by females in a couple).

Our study, apart from offering new evidence on the economic implications of terrorism at the micro level, may also provide insights into economic decisions taken by households when facing extremely uncertain events that may cause considerable fear and hardship. Our analysis points in particular to the fact that men and women, when experiencing the same extreme event, form quite different expectations and exhibit different levels of insecurity, which often result in divergent economic behavior. Such asymmetry in economic reactions across genders merits further investigation and highlights the need to consider heterogeneity in additional characteristics (e.g. education, cognitive abilities and marital status) and expectation formation when modeling saving and portfolio choices over the lifecycle.

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## Appendix A.1. Calculation of marginal effects

Given that marginal effects are nonlinear functions of the estimated parameters  $\hat{\beta}$ , we compute their point estimates and standard errors via Monte Carlo simulation (Train, 2003), by using the formula

$$E(g(\beta)) = \int g(\beta)f(\beta)d\beta$$

where  $g(\beta)$  denotes the marginal effect of interest and  $f(\beta)$  the joint distribution of all the elements in  $\beta$ . We implement this simulation estimator by drawing 1,000 times from the joint distribution of the vector of parameters  $\hat{\beta}$  under the assumption that it is asymptotically normal with mean and variance-covariance matrix equal to the maximum likelihood estimates. For a given parameter draw  $j$  we generate the marginal effect corresponding to each unit in our sample and then calculate the average marginal effect  $g(\hat{\beta}^j)$  as the weighted average (using sample weights) across units.<sup>35</sup> We then estimate  $E(g(\beta))$  and its standard error as the mean and standard deviation respectively of the distribution of  $g(\hat{\beta}^j)$  over all parameter draws.

When estimating the regressions for singles in Sections IV and V, marginal effects for females and males are computed by using the observations in the respective subsamples. Since in the case of singles there is an interaction term of the terrorism-related variable of interest and the female dummy, marginal effects for single females show the change in the relevant magnitudes when the values of both the non-interacted and interacted term are modified as specified in the text.

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<sup>35</sup> We do not evaluate marginal effects at sample means since this practice can lead to severely misleading results (see Train, 2003, pp. 33-34).

**Table 1: Distribution of answers to Q1-Q3 across selected characteristics of the survey respondents**

Variable	(1)	(2)	(3)	(4)
	Personal Sense of Security		Expectation of a Bioterrorist Attack in the US	Expectation to Become a Victim of a Bioterrorist Attack
	Not at all insecure	Very insecure		
Aged 50 - 65	0.16	0.18	0.63	0.21
Aged 65 plus	0.19	0.16	0.59	0.17
Male	0.25	0.11	0.61	0.14
Female	0.12	0.21	0.61	0.22
Depressed	0.15	0.27	0.63	0.22
Not depressed	0.18	0.15	0.60	0.18
Visits neighbours	0.16	0.17	0.60	0.19
Does not visit neighbours	0.20	0.17	0.62	0.20
Uses Internet regularly	0.16	0.12	0.63	0.19
Not a regular Internet user	0.18	0.19	0.60	0.19
Has children	0.17	0.17	0.61	0.19
No children	0.20	0.14	0.60	0.19
Religious very important	0.15	0.20	0.61	0.21
Religion not very important	0.21	0.12	0.61	0.16
Veteran	0.27	0.10	0.62	0.14
Not a veteran	0.14	0.19	0.60	0.21
White	0.17	0.15	0.62	0.18
African American	0.15	0.34	0.55	0.23
Other race	0.20	0.23	0.58	0.23
Less than high school	0.18	0.25	0.57	0.20
High school graduate	0.16	0.17	0.62	0.20
College graduate	0.20	0.10	0.62	0.16
Couple	0.17	0.15	0.61	0.18
Widow	0.17	0.21	0.58	0.18
Never married	0.22	0.16	0.60	0.23
Retired	0.19	0.17	0.60	0.18
Working	0.17	0.15	0.63	0.20
1st income quartile	0.19	0.24	0.58	0.20
2nd income quartile	0.17	0.19	0.59	0.20
3d income quartile	0.18	0.16	0.62	0.19
4th income quartile	0.16	0.11	0.63	0.17
1st wealth quartile	0.18	0.23	0.59	0.21
2nd wealth quartile	0.18	0.19	0.61	0.20
3d wealth quartile	0.18	0.15	0.61	0.19
4th wealth quartile	0.16	0.13	0.62	0.17
New England	0.16	0.16	0.63	0.20
Middle Atlantic	0.15	0.23	0.59	0.21
South Atlantic	0.17	0.20	0.61	0.20
East North Central	0.17	0.14	0.61	0.19
East South Central	0.18	0.21	0.60	0.21
West North Central	0.17	0.12	0.60	0.17
West South Central	0.17	0.19	0.62	0.19
Mountain	0.20	0.11	0.63	0.17
Pacific	0.20	0.12	0.60	0.16
Protestant	0.17	0.17	0.61	0.19
Jewish	0.13	0.23	0.61	0.22
Catholic	0.16	0.18	0.60	0.19
Other religions	0.28	0.19	0.57	0.16
No religious preference	0.25	0.11	0.64	0.17

**Note:** Columns 1 and 2 display weighted sample proportions, while columns 3 and 4 weighted sample means.

**Source:** 2002 HRS.

**Table 2: Marginal effects of characteristics on the three terrorism-related variables**

Variable	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
	Personal Sense of Security								Expectation of a Bioterrorist Attack in the US				Expectation to Become a Victim of a Bioterrorist Attack			
	Not at all insecure				Very insecure				Marg. Effect		Std. Error		Marg. Effect		Std. Error	
	Marg. Effect	Std. Error	Marg. Effect	Std. Error	Marg. Effect	Std. Error	Marg. Effect	Std. Error	Marg. Effect	Std. Error	Marg. Effect	Std. Error	Marg. Effect	Std. Error	Marg. Effect	Std. Error
Age	0.002	0.000 ***	-0.002	0.000 ***	0.000	0.000 ***	0.000	0.000 ***	-0.002	0.000 ***						
Female	-0.104	0.007 ***	0.095	0.006 ***	0.010	0.007	0.071	0.005 ***								
Depressed	-0.056	0.006 ***	0.063	0.007 ***	0.039	0.007 ***	0.024	0.006 ***								
Visits neighbours	-0.030	0.005 ***	0.027	0.005 ***	-0.016	0.006 ***	-0.001	0.004								
Uses internet regularly	0.018	0.005 ***	-0.017	0.005 ***	0.008	0.006	-0.005	0.004								
Has children	-0.007	0.011	0.007	0.010	-0.004	0.013	-0.003	0.009								
Religion very important	-0.037	0.005 ***	0.034	0.005 ***	0.015	0.005 ***	0.029	0.004 ***								
Veteran	0.014	0.007 *	-0.013	0.007 *	0.026	0.008 ***	-0.005	0.006								
African American	-0.054	0.007 ***	0.063	0.009 ***	-0.080	0.009 ***	0.011	0.007								
Other race	-0.012	0.014	0.012	0.014	-0.039	0.014 ***	0.025	0.013 *								
High school graduate	0.014	0.006 **	-0.015	0.007 **	0.019	0.007 ***	0.000	0.006								
College graduate	0.050	0.008 ***	-0.046	0.008 ***	0.007	0.010	-0.013	0.007 *								
Couple	-0.006	0.008	0.006	0.008	-0.024	0.008 ***	-0.008	0.007								
Widow	-0.008	0.009	0.008	0.009	-0.008	0.010	-0.018	0.008 **								
Never married	0.016	0.018	-0.013	0.016	-0.009	0.021	0.020	0.016								
Retired	-0.013	0.006 **	0.012	0.006 **	0.011	0.007	0.020	0.005 ***								
Working	-0.007	0.007	0.006	0.007	0.009	0.008	0.021	0.006 ***								
2nd income quartile	-0.006	0.008	0.006	0.007	0.022	0.009 **	0.009	0.006								
3d income quartile	0.002	0.008	-0.002	0.008	0.043	0.009 ***	0.011	0.007								
4th income quartile	-0.002	0.009	0.002	0.009	0.044	0.011 ***	0.001	0.008								
2nd wealth quartile	0.003	0.007	-0.003	0.007	0.004	0.008	0.000	0.006								
3d wealth quartile	-0.007	0.008	0.007	0.007	0.008	0.009	0.000	0.006								
4th wealth quartile	-0.013	0.008	0.013	0.008	0.012	0.009	-0.007	0.007								
Middle Atlantic	0.001	0.011	-0.002	0.013	-0.051	0.013 ***	-0.002	0.010								
South Atlantic	0.013	0.011	-0.015	0.012	-0.035	0.013 ***	-0.023	0.010 **								
East North Central	0.036	0.011 ***	-0.038	0.012 ***	-0.037	0.013 ***	-0.027	0.011 ***								
East South Central	0.005	0.014	-0.006	0.016	-0.051	0.015 ***	-0.004	0.013								
West North Central	0.041	0.012 ***	-0.041	0.013 ***	-0.047	0.014 ***	-0.034	0.011 ***								
West South Central	0.027	0.012 **	-0.028	0.013 **	-0.024	0.014 *	-0.027	0.011 **								
Mountain	0.059	0.014 ***	-0.056	0.013 ***	-0.016	0.015	-0.040	0.011 ***								
Pacific	0.044	0.012 ***	-0.044	0.013 ***	-0.055	0.014 ***	-0.041	0.010 ***								
Protestant	0.001	0.026	-0.003	0.025	0.020	0.026	-0.011	0.020								
Jewish	-0.090	0.028 ***	0.122	0.032 ***	0.009	0.032	0.050	0.024 **								
Catholic	-0.022	0.026	0.020	0.025	-0.012	0.026	-0.009	0.021								
No religious preference	0.039	0.028	-0.034	0.026	0.029	0.028	-0.010	0.022								
Number of ADL's	-0.001	0.003	0.001	0.003	0.009	0.004 **	0.003	0.003								
Word recall score	-0.003	0.001 **	0.003	0.001 **	0.005	0.002 ***	0.001	0.001								
Numeracy score	0.006	0.001 ***	-0.006	0.001 ***	0.000	0.002	-0.003	0.001 **								
Months after 9/11 (log)	0.003	0.001 **	-0.003	0.001 **	-0.003	0.001 **	-0.001	0.001								
Number of observations	15,289				14,206				13,962							

Note: \*\*\*, \*\*, \* denote statistical significance at 1%, 5% and 10% respectively.

**Table 3. Marginal effects of the three terrorism-related variables on household asset investments**

Asset	Gender	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)		(9)		(10)		(11)		(12)	
		Insecure		Expectation of a Bioterrorist Attack in the US		Expectation to become a victim of a bioterrorist attack		Insecure		Expectation of a Bioterrorist Attack in the US		Expectation to become a victim of a bioterrorist attack		M. Eff. Std. Error		M. Eff. Std. Error		M. Eff. Std. Error		M. Eff. Std. Error		M. Eff. Std. Error		M. Eff. Std. Error	
<b>Panel A. By Family Kind</b>																									
		<b>Couples</b>												<b>Singles</b>											
Shares	Male	0.051	0.031	0.008	0.004	**	-0.001	0.006	-0.073	0.059	0.003	0.008	-0.009	0.010											
	Female	-0.073	0.028	***	0.007	0.004	*	0.004	0.005	-0.033	0.035	-0.006	0.005	-0.011	0.006	*									
Bonds	Male	0.067	0.033	**	-0.002	0.004	-0.001	0.006	-0.035	0.066	0.001	0.008	-0.004	0.010											
	Female	-0.011	0.028		0.007	0.004	*	-0.003	0.005	0.001	0.034	-0.002	0.005	-0.003	0.006										
Own Business	Male	0.016	0.031		0.005	0.003	0.001	0.006	-0.095	0.017	***	-0.002	0.005	-0.005	0.008										
	Female	-0.016	0.023		-0.004	0.003	0.000	0.004	-0.003	0.018	0.001	0.003	0.005	0.004											
<b>Panel B. Individuals</b>																									
Life Insurance	Male	-0.026	0.024		0.008	0.003	***	0.003	0.004																
	Female	0.033	0.017	**	0.004	0.003	0.001	0.003																	

Note: \*\*\*, \*\*, \* denote statistical significance at 1%, 5% and 10% respectively.

**Table 4. Marginal effects of the three terrorism-related variables on household expenditure**

Item	Gender	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)		(9)		(10)		(11)		(12)	
		Insecure		Expectation of a Bioterrorist Attack in the US		Expectation to become a victim of a bioterrorist attack		Insecure		Expectation of a Bioterrorist Attack in the US		Expectation to become a victim of a bioterrorist attack		Insecure		Expectation of a Bioterrorist Attack in the US		Expectation to become a victim of a bioterrorist attack		Insecure		Expectation of a Bioterrorist Attack in the US		Expectation to become a victim of a bioterrorist attack	
		M. Eff.	Std. Error	M. Eff.	Std. Error	M. Eff.	Std. Error	M. Eff.	Std. Error	M. Eff.	Std. Error	M. Eff.	Std. Error	M. Eff.	Std. Error	M. Eff.	Std. Error	M. Eff.	Std. Error	M. Eff.	Std. Error	M. Eff.	Std. Error	M. Eff.	Std. Error
		<b>Couples</b>												<b>Singles</b>											
Food at Home and Alcohol	Male	0.0001	0.0142	0.0006	0.0018	-0.0053	0.0038	-0.1580	0.1129	0.0032	0.0042	-0.0026	0.0085												
	Female	0.0043	0.0144	0.0022	0.0016	0.0028	0.0024	0.0206	0.0177	0.0031	0.0049	-0.0002	0.0040												
Clothing	Male	0.0019	0.0050	-0.0008	0.0004 *	-0.0005	0.0010	0.0229	0.0806	0.0000	0.0016	0.0009	0.0026												
	Female	0.0034	0.0036	0.0000	0.0005	-0.0002	0.0006	-0.0047	0.0050	-0.0013	0.0023	-0.0006	0.0014												
Food Outside Home	Male	0.0151	0.0096	0.0006	0.0008	0.0023	0.0019	0.0618	0.1383	0.0010	0.0024	0.0007	0.0029												
	Female	-0.0025	0.0063	0.0005	0.0009	-0.0013	0.0010	0.0027	0.0082	0.0010	0.0019	0.0016	0.0014												
Personal Care	Male	-0.0004	0.0019	-0.0002	0.0002	0.0004	0.0004	0.0050	0.0227	0.0005	0.0004	0.0009	0.0008												
	Female	0.0041	0.0016 ***	0.0000	0.0002	-0.0006	0.0002 ***	-0.0001	0.0119	-0.0005	0.0005	-0.0011	0.0006 *												
Recreation	Male	-0.0004	0.0087	-0.0023	0.0009 ***	0.0015	0.0019	-0.0024	0.0613	-0.0004	0.0028	-0.0071	0.0052												
	Female	-0.0049	0.0067	-0.0018	0.0010 *	-0.0037	0.0013 ***	-0.0029	0.0059	-0.0007	0.0022	-0.0001	0.0014												
Medical Expenses	Male	-0.0176	0.0115	-0.0002	0.0012	-0.0016	0.0026	0.0483	0.1817	-0.0038	0.0030	0.0040	0.0055												
	Female	0.0128	0.0111	0.0020	0.0014	0.0003	0.0018	0.0075	0.0152	-0.0015	0.0025	-0.0003	0.0027												
Housing Expenses	Male	-0.0045	0.0129	0.0002	0.0011	0.0020	0.0024	0.0608	0.0925	-0.0035	0.0024	0.0032	0.0034												
	Female	0.0281	0.0113 ***	-0.0010	0.0014	-0.0006	0.0016	0.0096	0.0109	-0.0025	0.0015	-0.0019	0.0020												
Vehicle Costs	Male	0.0248	0.0110 **	0.0022	0.0009 ***	0.0020	0.0018	-0.0413	0.0646	-0.0018	0.0034	-0.0057	0.0036												
	Female	-0.0047	0.0070	0.0022	0.0008 ***	0.0019	0.0012	-0.0071	0.0097	0.0033	0.0035	-0.0006	0.0021												

Note: \*\*\*, \*\*, \* denote statistical significance at 1%, 5% and 10% respectively.

**Table A.1. Median Shares and Amounts of Annual  
Non-durable Expenditure for Major Items**

Item	(1)	(2)	(3)	(4)
	Median Share	Median Value	Median Share	Median Value
	Couples		Singles	
<b>Food at Home</b>	0.0784	1,800	0.0762	1,000
<b>Clothing</b>	0.0218	600	0.0222	360
<b>Food Outside Home</b>	0.0296	720	0.0220	300
<b>Personal Care</b>	0.0131	400	0.0162	240
<b>Recreation</b>	0.0571	1,560	0.0262	395
<b>Medical Expenses</b>	0.1218	3,700	0.1121	1,944
<b>Housing Expenses</b>	0.0616	1,594	0.0600	800
<b>Vehicle Costs</b>	0.1061	2,894	0.0943	1,455
<b>Utilities</b>	0.1232	3,429	0.1638	2,304
<b>Total Nodurable Expenditure</b>	-.-	30,763	-.-	15,306

**Note:** Median shares are computed as the weighted median of the shares across sample units. Medians of sub-aggregate items do not add up in general to the median of the corresponding aggregate magnitude.

**Source:** 2003 CAMS.



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