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The effect of combat exposure on financial problems

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ABSTRACT

This paper examines whether combat exposure leads to financial problems among surviving deployed veterans. We use restricted panel data for the years 2001 through 2016 from 64,508 deployed Millennium Cohort Study participants, and we accommodate real-world uncertainty with an information theoretic, semi-parametric Generalized Maximum Entropy model. The average predicted probability of developing a new major financial problem (such as bankruptcy) and greater financial distress increases 0.44 percentage points (21 percent relative to the mean probability) following a single combat exposure and increases 0.90 percentage points (43 percent relative to the mean probability) following multiple combat exposures. Simulation results identify policy-relevant characteristics to target before a veteran deploys. The results point toward veterans with poorer pre-deployment mental or physical health, veterans in enlisted ranks, and veterans between the ages of 26 and 36 as being less resilient to the effects of combat exposure on financial problems.

1. Introduction

Though over 2.7 million veterans received several hundred additional dollars from imminent danger pay and combat zone tax exclusions for each month of post-September 11, 2001 deployment (Pleeter et al., 2011; Wenger et al., 2018), a recent study suggests over a third of veterans may have encountered post-deployment financial problems meeting basic needs such as food, shelter, clothes, transportation, social activities, or medical care (Elbogen et al., 2012).[1] Furthermore, the study indicated financial problems are positively associated with homelessness, criminal arrests, alcohol misuse, drug misuse, suicidal behavior, physical aggression, and poor mental health (Elbogen et al., 2012). Veteran financial problems also create substantial risks for firms and the financial sector.

Combat exposure could have contributed to veteran financial problems as a result of neuropsychological degradation or behavioral changes. Many combat veterans have experienced post-deployment migraine headaches as well as declines in memory and sustained attention (Cesur et al., 2015; Vasterling et al., 2006). Additionally, combat exposure may lead to mental disorders (Cesur et al., 2013). Almost one fourth of deployed veterans are estimated to have post-traumatic stress disorder, and more than one in ten are estimated to have depression (Fulton et al., 2015; Gadermann et al., 2012). Veterans may employ risky or self-damaging strategies to escape

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[1] Research often uses different criteria to define a "veteran." Elbogen et al. (2012) classify only individuals who separated from the US military and reservists as veterans. Veteran can also refer to individuals serving in a specific military conflict (e.g. Vietnam Veteran). Our current study examines all individuals who served in the US military, regardless of whether they continued military service or received an honorable or dishonorable discharge, in support of the Global War on Terror. Our examination suggests policy implications affecting the needs of a broader population.

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emotional stress from combat exposure (US Institute of Medicine, 2013). Recent studies examining relationships between veteran combat exposure and educational attainment, cigarette consumption, substance use, domestic violence, and divorce suggest a wide range of non-pecuniary consequences that could harm economic well-being (Armey & Lipow, 2016; Cesur et al., 2016; Cesur & Sabia, 2016; Edwards, 2015).

While ongoing overseas conflicts have driven research interest in the costs of war, empirical limitations have led to an incomplete picture of veteran economic well-being following combat exposure (US Institute of Medicine, 2013). An economic analysis of a cross-sectional sample of 753 deployed and non-deployed veterans did not reveal an association between combat exposure and reduced household income (Edwards, 2015). However, deployment- and disability-related compensation can make detecting changes in spending, borrowing, and savings from income comparisons difficult, especially with a small sample. Furthermore, observable and unobservable characteristics of veterans who deploy overseas differ significantly from similarly aged counterparts, both outside and within the military, and empirical analyses of deployed veterans and non-deployed populations can be biased by pre-deployment differences related to economic well-being (Armed Forces Health Surveillance Center, 2007).

The current study uses new data and estimation procedures to better understand how combat exposure affects the economic well-being of surviving deployed veterans. We capture individual financial declines with restricted panel data for the years 2001 through 2016 from 64,508 veterans. Our measurement of financial decline includes objective and subjective economic well-being aspects to bolster the policy relevance of our estimates (Ayllón & Fusco, 2017; Deaton, 2010). Our multinomial models account for a wide range of observable pre-deployment and deployment factors related to the macro-economic environment, family, and individual. We also used an information theoretic, semi-parametric Generalized Maximum Entropy (GME) estimator, which does not restrict the expected error term to zero to account for real-world uncertainty. The approach reduces the sensitivity of estimates to noisy samples, infrequently observed outcomes, and highly correlated covariates (Golan, Judge, & Miller, 1996). Moreover, we leverage military-induced variation in deployed veterans' assignments, which we view as determining reported combat exposure, to address potential bias from non-random selection on unobservable characteristics (Cesur et al., 2013). Finally, we investigate how effects of combat exposure vary over different time periods and across veterans with different pre-deployment characteristics. The examination of individual characteristics before deployment provides information relevant to proactive policy recommendations.

Our results show an assignment with combat exposure increases the predicted probability of a deployed veteran developing both financial distress and a major financial problem. Furthermore, the estimated effect of combat exposure on financial decline increases with multiple exposures and poorer pre-deployment health. Our estimates are robust to specifications with alternate combat exposure measures and falsification tests. Back-of-the-envelope calculations suggest recent combat exposures added $41 million in short-term productivity losses and as many as 3629 (1.34 per 1000 veterans) personal bankruptcies.

Our work creates a more complete picture of economic well-being following combat exposure. Similar to work suggesting combat exposure increases the probability of homelessness (Ackerman et al., 2020), our analysis overcomes past empirical limitations and reveals a policy-relevant aspect of economic disadvantage not previously discerned. Second, while a recent study suggests non-shared environmental factors among siblings may explain more than a third of the variance in financial distress (Xu et al., 2017), understanding how specific environmental factors affect an individual's financial outcomes is complicated by potential endogeneity. Our analysis exploits plausibly exogenous military-induced variation in assignments, and, to our knowledge, we are the first to identify that the policy-relevant environmental factor, combat exposure, may trigger a financial decline. Finally, we add evidence supporting a strategy of health capital investments to increase economic resiliency to traumatic events. A wide body of economic literature documents positive effects of health capital on economic outcomes (Smith, 1999), and psychological literature suggests health capital can improve psychological resilience to traumatic exposure (Bonanno et al., 2007). However, to the best of our knowledge, only one other study has demonstrated health capital may mitigate the impact of traumatic exposure on economic well-being (Ackerman et al., 2020).

2. Data

The Millennium Cohort Study was designed to evaluate the effects of military exposures, and it is the largest prospective study ever undertaken in the US military. The study enrolled US military personnel from all service branches and active duty, Reserve, and National Guard components, and follows participants during service and after separation from the military. Questionnaires include over 450 measures for overall well-being, military experiences, and other militarily relevant issues. Participants complete questionnaires via secure website or mail at approximately 3-year intervals between their baseline and 2016 surveys. Fig. 1 displays the study

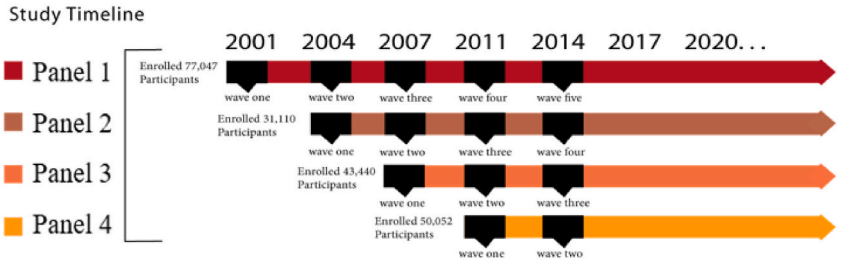

Fig. 1. Millennium Cohort Study timeline.

timeline.

The Millennium Cohort Study currently has 201,619 participants who enrolled during four separate panels between 2001 and 2013. Panel 1 (July 2001–June 2003) enrolled 77,047 consenting participants drawn from a population-based sample of the October 2000 US military, with oversampling of females, those with previous deployment experience, and Reserve/Guard personnel. Panel 1 received five waves of questionnaires prior to 2016. Panels 2 and 3 sampled service members with 1–3 years of military service and oversampled females and Marines. Panel 2 (June 2004–February 2006) enrolled 31,110 participants, and Panel 3 (June 2007–December 2008) enrolled 43,439 participants. Panel 2 received four waves of questionnaires prior to 2016, and Panel 3 received three waves of questionnaires prior to 2016. Panel 4 sampled service members with 2–5 years of military service and oversampled females and married service members. Panel 4 (April 2011–April 2013) enrolled 50,052 participants. Panel 4 received two waves of questionnaires prior to 2016. Panel 5 is currently being collected. Over 70 percent of all participants completed at least one follow-up questionnaire.

Questionnaires are only one part of Millennium Cohort Study data collection. The Millennium Cohort Study links questionnaires with electronically maintained military datasets, including Defense Manpower Data Center (DMDC) information on deployments in support of the post-9/11 conflicts. The military datasets provide information to supplement and validate many questionnaire items (see pp 55–77 of Crum-Cianflone, 2013, for details on the study design and integration with military records). Multiple investigations of the Millennium Cohort Study have found it to contain reliable data reporting with minimal non-response bias (Chretien et al., 2007; LeardMann et al., 2007; Riddle et al., 2007; Ryan et al., 2007; Smith, Wingard, et al., 2007; 2007; Smith, Wingard, et al., 2007, 2007; Wells et al., 2008). The comprehensiveness of the Millennium Cohort Study data makes it well suited for this study, and the longitudinal nature enables evaluation of temporal sequences from combat exposure to different outcomes.

The available data are conditioned to represent only veterans likely eligible to experience combat and financial decline. To capture veterans likely eligible to experience combat, sample observations include only those from 80,982 veterans with post-9/11 conflict deployments in 2001 or later, a basic military entry date, and information to determine a veteran's military component at the baseline survey, and non-missing information on self-reported traumatic exposure at baseline and at least one follow-up. To capture the onset of financial problems, sample observations are further restricted to those from 64,654 veterans not reporting the highest level of financial distress or a major financial problem in the prior period. The sample also excludes observations from 146 veterans with missing or invalid information for age, gender, race, or education. The data include multiple observations from the same veteran when available, and 64,508 veterans, including 27,635 Panel 1 veterans, 10,694 Panel 2 veterans, 13,698 Panel 3 veterans, and 12,481 Panel 4 veterans, provide a total of 131,036 sample observations for analysis.

Four mutually exclusive states of financial decline are defined using a veteran's survey responses on two items assessing financial problems from two consecutive waves. One survey item asks veterans to indicate one of three levels of stress concerning financial problems in the past 4 weeks, while the other survey item provides a more objective metric and asks veterans to indicate whether they have suffered a major financial problem (such as bankruptcy) in the past 3 years. Financial decline is categorized into four levels by the intersection of increased perceived stress (increased vs. steady/declined) and presence of major financial problems (present vs. absent).

Though the use of two consecutive survey responses to create a single observation of financial decline is somewhat non-traditional, the financial decline variable fits naturally with the Millennium Cohort Study's staggered panels and is well suited to understand a veteran's response to combat exposure. The financial decline variable makes use of information from all available survey questions on financial problems. Although the variable does not assess the prevalence of specific types of financial problems like bankruptcy and foreclosure, it leverages the sequential structure of the data to capture individual, rather than average, changes in financial problems. Considering the production of financial problems as a transition from one state of economic well-being to another, the financial decline variable captures a first-order Markov process for economic well-being where an individual's current state of economic well-being is dependent on the individual's previous state of economic well-being.

Table 1 describes the distribution of financial decline at each follow-up survey wave, with the sample size shown in the last row. Approximately three fourths of observations fall into the state, "None", which represents reporting neither increasing stress about finances nor a new major financial problem since the prior survey wave. The three other states capture different financial declines since

Table 1
Distribution of financial decline, by survey wave.

State	Definition	Wave 2	Wave 3	Wave 4	Wave 5	Total
None	No new distress or major problem	75.41	75.49	73.6	77.34	75.34
Distress Only	Stress level (none, a little, or a lot) in the last 4 weeks from financial problems reported at current survey > stress level in the last 4 weeks from financial problems reported at prior survey. Did not also report new major problem.	21.23	21.17	22.03	19.67	21.17
Major Problem Only	Major financial problems (such as bankruptcy) in the past 3 years reported at current survey and not previous survey. Did not also report higher distress.	1.32	1.25	1.68	1.32	1.37
Major Problem & Distress	Reported new major problem and higher distress.	2.04	2.09	2.69	1.67	2.13
Observations		55,819	34,291	24,428	16,498	131,036

Source: 2001–2016 Millennium Cohort Study, Panels 1–4, authors' unweighted computations.

the prior survey wave. The "Distress Only" state captures veterans reporting only increased financial stress in the 4 weeks prior to the follow-up survey. The state is likely to capture financial decline in response to combat exposure; however, the increase in financial distress may only reflect an expected increase in financial problems or a new minor financial problem. Approximately one in five veterans at each wave report only increased financial distress. The "Major Problem Only" state captures veterans reporting only an increase in past major financial problems in the past 3 years. The state may capture a major financial decline following a combat exposure, but the information in the state alone is insufficient to determine whether the financial decline started prior to combat exposure. A little more than 1 percent of veterans at each wave report a major problem only. The state, "Major Problem & Distress", captures new major financial problems such as bankruptcy with an increased level of financial distress, and about 2 percent of veterans at each wave report the combined transition. The state is of principal interest because it captures a large financial decline following combat exposure alongside increased levels of subjective financial distress. The states are nominal, rather than ordered, because the expected relationship between each pair of states is unknown.

3. Empirical methods

Our estimation objective is to determine whether combat exposure affects financial decline. We explain background and motivation for the use of GME multinomial models with the given data, and then we discuss assumptions needed to identify the effect of combat exposure on financial decline. After outlining support for identifying assumptions, we present the framework to assess the effect of combat exposure on financial decline.

3.1. Generalized Maximum Entropy estimation

Conceptual econometric models have unobserved parameters and noise components intended to reflect the true data generation process. Real world samples with small random changes in individual financial transitions over time, infrequently observed outcomes, and highly correlated covariates contribute to uncertainty when estimating parameters and making inferences from available information. The GME approach builds on information theory and the Maximum Entropy (ME) principle to analyze problems with limited and complex data.

The GME approach uses an objective function that is the sum of the coefficient distribution entropy and the error distribution entropy. In information theory, Shannon's entropy is a measure reflecting the expected information content of an outcome, when considering all possible outcomes. If a probability distribution has only one possible outcome, then the distribution entropy is zero. On the other hand, if a distribution has uniform probabilities for multiple outcomes, then the distribution entropy is maximum. The ME approach to the multinomial choice problem selects among all possible coefficient distributions the one that maximizes uncertainty remaining in the distribution while adhering to observed sample moment constraints. In this manner, ME estimation uses the limited observed information to provide the most noncommittal option while avoiding parametric modeling assumptions. The GME approach advances the ME approach by not restricting expected errors to zero, thus accounting for unknown disturbances that impose challenges with Maximum Likelihood (ML) logit and Maximum Entropy multinomial estimators (Golan, Judge, & Perloff, 1996). The GME multinomial estimator, in all finite samples, outperforms traditional Maximum Likelihood (ML) logit and Maximum Entropy multinomial estimators in terms of efficiency and robustness (Golan, Judge, & Miller, 1996; 1996b). Traditional likelihood-based inference tests still apply to GME multinomial estimates as ML logit estimates are equal to GME multinomial estimates in cases where all errors are actually zero or the sample size approaches infinity. GME estimations are performed with NLOGIT 6.0 software (Greene, 2016). Information theoretic methods of inference fall into an info-metrics framework, and Golan (2018) provides in-depth discussion of info-metric foundations and widespread applications.

3.2. Identification

Combat exposure itself is best thought of as a random process resulting from military factors, including occupational group, deployment location, and deployment timing, plausibly exogenous to an individual's risk of financial decline. Much work has been conducted identifying variable risk of location on risk of combat exposure. The estimation strategy identifies an effect of combat exposure on financial decline that is conditional only on a few observable military characteristics, specifically an individual's military component, branch, rank, occupation, and timing of service. Identification requires two assumptions. First, combat exposure needs to result from a conditionally random assignment process. Variation in combat exposure is known to exist with different deployment assignments; recent killed- or wounded-in-action rates per thousand deployed members varied from 0 to nearly 13 across countries in a combat zone (Pleeter et al., 2011). Similar variation in combat exposure also occurs within countries. Second, deployment assignments and experiences, conditional on only observable military characteristics, should be exogenous to individual pre-deployment characteristics. In other words, non-military individual characteristics that could determine financial problems should not explain variation in deployment assignments and experiences.

Several researchers present a compelling argument for individual deployment assignments not being driven by forces related to non-military individual characteristics (Cesur et al., 2013, 2015, 2016; Ackerman et al., 2020; Cesur & Sabia, 2016; Engel et al., 2010; Loughran & Heaton, 2013; Lyle, 2006). The premise of the argument stems from evolving overseas events and military unit availability driving the military deployment process. As overseas military operations normally involve large, complex and coordinated actions, it is not practical for the military to task a single veteran to handle all requirements. The hierarchal nature of the military normally results in units being tasked to conduct overseas operations, and the military, as a rule, does not use non-military personal characteristics (*e.g.*

number of dependents, risk-taking preferences, past financial behavior) when making deployment selections. Instead, veterans with the same branch, rank, and occupation are viewed as interchangeable in the deployment process. See Lyle (2006) for the seminal explanation of military deployment process assumptions, and reference Cesur et al. (2013) for the extension of the argument to assess the experience of combat exposure.

Researchers also use data to support the conditional random assignments assumption. Closely following past studies of combat exposure leveraging variation induced by the deployment assignment process, the model examining the conditional random assignments assumption takes the form of an experiment consisting of N trials. The probabilities of a set of binary random variables, $Assign_{1j}$, $Assign_{2j},\ldots,Assign_{Nj}$, which equal one if combat exposure category j ($j = 1, 2, \ldots, J$) is observed for trial i ($i = 1, 2, \ldots, N$), are related to a set of explanatory variables with the equation:

$$p_{ij} = \Pr\left(Assign_{ij} = 1 \middle| \mathbf{M}_i, \mathbf{X}_i\right) = \mathrm{F}\left(\beta_{0j} + \beta_{1j}{}' \mathbf{M}_i + \beta_{2j}{}' \mathbf{X}_i\right) > 0 \quad (1)$$

subject to $\sum_j p_{ij} = 1$. The three possible categories of combat exposure are no combat exposure, single combat exposure, and multiple combat exposure. Combat exposure is primarily determined by a veteran indicating personal exposure to witnessing a person's death due to war, disaster, or tragic event in the past 3 years. In 150 observations where a veteran's primary indication of combat exposure is missing, combat exposure is determined by a veteran indicating seeing Americans who were seriously injured or killed during deployment. Of veterans in the sample with both combat exposure measures, more than 76 percent of veterans indicating combat exposure with the alternate measure also indicate combat exposure with the primary measure. While the alternate deployment specific measure may be preferable, the Millennium Cohort Study did not ask about deployment specific exposure until the 2007–2008 questionnaire. To address misclassification concerns with the primary measure and improve estimates of combat exposure, a binary variable indicating another tragic loss, defined by the death of serious illness of a loved one or family member in the past 3 years, is included in all models. Other research with the Millennium Cohort Study indicates 98.4 percent of individuals endorsing this proxy for combat exposure endorse additional specific measures of combat exposure (Porter et al., 2018). Additionally, while geographic deployment location data may permit identification of risk in a particular time period, the period of the current study spans such a wide range that the level of combat exposure associated with deployment to specific locations varies over time. For example, between 2007 and 2010, killed in action rates in Afghanistan increased seven fold while killed in action rates in Iraq decreased by two thirds (Pleeter

Table 2
Description of combat exposure, deployed time, and military control variables.

Variable	Description	Mean	Std. Dev.
Combat exposure	Reference group is *no reported combat exposure*		
Single exposure	Equal to 1 if only one reported combat exposure, 0 otherwise	0.06	0.23
Multiple exposures	Equal to 1 if two or more reported combat exposures, 0 otherwise	0.12	0.32
Deployed time	Reference group is no reported deployed time in period		
Deployed 1–179 days	Equal to 1 if 1–179 days deployed, 0 otherwise	0.22	0.41
Deployed 180–364 days	Equal to 1 if 180–364 days deployed, 0 otherwise	0.20	0.40
Deployed 365 days or more	Equal to 1 if 365 days or more deployed, 0 otherwise	0.06	0.24
Service entry	Reference group is *initial service in 2001 or earlier*		
Post-2001 entry	Equal to 1 if initial service in 2002 or later, 0 otherwise	0.37	0.48
Years of service	Reference group is *less than 7 years of military service*		
7–12	Equal to 1 if years of military service $\geq$7 and $<$ 13, 0 otherwise	0.21	0.41
v13–18	Equal to 1 if years of military service $\geq$13 and $<$ 19, 0 otherwise	0.17	0.37
19 or more	Equal to 1 if years of military service $\geq$19, 0 otherwise	0.23	0.42
Rank	Reference group is *enlisted*		
Officer	Equal to 1 if officer rank either W1 or O1 or higher, 0 otherwise	0.30	0.46
Branch of service	Reference group is *Army*		
Navy	Equal to 1 if in the Navy or Coast Guard, 0 otherwise	0.15	0.36
Air Force	Equal to 1 if in the Air Force, 0 otherwise	0.32	0.47
Marine Corps	Equal to 1 if in the Marine Corps, 0 otherwise	0.06	0.25
Component	Reference group is *active duty*		
Reserve or National Guard	Equal to 1 if in Reserve or National Guard, 0 otherwise	0.37	0.48
Separated	Equal to 1 if separated or unknown component, 0 otherwise (some separated respondents return to service)	0.09	0.28
Occupational classification	Reference group is *combat specialist*		
Electrical repair	Equal to 1 if electrical repair occupation, 0 otherwise	0.09	0.29
Comm/intel	Equal to 1 if communications/intelligence occupation, 0 otherwise	0.09	0.29
Health care	Equal to 1 if health care occupation, 0 otherwise	0.10	0.30
Other technical	Equal to 1 if other technical or specialty occupation, 0 otherwise	0.03	0.16
Functional support	Equal to 1 if functional support occupation, 0 otherwise	0.18	0.38
Equipment repair	Equal to 1 if equipment repair occupation, 0 otherwise	0.14	0.34
Craft workers	Equal to 1 if craft worker occupation, 0 otherwise	0.03	0.17
Service and supply	Equal to 1 if service and supply occupation, 0 otherwise	0.10	0.30
Other	Equal to 1 if other occupation, 0 otherwise	0.04	0.19
Observations		131,036	

DMDC = Defense Manpower Data Center.
Table displays unweighted means of variables generated using survey responses and DMDC data at the wave prior to assessing financial decline.

et al., 2011). In the current study, veterans reported a single combat exposure in the past 3 years 6 percent of the time, and veterans reported more than one combat exposure in the past 3 years 12 percent of the time.

The military vector **M** includes an individual's service entry, years of service, rank, branch, component, and military occupation at the wave prior to the assessment of financial decline. Table 2 provides variable definitions and descriptive statistics for combat exposure, deployed time and the vector **M**.

The vector **X** includes individual and family background variables at the survey prior to deployment assignment that could be associated with combat assignment or financial decline. These variables represent past financial distress, gender, age, race, ethnicity, education, family structure, physical health, mental health, health behaviors, and adverse childhood experiences. Additionally, vector **X** includes macroeconomic measures of the real gross domestic product (GDP) annual growth rate, real military pay annual growth rate, and respective 3 year lags for the survey year. Table 3 provides variable definitions and descriptive statistics for vector **X**.

The scalars β_{0j} represent the function intercepts, the coefficient vectors $\beta_{1j}{}'$ measure whether military observables explain combat exposure, and the coefficient vectors $\beta_{2j}{}'$ measures whether background variables explain combat exposure. F(•) is the function linking the probability with the covariates for an individual. If combat exposure is exogenous to an individual's financial decline, then the

Table 3
Description of non-military background variables.

Variable	Description	Mean	Std. Dev.
Lag financial distress	Equal to 1 if reported stress from financial problems, 0 otherwise	0.33	0.47
Female	Equal to 1 if female gender, 0 otherwise	0.24	0.43
Age	Age in years measured at follow-up survey	37.40	9.32
Age^2	Age in years × Age in years measured at follow-up survey	1485.70	764.17
Race & ethnicity	Reference group is *white, non-Hispanic*		
Black	Equal to 1 if black race and non-Hispanic ethnicity, 0 otherwise	0.09	0.29
Other	Equal to 1 if other race and non-Hispanic ethnicity, 0 otherwise	0.11	0.31
Hispanic	Equal to 1 if Hispanic ethnicity, 0 otherwise	0.07	0.25
Education	Reference group is *high school or less*		
Some college	Equal to 1 if only some college education, 0 otherwise	0.48	0.50
College degree	Equal to 1 if bachelor's degree or higher, 0 otherwise	0.40	0.49
Family structure			
Dependents	Equal to number of dependents in military record Last known value used if value missing at prior survey	1.54	1.51
Recent divorce	Equal to 1 if divorced or separated in past 3 years (or ever if baseline survey), 0 otherwise	0.13	0.33
Health			
PCS	Physical health component summary*	54.13	6.72
MCS	Mental health component summary*	52.48	8.47
Smoking	Equal to 1 if past year smoked cigarettes (ever smoked 100 cigarettes if baseline survey), 0 otherwise	0.28	0.45
Heavy drinking	Equal to 1 if 15 (8) drinks or more during a typical week for men (women), 0 otherwise	0.07	0.25
Childhood Experiences			
Neglect	Equal to 1 if respondent indicated grown-ups did not take care of them in the way that they should before the age of 18, 0 otherwise. Examples of neglect in question include respondent not getting enough food, receiving medical care when sick, and having a safe place to stay.	0.07	0.25
Verbal abuse	Equal to 1 if respondent indicated grown-ups made them feel scared or really bad by saying mean things to them before the age of 18, 0 otherwise	0.18	0.39
Physical abuse	Equal to 1 if respondent indicated grown-ups hit (not including spanking on the bottom), beat, kicked, or physically hurt them before the age of 18, 0 otherwise	0.25	0.43
Sexual abuse	Equal to 1 if respondent indicated grown-ups touched private parts when they shouldn't have, made them touch their private parts, or forced them to have sex, 0 otherwise	0.08	0.27
Macroeconomic			
GDP growth	Real US GDP annual growth rate at follow-up survey year (Source: US Department of Commerce, 2017)	2.21	0.89
Lag GDP growth	GDP growth 3 years prior to follow-up survey year	1.37	1.72
Military pay growth	Real US military pay annual growth rate at follow-up survey year. (Source: Defense Finance and Accounting Service, 2017)	0.48	1.34
Lag military pay growth	Military pay growth 3 years prior to survey follow-up year	1.08	1.19
Observations		131,036	

DMDC = Defense Manpower Data Center, GDP = gross domestic product.
Table displays unweighted means of variables generated using survey responses and DMDC data at the wave prior to assessing financial decline unless otherwise noted. Description of dummy variables for missing family structure, health, health behaviors, and childhood variable responses not displayed.
*The MCS and PCS are standard health instruments commonly used in veteran studies. Higher scores imply better health. The scores are derived from 36 ordinal scale questions in eight health domain: physical functioning, role limitations due to physical problems, bodily pain, general health perceptions, energy/vitality, social functioning, role limitations due to emotional problems, and mental health. The transformation of the questions into the uncorrelated component summary scales is accomplished using weights derived from a national probability sample of the US population, and the scales are standardized so the MCS and PCS have a direct interpretation to a US population mean of 50 and standard deviation of 10 (Hays et al., 1993; Kazis et al., 2004).

coefficient vectors $\beta_{2j}^{'}$ should not help explain combat exposure. To make model interpretation more tangible, results display the estimated marginal effect of each independent variable on the overall probability of observing a category. The marginal effect for each continuous variable is calculated with all independent variables set to the mean. The marginal effect for each categorical variable is

Table 4
Marginal effects of background characteristics on combat exposure probabilities.

	(1)		(2)		(3)	
	Combat Exposure					
	None		Single		Multiple	
Variables	**Effect**	**SE**	**Effect**	**SE**	**Effect**	**SE**
Military						
Service Entry						
Post-2001 entry	−0.0041	0.0032	0.0000	0.0020	0.0041	0.0025
Years of service						
7–12	0.0146	0.0032	−0.0051	0.0021	−0.0095	0.0025
13–18	0.0056	0.0042	0.0003	0.0028	−0.0060	0.0032
19 or more	0.0180	0.0049	0.0002	0.0033	−0.0182	0.0038
Rank						
Officer	0.0009	0.0033	−0.0050	0.0022	0.0042	0.0026
Branch of service						
Navy	0.1063	0.0024	−0.0301	0.0016	−0.0762	0.0019
Air Force	0.0261	0.0038	−0.0147	0.0026	−0.0115	0.0028
Marine Corps	0.1058	0.0032	−0.0239	0.0020	−0.0820	0.0026
Component						
Reserve or National Guard	0.0221	0.0022	−0.0028	0.0015	−0.0193	0.0017
Separated	0.0902	0.0048	−0.0222	0.0030	−0.0680	0.0039
Occupational classification						
Electrical repair	0.1062	0.0042	−0.0209	0.0026	−0.0853	0.0034
Comm/intel	0.0396	0.0037	−0.0147	0.0025	−0.0249	0.0027
Health care	−0.0669	0.0034	0.0050	0.0025	0.0619	0.0024
Other technical	0.0166	0.0059	−0.0013	0.0039	−0.0152	0.0045
Functional support	0.0778	0.0033	−0.0157	0.0021	−0.0621	0.0026
Equipment repair	0.0924	0.0037	−0.0140	0.0023	−0.0784	0.0030
Craft workers	0.0583	0.0062	−0.0089	0.0039	−0.0494	0.0050
Service and supply	0.0311	0.0035	−0.0030	0.0023	−0.0281	0.0026
Other	0.0166	0.0048	−0.0013	0.0032	−0.0152	0.0036
Non-Military						
Financial distress	0.0057	0.0021	−0.0003	0.0014	−0.0054	0.0016
Female	0.0719	0.0022	−0.0143	0.0015	−0.0576	0.0016
Age	0.0007	0.0002	−0.0006	0.0002	−0.0001	0.0002
Race						
Black	0.0236	0.0032	0.0054	0.0023	−0.0290	0.0023
Other	0.0067	0.0030	0.0004	0.0021	−0.0071	0.0022
Hispanic	0.0090	0.0037	0.0037	0.0025	−0.0127	0.0027
Education						
Some college	−0.0129	0.0031	0.0011	0.0019	0.0118	0.0024
College degree	−0.0034	0.0041	−0.0019	0.0026	0.0053	0.0033
Family structure						
Dependents	−0.0004	0.0008	0.0004	0.0005	0.0000	0.0006
Divorce	−0.0191	0.0030	0.0068	0.0019	0.0124	0.0024
Health						
PCS	0.0016	0.0001	−0.0005	0.0001	−0.0011	0.0001
MCS	0.0009	0.0001	−0.0004	0.0001	−0.0005	0.0001
Smoking	−0.0139	0.0023	0.0061	0.0015	0.0078	0.0018
Heavy drinking	−0.0062	0.0039	−0.0040	0.0023	0.0102	0.0031
Childhood experiences						
Neglect	−0.0204	0.0044	0.0048	0.0027	0.0156	0.0035
Verbal abuse	−0.0103	0.0031	0.0059	0.0020	0.0044	0.0024
Physical abuse	−0.0276	0.0028	0.0081	0.0018	0.0196	0.0022
Sexual abuse	−0.0038	0.0039	0.0023	0.0025	0.0015	0.0030
Observations	131,036					
Pseudo-R^2	0.52					
Pseudo-R^2 (military only)	0.51					

GME = Generalized Maximum Entropy, MCS, mental health component summary, PCS = physical health component summary, SE = standard error. Columns 1–3 display GME marginal effects for multinomial combat exposure assignment model. The marginal effect for each continuous variable is calculated with all independent variables set to the mean. The marginal effect for each categorical variable is calculated by changing all observations from the reference value to the category value with all other independent variables set to the mean. All columns include macroeconomic variables in Table 3. All columns include dummy variables for missing values of family structure, health, health behaviors, and childhood experiences.

calculated by changing all observations from the reference value to the category value with all other independent variables set to the mean.

Table 4 reveals support for the assumption of conditional random assignments with model fit statistics and estimated marginal effects of individual non-military variables on the different levels of combat exposure. The Pseudo-R^2 measure captures the goodness of fit between the sample information and the model on an increasing scale of 0–1 by comparing the (maximized) entropy of the fitted

Table 5
Marginal effects of deployment-related variables on financial decline.

	(1)		(2)	
	Military Only Controls		Military and Non-Military Controls	
	Effect	SE	Effect	SE
Probability (Y = None)				
Combat exposure (reference is none)				
Single	−0.0338	0.0053	−0.0260	0.0051
Multiple	−0.0395	0.0041	−0.0306	0.0039
*Weighted average of exposure**	−0.0377	0.0034	−0.0291	0.0033
Deployed time (reference is none)				
Deployed 1–179 days	0.0230	0.0033	0.0231	0.0031
Deployed 180–364 days	0.0309	0.0032	0.0267	0.0032
Deployed 365 days or more	0.0450	0.0049	0.0437	0.0047
*Weighted average of deployed time**	0.0291	0.0026	0.0273	0.0025
Disabling illness or injury	−0.1362	0.0059	−0.1029	0.0058
Other tragic loss	−0.0317	0.0024	−0.0291	0.0024
Probability (Y = Distress Only)				
Combat exposure (reference is none)				
Single	0.0266	0.0051	0.0215	0.0049
Multiple	0.0249	0.0039	0.0193	0.0038
*Weighted average of exposure**	0.0254	0.0032	0.0200	0.0032
Deployed time (reference is none)				
Deployed 1–179 days	−0.0185	0.0030	−0.0207	0.0029
Deployed 180–364 days	−0.0221	0.0030	−0.0206	0.0029
Deployed 365 days or more	−0.0311	0.0046	−0.0322	0.0043
*Weighted average of deployed time**	−0.0220	0.0025	−0.0227	0.0024
Disabling illness or injury	0.0868	0.0055	0.0681	0.0055
Other tragic loss	0.0233	0.0023	0.0231	0.0023
Probability (Y = Major Problem Only)				
Combat exposure (reference is none)				
Single	0.0016	0.0013	0.0005	0.0009
Multiple	0.0043	0.0011	0.0025	0.0008
*Weighted average of exposure**	0.0034	0.0009	0.0018	0.0007
Deployed time (reference is none)				
Deployed 1–179 days	−0.0017	0.0007	−0.0007	0.0006
Deployed 180–364 days	−0.0028	0.0007	−0.0015	0.0006
Deployed 365 days or more	−0.0035	0.0010	−0.0021	0.0008
*Weighted average of deployed time**	−0.0025	0.0006	−0.0012	0.0005
Disabling illness or injury	0.0147	0.0018	0.0090	0.0013
Other tragic loss	0.0029	0.0006	0.0015	0.0005
Probability(Y = Major Problem & Distress)				
Combat exposure (reference is none)				
Single	0.0062	0.0016	0.0044	0.0015
Multiple	0.0107	0.0013	0.0090	0.0013
*Weighted average of exposure**	0.0089	0.0010	0.0074	0.0010
Deployed time (reference is none)				
Deployed 1–179 days	−0.0021	0.0008	−0.0012	0.0008
Deployed 180–364 days	−0.0052	0.0007	−0.0038	0.0008
Deployed 365 days or more	−0.0086	0.0008	−0.0078	0.0009
*Weighted average of deployed time**	−0.0046	0.0007	−0.0033	0.0007
Disabling illness or injury	0.0347	0.0023	0.0258	0.0021
Other tragic loss	0.0055	0.0006	0.0046	0.0007
Observations	131,036		131,036	
Pseudo-R^2	0.52		0.55	

GME = Generalized Maximum Entropy, SE = standard error.
GME marginal effects for multinomial models displayed. The marginal effect for each continuous variable is calculated with all independent variables set to the mean. The marginal effect for each categorical variable is calculated by changing all observations from the reference value to the category value with all other independent variables set to the mean. Column 1 includes military control variables in Table 2 and macroeconomic variables in Table 3. Column 2 includes column 1 variables and all other background variables in Table 3 and dummy variables for missing values of family structure, health, health behaviors, and childhood experiences. *Weighted average of unspecified switch from reference category computed using sample shares of each category.

model with the entropy of the uniform distribution (Golan, 2018). The inclusion of all individual non-military background variables in the model increases respective Pseudo-R^2 goodness-of-fit measures by only one hundredth relative to the model without individual non-military background variables. The measures indicate non-military background characteristics, as a whole, do little to explain dispersion in combat exposure. While columns 1 through 3 show some military background variables can influence assignment probabilities by 10 percent, columns 1 through 3 also show each individual non-military background variable on the assignment probabilities to combat exposure is generally no more than about 2 percent. Gender is the only consistent exception, and the results indicate female service members are less likely to be assigned to a war environment or combat exposure. A reasonable explanation in line with exogenous selection is previous policies limiting the role of females in combat (see Cesur et al., 2016, for full discussion). Although the potential for endogenous selection cannot be completely ruled out, the results, taken together, provide support for the conditional random assignments assumption.

3.3. Modeling the effect of combat exposure on financial decline

The model to determine the conditional effect of reported combat exposure on financial decline takes the form of an experiment consisting of N trials. The probabilities of a set of binary random variables, $Y_{1j}, Y_{2j}, \ldots, Y_{Nj}$, which equal one if state j $(j = 1, 2, 3, 4)$ corresponding to *None, Distress Only, Major Problem Only,* and *Major Problem & Distress* is observed for trial i $(i = 1, 2, \ldots, N)$, are related to explanatory variables with the equation:

$$p_{ij} = \Pr\left(Y_{ij} = 1 \middle| \mathbf{M}_i, \mathbf{X}_i\right) = \mathrm{F}\left(\delta_{0j} + \delta_{1j}{}'\mathbf{D} + \pi_{1j}{}'\mathbf{M} + \pi_{2j}{}'\mathbf{X}\right) > 0 \tag{2}$$

subject to $\sum_j p_{ij} = 1$. F(•) is the function linking the probability of a state with the covariates for an individual. The scalars δ_{0j} are the function intercepts. The vector **D** includes deployment experiences including the relevant combat exposure and time spent deployed, and the coefficient vectors $\delta_{1j}{}'$ show how vector **D** is associated with the probability of developing financial problems. The vectors **M** and **X** are as previously described, and coefficient vectors $\pi_{1j}{}'$ and $\pi_{2j}{}'$ explain how the variables in **M** and **X** relate to the financial decline. The validity of the exogeneity assumption can be further assessed by estimating equation (2) without the individual non-military background variables in vector **X**. If the exogeneity assumption is valid, then the marginal effects of the combat exposure should be stable.

4. Results

Table 5 provides estimated marginal effects of combat exposure and other deployment-related variables on financial decline. After comparing models with and without individual non-military background variables, the possibility of the effect of combat exposure extending into other survey periods is examined. Graphical analysis examines predicted variation in the effect of combat exposure on an increase in both a major problem and distress with background characteristics. Lastly, estimates with alternate measures of combat exposure demonstrate the robustness of findings.

Table 5 results suggest detrimental effects to economic well-being from combat exposure. For Table 5, the model in column 1 with only military variables and the model in column 2 with both military and other control variables lead to the same conclusions. The estimated marginal effects of combat exposure on the state of no financial decline are negative, and the estimated marginal effects of combat exposure on an increase in financial distress only, an increase in a major financial problem only, and an increase in distress and a major problem are consistently positive. A single combat exposure increases the probability of developing a major problem and distress by about half a percentage point, and multiple combat exposures increase the probability of developing a major problem and distress by about one percentage point. The influence of combat exposure is substantial relative to the 2.1 percent average predicted probability of developing a major problem and distress.

The inclusion of individual non-military background variables in Table 5 has little influence on the magnitude of findings, and a comparison of estimates provides further support for the conditional independence of combat exposure to personal characteristics. An informal gauge of the strength of likely bias from unobservable characteristics can be calculated by dividing the marginal effect of combat exposure in column 2 by its difference with the marginal effect in column 1 (Altonji et al., 2005). Using the conditional share weighted average effect of combat exposure on the probability of developing a major problem and distress, the computed ratio implies selection on unobservable characteristics would need to be nearly five times greater than selection on non-military background variables, including the previous level of financial distress, to explain away the estimated effect. The Pseudo-R^2 measures indicate including non-military background variables improves goodness of model fit, thus models including non-military background variables represent preferred specifications.

Combat exposure is not the only deployment-related factor influencing the probability of financial decline. Table 5 shows deployed time reduces the probability of financial decline. The estimate of the conditional share weighted average effect of deployed time on developing a major problem and distress is similar in magnitude to the conditional share weighted average effect of combat exposure. The results suggest deployment time, possibly due to temporary increases in pay and benefits, can help counterbalance harmful effects of combat exposure. On the other hand, physical illness or disability during the survey period, results increase the estimated probability of developing a major problem and distress by more than 2 percentage points. The influence of other tragic losses involving a veteran's family or loved ones on financial decline appears similar to influence of combat exposure on financial decline, and the results suggest inclusion of other tragic losses in the model helps reduce possible conflating of estimates of combat and non-combat traumatic

experiences that could be captured by the defined combat exposure variable. As the primary interest is in the consequences of combat experiences, the influence of all background variables on financial decline is described in Table A1.

To evaluate whether any effects of combat exposure are delayed or anticipatory, combat exposures reported in other survey periods are included in the model. Columns 1 and 2 in Table 6 reveal that any influence of combat exposure from the prior survey periods on

Table 6
Marginal effects of combat exposure over time on financial decline.

	(1)		(2)		(3)	
	Effect	SE	Effect	SE	Effect	SE
Probability (Y=None)						
Combat Exposure						
Single	−0.0251	0.0052	−0.0312	0.0076		
Multiple	−0.0286	0.0041	−0.0344	0.0060		
1-Period Lag Combat Exposure						
Single	−0.0091	0.0043	−0.0091	0.0066		
Multiple	−0.0064	0.0035	−0.0084	0.0052		
2-Period Lag Combat Exposure						
Single			−0.0083	0.0057		
Multiple			0.0051	0.0047		
1-Period Lead Combat Exposure						
Single					−0.0014	0.0064
Multiple					0.0101	0.0046
Probability (Y = Distress Only)						
Combat Exposure						
Single	0.0205	0.0050	0.0265	0.0073		
Multiple	0.0175	0.0039	0.0226	0.0057		
1-Period Lag Combat Exposure						
Single	0.0069	0.0041	0.0075	0.0064		
Multiple	0.0056	0.0034	0.0064	0.0050		
2-Period Lag Combat Exposure						
Single			0.0075	0.0055		
Multiple			−0.0060	0.0045		
1-Period Lead Combat Exposure						
Single					0.0023	0.0064
Multiple					−0.0120	0.0046
Probability (Y = Major Problem Only)						
Combat Exposure						
Single	0.0005	0.0010	−0.0006	0.0011		
Multiple	0.0025	0.0009	0.0027	0.0011		
1-Period Lag Combat Exposure						
Single	−0.0005	0.0008	−0.0003	0.0010		
Multiple	−0.0001	0.0006	−0.0002	0.0008		
2-Period Lag Combat Exposure						
Single			−0.0003	0.0009		
Multiple			0.0010	0.0008		
1-Period Lead Combat Exposure						
Single					−0.0008	0.0015
Multiple					0.0003	0.0012
Probability(Y = Major Problem & Distress)						
Combat Exposure						
Single	0.0041	0.0014	0.0061	0.0022		
Multiple	0.0086	0.0013	0.0091	0.0019		
1-Period Lag Combat Exposure						
Single	0.0027	0.0011	0.0019	0.0017		
Multiple	0.0009	0.0009	0.0022	0.0013		
2-Period Lag Combat Exposure						
Single			0.0011	0.0014		
Multiple			−0.0001	0.0011		
1-Period Lead Combat Exposure						
Single					−0.0001	0.0014
Multiple					0.0016	0.0012
Observations	130,950		70,916		72,100	
Pseudo-R^2	0.55		0.55		0.57	

GME = Generalized Maximum Entropy, SE = standard error.
GME marginal effects for multinomial models displayed. The marginal effect for each continuous variable is calculated with all independent variables set to the mean. The marginal effect for each categorical variable is calculated by changing all observations from the reference value to the category value with all other independent variables set to the mean. All columns include military control variables in Table 2, all other deployment-related variables in Table 5, all other background variables in Table 3, and dummy variables for missing values of family structure, health, health behaviors, and childhood experiences.

the probability of developing financial problems is rather limited, and the results consistently find combat exposure in the most recent 3-year survey period associated with a decline in economic well-being. If combat exposure was correlated with pre-deployment unobservables that contribute to financial decline, then the one period lead of combat exposure in the model would likely be significant. Instead, the column 3 results serve as evidence of a falsification test supporting the identification strategy.

Groups of veterans with different background characteristics may be more or less resilient to combat exposure. While the marginal effects computed with all other variables set to sample means provide insight at one important point, estimates with a range of values for background characteristics help us understand how the predicted effect of combat exposure on development of both a major problem and distress changes. Figs. 2 and 3, simulated using parameters estimated for Table 5 model specification with all background variables, show 'what if' changes in the effects of combat exposure when veterans have different ranks, ages, and health. Unobservable differences may also exist among some groups of veterans in the full sample; however, estimates, displayed graphically in Figure A1, from samples divided by gender, samples divided by military service component, samples divided by combat specialist and non-combat specialist occupations, samples divided by military service entry period, and samples divided by prior financial stress appear consistent with estimates from the sample with all groups.

Fig. 2 reveals predicted variation in the effect of combat exposure on financial decline over rank and age. The variation in the effects exhibit similar patterns for single and multiple exposures, but the variation is more pronounced for multiple exposures. As higher military rank and years of service equate to higher military pay that can provide a financial buffer, it is not surprising the oldest officers are the least vulnerable to effects of combat exposure. Interestingly, the veterans most vulnerable to effects of combat exposure are not the youngest enlisted veterans, but enlisted veterans around 30 years old. Possible explanations for the finding include the youngest veterans having fewer responsibilities and the military placing more restrictions on the youngest veterans (e.g., unable to live off base).

Fig. 3 reveals veterans with poorer pre-deployment self-reported health scores appear more vulnerable to the effects of combat exposure on financial decline. The variation in the effects exhibit similar patterns for combat exposure frequency and health category, but the variation is more pronounced for multiple exposures and mental health. Each 10-point, or 1 standard deviation for the US population, mental component score decline translates to the marginal effect of multiple combat exposure on the probability of developing a financial stress and a major financial problem increasing roughly 0.3 percentage points. The findings suggest increased health capital, a non-monetary resource, can lessen the impact of traumatic exposure on financial decline.

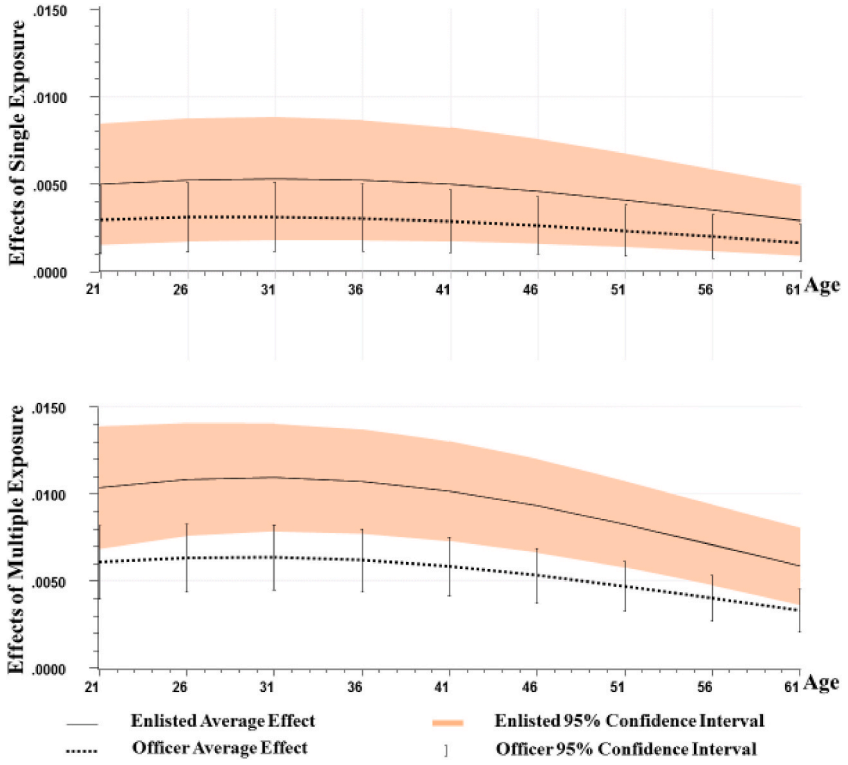

Fig. 2. Marginal effects of combat exposure by rank at ages on probability (Major Problem & Distress). Generalized Maximum Entropy marginal effects for categorical values of combat exposure and rank computed by setting all observations to category value and comparing to respective base value with age set to values 21, 26, …, 56, 61, and all other variables set to sample means. Model includes military control variables in Table 2, all deployment-related variables in Table 6, all other background variables in Table 3, and dummy variables for missing values of family structure, health, health behaviors, and childhood experiences.

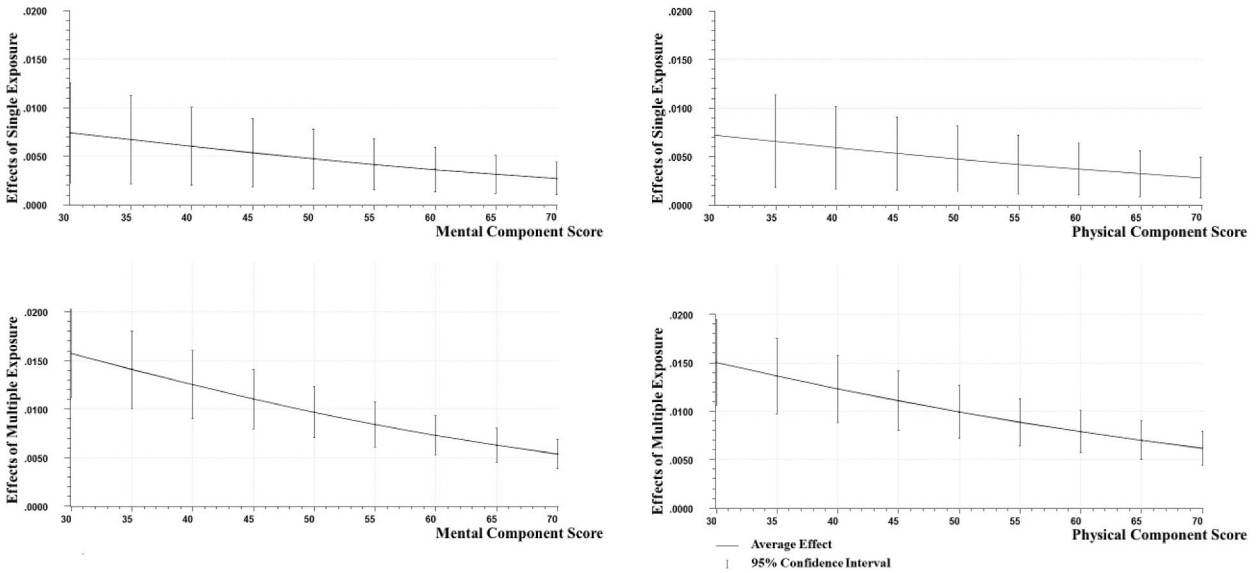

Fig. 3. Marginal effects of combat exposure at health scores on probability (Major Problem & Distress). Generalized Maximum Entropy marginal effects for categorical values of combat exposure computed by setting all observations to category value and comparing to base value with health score set to values 30, 35, …,65, 70, and all other variables set to sample means. Model includes military control variables in Table 2, all other background variables in Table 3, and dummy variables for missing values of family structure, health, health behaviors, and childhood experiences.

4.1. Additional robustness checks

Alternate measures of combat exposure were substituted into the model to evaluate the robustness of the main finding, the marginal effect of combat exposure on the probability of developing financial distress and a major financial problem. The 2007 survey introduced questions regarding the frequency that veterans experienced enemy attacks or ambushes and improvised explosive devices during deployments in the past 3 years. Columns 2 and 3 of Table 7 display estimates for the alternate combat exposure measures, created from the 2007 and later survey question responses, that are similar to the estimates of the primary measure of combat exposure in column 1.

The 2011 survey introduced a question enabling another falsification test of the main finding. Specifically, the survey asked veterans about the frequency of exposure to smoke from burning trash or feces during deployments in the past 3 years. Smoke exposure

Table 7
Marginal effects of other combat measures on probability (major problem & distress).

	(1)		(2)		(3)		(4)		(5)	
	Effect	SE	Effect	SE	Effect	SE	Effect	SE	Effect	SE
Combat exposure										
Single	0.0039	0.0018							0.0017	0.0022
Multiple	0.0094	0.0015							0.0087	0.0020
Other measures										
Attacked										
Single			0.0049	0.0019						
Multiple			0.0069	0.0011						
IED										
Single					0.0032	0.0019				
Multiple					0.0067	0.0015				
Smoke										
Single							0.0003	0.0033	0.0003	0.0032
Multiple							0.0037	0.0012	0.0021	0.0012
Observations	57,221		57,221		57,221		32,516		32,516	
Pseudo-R^2	0.56		0.56		0.56		0.55		0.55	

GME = Generalized Maximum Entropy, IED = improvised explosive device, SE = standard error.
GME marginal effects for multinomial models displayed. Estimates for *None, Distress Only,* and *Major Problem Only* states not displayed. The marginal effect for each continuous variable is calculated with all independent variables set to the mean. The marginal effect for each categorical variable is calculated by changing all observations from the reference value to the category value with all other independent variables set to the mean. All columns include military control variables in Table 2, all other deployment-related variables in Table 5, all other background variables in Table 3 and dummy variables for missing values of family structure, health, health behaviors, and childhood experiences.

from burning trash or feces seems unlikely to test a veteran's understanding of the world or change financial behaviors. Though smoke exposure in some veterans could have caused health conditions with major financial consequences, the inclusion of controls for disability or illness in the model make any expected influence of smoke exposure on financial decline small. Table 7 column 4 displays results for estimations with the smoke exposure measures, created from the 2011 and later survey question responses, substituted for the primary combat exposure measures, and Table 7 column 5 displays results for estimations with the smoke exposure measures and the primary combat exposure measures. The results provide support for the hypothesis that combat exposure leads to financial decline. Table 7 column 5 also indicates estimations for the primary combat exposure measures are robust when only considering a single year of financial decline observations.

5. Summary of results and discussion

Finances are the most commonly reported stressor for the US population and most Americans experience multiple traumatic events (American Psychological Association, 2015; Kilpatrick et al., 2013), yet, to the best of our knowledge, this is the first study to measure financial decline following traumatic exposure. The results consistently support the hypothesis combat exposure is associated with financial declines for deployed veterans. The results indicate, on average, the probability of developing a new major financial problem (such as bankruptcy) and greater financial distress increases 0.44 percentage points (21 percent relative to the mean probability) following a single combat exposure and increases 0.90 percentage points (43 percent relative to the mean probability) following multiple combat exposures.

We translate the results to a crude lower bound cost estimate of lost productivity and a crude upper bound estimate of bankruptcies for the 2.7 million veterans deployed from 2001 through 2016. First, assuming average rates of combat exposure reported in the study, the results suggest combat exposure contributed to an additional 3629 veterans with major financial problems and distress. Next, we define our average veteran to be a 29-year-old enlisted (E−5) service member in 2016 with approximate annual basic pay of $38,000 (not counting local allowances for housing, sustenance, or deployments). Assuming financial problems result in a conservative 10 percent productivity loss, or $11,400 over a 3 year survey period (Garman et al., 1996), the marginal effects of combat exposure on major financial problems and distress translate to a lower bound, short-term productivity loss of $41 million. Next, we assume all respondents only considered the survey question example of bankruptcy as a major financial problem. In this case, we end up with an upper bound estimate of 3629 (1.34 per 1000 veterans) personal bankruptcies due to combat exposure. Moreover, neither estimate captures the financial problem related costs to individual health, military security, military recruitment, or long-term productivity.

The current study also stands out among other economic studies using longitudinal data to identify deleterious influences of combat exposure on non-market outcomes (Cesur et al., 2013, 2015, 2016; Armey & Lipow, 2016; Cesur & Sabia, 2016) because simulation results help identify policy-relevant characteristics that may be targeted before a veteran is sent into harm's way. The results point toward veterans with poorer pre-deployment mental or physical health, veterans in enlisted ranks, and veterans between the ages of 26 and 36 as being less resilient to the effects of combat exposure on financial problems. As changes in the deployment selection process could be problematic, the results suggest policies to strengthen health or financial management skills may be best applied to targeted populations regardless of deployment selection. Additionally, as Edwards (2015) economic study with cross-sectional data reveals no significant association between household income and combat exposure, the current study highlights the value added by examining variation within individuals and with alternate economic measures to understand the impact of combat exposure on economic well-being.

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Author statement

Adam Ackerman: Conceptualization; Project administration (equal); Data curation (equal); Methodology; Formal analysis; Writing – original draft preparation; Review and editing (equal). Bennett Porter: Project administration (equal); Data curation (equal); Writing – review and editing (equal).

Declaration of competing interest

Ben Porter also holds an affiliation with the Social Science Research Center at Mississippi State University.

Appendix

Table A1 displays the influence of individual military, individual non-military, and economic variables on financial decline. Several military variables influence financial decline. Military service of more than 6 years, officer rank, Air Force branch, and active duty component are each associated with increases in the no probability of financial decline. The time of military service entry is not associated with financial decline, and variation in financial decline explained by occupational classifications is relatively limited.

The results suggest several individual non-military variables also influence financial decline. Hispanic ethnicity, higher numbers of dependents, divorce in the past 3 years, smoking, heavy drinking, and adverse childhood experiences are associated with decreases in the probability of no financial decline. Higher educational attainment, higher physical health component summary scores (PCS), and higher mental health component summary scores (MCS) are associated with increases in the probability of no financial decline. The inclusion of the pre-deployment financial distress variable improves the model accuracy, but the marginal effects require caution in interpretation given that veterans with pre-deployment financial distress can only move one level (rather than two levels for veterans without pre-deployment financial distress) higher on the financial distress scale. As the age variable enters the model non-linearly, the displayed marginal effects at the mean age on financial decline require caution in interpretation.

The model suggests recent economic conditions have greater influence on financial decline than pre-deployment economic conditions, but a one percent change in any economic condition is associated with less of change in the probability of financial decline than is expected from a single combat exposure. Higher recent gross domestic product (GDP) growth and higher inflation-adjusted military pay growth are associated with increases in the probability of no financial decline. On the other hand, the variation in financial decline explained by pre-deployment GDP growth and inflation-adjusted military pay growth is relatively limited. A possible takeaway is that policies increasing military pay (at levels observed in the sample) may not help prevent veteran financial problems in the long-term and policymakers may want to consider other interventions to prevent veteran financial problems in the long-term.

Table A1
Marginal Effects of Background Variables on Financial Decline

	(1)		(2)		(3)		(4)	
	Pr(Y=None)		Pr(Y = DO)		Pr(Y = MPO)		Pr(Y = D&MP)	
	Effect	SE	Effect	SE	Effect	SE	Effect	SE
Other military variables								
Service entry								
Post-2001 entry	0.0035	0.0038	−0.0011	0.0037	−0.0019	−0.0005	−0.0005	0.0010
Years of service								
7–12	0.0151	0.0036	−0.0137	0.0035	−0.0007	−0.0007	−0.0007	0.0010
13–18	0.0209	0.0050	−0.0153	0.0048	−0.0022	−0.0033	−0.0033	0.0012
19 or more	0.0169	0.0058	−0.0093	0.0057	−0.0037	−0.0039	−0.0039	0.0014
Rank								
Officer	0.0674	0.0037	−0.0556	0.0035	−0.0035	−0.0083	−0.0083	0.0010
Branch of service								
Navy	−0.0063	0.0036	0.0072	0.0034	−0.0006	−0.0004	−0.0004	0.0009
Air Force	0.0566	0.0028	−0.0504	0.0026	−0.0004	−0.0058	−0.0058	0.0007
Marine Corps	−0.0318	0.0051	0.0359	0.0050	−0.0018	−0.0023	−0.0023	0.0011
Component								
Reserve or National Guard	−0.0523	0.0028	0.0407	0.0027	0.0022	0.0094	0.0094	0.0009
Separated	−0.0118	0.0050	0.0107	0.0048	0.0005	0.0006	0.0006	0.0013
Occupational classification								
Electrical repair	0.0034	0.0046	−0.0054	0.0044	0.0015	0.0005	0.0005	0.0014
Comm/intel	0.0054	0.0045	−0.0062	0.0043	−0.0001	0.0008	0.0008	0.0013
Health care	−0.0122	0.0048	0.0117	0.0046	0.0001	0.0005	0.0005	0.0013
Other technical	−0.0149	0.0077	0.0127	0.0073	0.0013	0.0010	0.0010	0.0020
Functional support	0.0093	0.0039	−0.0100	0.0037	0.0003	0.0004	0.0004	0.0011
Equipment repair	0.0054	0.0042	−0.0074	0.0040	0.0013	0.0008	0.0008	0.0012
Craft workers	0.0016	0.0070	−0.0069	0.0066	0.0016	0.0037	0.0037	0.0020
Service and supply	−0.0124	0.0045	0.0093	0.0043	0.0006	0.0025	0.0025	0.0013
Other	0.0212	0.0062	−0.0176	0.0059	−0.0008	−0.0028	−0.0028	0.0017
Non-military background variables								
Financial distress	0.1724	0.0025	−0.1942	0.0023	0.0224	−0.0005	−0.0005	0.0006
Female	−0.0027	0.0030	0.0049	0.0029	−0.0017	−0.0005	−0.0005	0.0008
Age	0.0029	0.0003	−0.0029	0.0003	0.0001	−0.0002	−0.0002	0.0001
Race								
Black Non-Hispanic	−0.0007	0.0041	−0.0059	0.0039	0.0023	0.0043	0.0043	0.0012
Other Non-Hispanic	0.0057	0.0039	−0.0046	0.0037	−0.0007	−0.0004	−0.0004	0.0011
Hispanic	−0.0184	0.0047	0.0156	0.0045	0.0008	0.0020	0.0020	0.0012
Education								
Some college	0.0122	0.0036	−0.0109	0.0035	−0.0003	−0.0010	−0.0010	0.0009
College degree	0.0262	0.0047	−0.0217	0.0045	−0.0016	−0.0029	−0.0029	0.0012

(*continued on next page*)

Table A1 (*continued*)

	(1)		(2)		(3)		(4)	
	Pr(Y=None)		Pr(Y = DO)		Pr(Y = MPO)		Pr(Y = D&MP)	
	Effect	SE	Effect	SE	Effect	SE	Effect	SE
Family structure								
Number of dependents	−0.0121	0.0009	0.0093	0.0009	0.0009	0.0019	0.0019	0.0002
Divorce	−0.0109	0.0036	0.0041	0.0034	0.0026	0.0042	0.0042	0.0010
Health								
PCS	0.0042	0.0002	−0.0038	0.0002	0.0000	−0.0004	−0.0004	0.0000
MCS	0.0055	0.0001	−0.0051	0.0001	0.0000	−0.0005	−0.0005	0.0000
Smoking	−0.0178	0.0027	0.0127	0.0026	0.0015	0.0035	0.0035	0.0007
Heavy drinking	−0.0191	0.0047	0.0198	0.0046	−0.0016	0.0009	0.0009	0.0011
Childhood experiences								
Neglect	−0.0099	0.0050	0.0045	0.0047	0.0025	0.0029	0.0029	0.0012
Verbal abuse	−0.0318	0.0038	0.0254	0.0036	0.0008	0.0056	0.0056	0.0011
Physical abuse	−0.0213	0.0032	0.0183	0.0031	0.0009	0.0021	0.0021	0.0009
Sexual abuse	−0.0331	0.0047	0.0279	0.0046	0.0018	0.0034	0.0034	0.0012
Macroeconomic								
GDP growth	0.0220	0.0016	−0.0181	0.0015	−0.0004	−0.0036	−0.0036	0.0004
Lag GDP growth	0.0020	0.0010	−0.0004	0.0009	−0.0008	−0.0007	−0.0007	0.0003
Military pay growth	0.0219	0.0018	−0.0178	0.0018	−0.0003	−0.0038	−0.0038	0.0005
Lag military pay growth	−0.0016	0.0016	0.0003	0.0015	0.0002	0.0012	0.0012	0.0005
Observations	131,036							
Pseudo-R^2	0.55							

DO = Distress Only, **MPO** = Major Problem Only, **D&MP** = Distress & Major Problem.
Effect = Generalized Maximum Entropy marginal effect, GDP = gross domestic product, Generalized Maximum Entropy, MCS = mental health component summary score, PCS physical health component summary score, SE = standard error. The marginal effect for each continuous variable is calculated with all independent variables set to the mean. The marginal effect for each categorical variable is calculated by changing all observations from the reference value to the category value with all other independent variables set to the mean. All columns include deployment-related variables in Table 5, and dummy variables for missing values of family structure, health, health behaviors, and childhood experiences.

Figure A1 presents the effects of combat exposure on the probability of a new major financial problems and distress for different sub-samples. The confidence interval of the marginal effects for each sub-sample overlap with the confidence interval of the marginal effects for the full sample. The results suggest combat exposure has a similar influence on different groups of veterans.

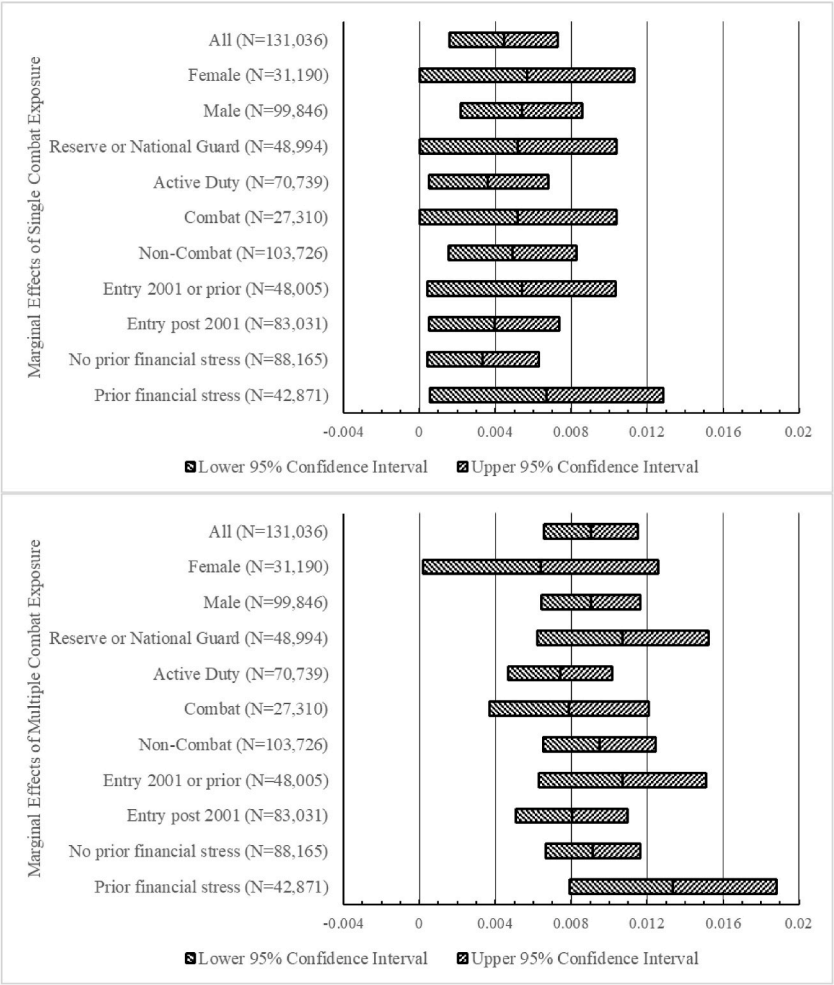

Fig. A.1. Marginal effects of combat exposure over sub-samples on probability (Major Problem & Distress). GME marginal effects for categorical variables computed by setting all observations to category value and comparing to respective base value with all other variables set to sample means. Model includes military control variables in Table 2, all deployment-related variables in Table 6, all other background variables in Table 3, and dummy variables for missing values of family structure, health, health behaviors, and childhood experiences. .

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