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RESEARCH ARTICLE

Asymmetry and Spillover Effects in the Relationship Between Stock Markets and Mental Health: An Alternative Approach

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ABSTRACT

Despite the arguments made by prospect theory, there is a lack of studies investigating asymmetric effects in the relationship between stock markets and mental health. We use the UK based Understanding Society panel dataset between 2010 and 2023 to investigate if stock market fluctuations have an asymmetric impact on mental health, and if there are mental health spillover effects on investors' household members, providing the first paper to investigate this relationship using an asymmetric fixed effects model for panel data. We find that a decreasing stock market index has a stronger impact on mental health than an increasing one, supporting prospect theory. We also suggest that prospect theory does not hold for males in explaining the relationship between stock market fluctuations and mental health. Finally, we provide novel evidence for a mental health spillover effect of negative 52-week returns on investors' household members.

1 | Introduction

Stock market fluctuations as one of the financial factors influencing mental health have been studied by an extensive body of literature (Liu and Fan 2024; Engelberg and Parsons 2016; Ratcliffe and Taylor 2015; Frijters et al. 2015). Despite the existence of Kahneman and Tversky's (1979) prospect theory, stating that losses have a greater impact than gains when making decisions under risk, the vast majority of studies employ symmetric models to investigate the impact of stock market fluctuations on various measures of mental health (Cotti and Simon 2018; Engelberg and Parsons 2016; Ratcliffe and Taylor 2015; Frijters et al. 2015). There is a lack of studies investigating asymmetry in the effect of stock market returns on people's mental health. Exceptions include Schwandt (2018), Cotti et al. (2015), and McInerney et al. (2013) who investigate the effects of wealth shocks, such as stock market booms and crashes, on mental health. Liu and Fan (2024) attempt to capture asymmetric effects of stock market returns on the use of antidepressant drugs by using dummy variables as a proxy for positive and negative returns in a linear regression model. However, there is no study to date investigating the impact of stock markets on mental health using an asymmetric fixed effects model for panel data. This model was originally introduced by York and Light (2017) and subsequently revised by Allison (2019) to provide a general method for investigating asymmetric relationships in panel data analysis. The novelty of this model is that the individual-specific effects of both positive and negative changes in independent variables can be estimated separately and quantified in a panel data setting using first differences. This model addresses the challenges faced by previous research (Liu and Fan 2024; Cotti et al. 2015), eliminating the need for dummy variables to capture asymmetric effects and allowing for the determination of effect magnitudes. We provide

the first paper to investigate the asymmetric effect of stock market fluctuations on mental health using an asymmetric fixed effects model for panel data to overcome these challenges experienced by previous research (Liu and Fan 2024; Cotti et al. 2015).

In line with prospect theory, we investigate if negative stock market returns have a greater impact on people's mental health than equivalent positive returns. Furthermore, we test if there are spillover effects of mental health impairments on other household members. This is grounded in the Jacobson model (Jacobson 2000) which states that people are not only producers of their own health, but also that of other family members, suggesting an interconnectedness of health among family members. Cotti and Simon (2018) provide the only study we are aware of investigating mental health spillover effects of stock market performance on children. To our knowledge, we provide the first study to investigate spillover effects of stock market fluctuations on the mental health of other household members aged 15 and over.

We use panel data during the period 2010 to 2023 which we obtain from the UK based Understanding Society dataset to conduct a longitudinal study investigating asymmetry and spillover effects in the relationship between stock market fluctuations and mental health. We use the 12-item General Health Questionnaire (GHQ-12) and the Mental Component Score of the 12-item Short-Form Health Survey (SF-12 MCS) as measures of self-reported mental health. To measure stock market performance, we use the FTSE 100 stock market index to calculate the 52-week logarithmic return prior to the interview, the level of stock market index on the day of the interview, and 52-week volatility prior to the interview which we calculate as the annualized standard deviation based on weekly logarithmic returns. We employ a standard fixed effects model (SFE) and a pooled ordinary least squares regression (POLS) to analyze the impact of stock market fluctuations on mental health, and an asymmetric fixed effects model (AFE) to capture asymmetric effects in this relationship. To investigate mental health spillover effects on other household members, we divide our dataset into three sub-samples, individuals with investment income, individuals with household investment income but no individual investment income, and individuals who have neither individual nor household investment income, and estimate the impact of stock markets on mental health separately for each sub-sample.

We find that 52-week returns have a positive impact on the GHQ-12 score, while 52-week volatility has a negative impact on mental health, with the effect of 52-week volatility being symmetric as confirmed by the asymmetric fixed effects model. We also provide evidence for an asymmetric effect of both positive and negative changes in the level of stock market index on the GHQ-12 score, with the effect of a decreasing index being 1.8 times stronger than the effect of increases, supporting prospect theory. Finally, we provide evidence for a mental health spillover effect of negative 52-week returns on investors' household members.

Besides making a methodological contribution to the literature by using an asymmetric fixed effects model for panel data, we also provide the first paper analyzing mental health spillover effects due to fluctuations in the stock market on other adult household members. In terms of our empirical analysis, we expand on the existing literature investigating the impact of stock markets on mental health by providing novel evidence for asymmetry and spillover effects in this relationship. We also suggest that reliance on investment income is a crucial moderator of the relationship between stock market fluctuations and mental health. Finally, we suggest that prospect theory does not hold for males in explaining the relationship between stock market fluctuations and mental health.

2 | Literature Review

The principle of diminishing marginal utility of income suggests that the positive impact of each additional unit of income on subjective well-being decreases as the level of income rises (Easterlin 2005). This implies that an increase in subjective well-being from an $X gain in income should be less than the equivalent decrease in subjective well-being from an $X loss. However, because the neo-classical theory originally defined utility over life-time wealth, a single bad year in the stock market would have a minimal impact on overall life-time wealth. As a result, the marginal utility of income remains relatively stable between a good and a bad year. Consequently, the gain in subjective well-being from an $X gain in income should not be significantly smaller than the loss in subjective well-being from an $X loss. Yet, in the behavioral economics literature, researchers have found that losses have a considerably larger impact than equivalent gains in both decisions under risk (Kahneman and Tversky 1979) and in riskless choice (Tversky and Kahneman 1991). This is central to Kahneman and Tversky's (1979) prospect theory, which argues that people (a) evaluate gains and losses relative to a reference point and (b) are naturally loss averse. This suggests that prospect theory predicts big asymmetries, whereas the diminishing marginal utility of income only predicts smaller ones.

Numerous studies test prospect theory by investigating asymmetry in the relationship between income and mental health or well-being (Boyce et al. 2013; Watson and Osberg 2019), and in the relationship between economic conditions and happiness (Beja 2017). The literature provides largely concordant findings suggesting that losses affect people more than gains, which supports prospect theory. Boyce et al. (2013) provide evidence that losses in income have a greater impact on well-being than an equivalent increase in income. Watson and Osberg (2019) find that the effect of negative income anxieties on people's psychological distress is considerably larger than the impact of positive income expectations. Finally, Beja (2017) reports that the impact of negative economic growth on happiness is two times stronger than an equivalent increase in economic growth. Building on the reference point hypothesis, Easterlin (2023) provides another explanation for the phenomenon of asymmetry in the relationship between changes in the level of income and happiness, stating that the effect depends on the benchmark used. While during a recession an individual's current income is compared with the previous peak income, in times of economic growth people use other people's income as a reference level (Easterlin 2023).

The majority of research on the relationship between stock markets and mental health agrees that stock market performance is positively associated with people's mental health (Cotti et al. 2015; Ratcliffe and Taylor 2015; Frijters et al. 2015). While Ratcliffe and Taylor (2015) and Frijters et al. (2015) suggest that people's subjective mental health and well-being are positively impacted by stock market returns, some studies also investigate the impact of wealth shocks on mental health, thereby capturing asymmetric effects in their analysis (Cotti et al. 2015; McInerney et al. 2013; Schwandt 2018). Cotti et al. (2015) provide evidence for a negative effect on mental health of monthly returns that are less than − 10%, while positive returns larger than 10% do not affect people's mental health. McInerney et al. (2013) investigate how people's mental health was impacted by the 2008 stock market crash. They provide evidence for an increase in people's feelings of depression and use of antidepressant drugs after the crash, with the effect being stronger for investors with large investments prior to the crash. Schwandt (2018) provides evidence for a symmetric, positive impact of stock market returns on the mental health of stock-holding retirees. Liu and Fan (2024) investigate the asymmetric effect of stock market returns on the use of antidepressant drugs during 2005–2006 and suggest that negative stock market returns lead to an increase in the consumption of antidepressant drugs, while positive returns do not have an impact. However, this study is limited in that a linear regression model is used with dummy variables as proxies for positive and negative stock market returns to capture their asymmetric effects. As a result, the coefficients are biased, and the magnitude of the effect cannot be determined due to the absence of numeric variables to measure stock market returns.

The literature proposes two different mechanisms to explain why stock market performance is associated with people's mental health: (1) a pure wealth effect, and (2) stock markets act as a barometer of economic prospects, social movements and social mood (Ratcliffe and Taylor 2015). According to the pure wealth effect, a stock market downturn reduces wealth for stock-holders, which has an impact on their mental health (Frijters et al. 2015; McInerney et al. 2013). This explanation is in line with literature suggesting that income and wealth are determinants of mental health (Hidrobo et al. 2023; Allen et al. 2014). The mechanism of stock markets being a barometer of economic prospects, social movements and social mood suggests that improving economic prospects lead to better mental health due to rising income expectations (Ratcliffe and Taylor 2015). In contrast, causality is reversed for social movements and social mood. According to the literature in behavioral finance, social mood, such as pessimism and optimism, can cause overreactions in the stock market. Examples of such phenomena include stock market crashes and bubbles (Prechter and Parker 2007).

Furthermore, there is a growing body of literature investigating mental health spillover effects on family members (Jung et al. 2024; Lee et al. 2021). Previous research suggests that mental health impairments due to unemployment or job displacement are contagious, particularly for the spouse (Zhao 2023; Nikolova and Ayhan 2019). Cotti and Simon (2018) investigate the impact of stock market fluctuations on the mental health of children, suggesting a spillover effect of stock markets on children's self-reported health status. The spillover effects identified by previous research can be linked to the Jacobson model which suggests that individuals are producers of both their own and other family members' health (Jacobson 2000). The Jacobson model is an extension of the Grossman model of health capital and the demand for health (Grossman 1972) which was extended by Jacobson (2000) to provide a theoretical framework for the interconnectedness of health among family members.

3 | Research Hypotheses

In line with theory provided by previous literature, we develop the following hypotheses:

H1. *Negative stock market returns have a stronger impact on mental health than positive ones.*

H2. *There is a spillover effect of stock market returns on the mental health of other household members.*

4 | Data

4.1 | Dependent Variables

We use data from the Understanding Society dataset, a UK based household longitudinal study. Our dataset includes information from 2010 to 2023 at both individual and household level (University of Essex. Institute for Social and Economic Research 2023). A full description of all variables is presented in Table 1. Our total sample encompasses 452,064 observations with 78,893 individuals who were interviewed annually over several years. We use the GHQ-12 score and SF-12 MCS as our dependent variables to measure subjective mental health. Both measures have been frequently used in the previous literature (Arulsamy and Delaney 2022; Cygan-Rehm et al. 2017). The GHQ-12 score is based on the short-form of the General Health Questionnaire (GHQ) which aims to detect psychiatric illness such as depression and anxiety (Goldberg 1972). The 12 questions contained in the questionnaire are answered on a 4-point Likert scale with the aim of measuring the respondent's subjective mental health and the likelihood of having a psychiatric disorder. The GHQ-12 score is calculated by combining the 12 answers into a score ranging from 0 to 36, with a low score indicating that the respondent is in good mental health. To enhance the interpretability of the GHQ-12 score and facilitate easier comparison with the SF-12 MCS, we reverse the GHQ-12 scale and normalize it to range from 0 to 100, where a higher score reflects better mental health. This approach of reversing and normalizing the GHQ-12 score has been applied by prior research (Carrino et al. 2020; Waqas et al. 2024). The SF-12 MCS is the Mental Component Summary (MCS) of the 12-Item Short-Form Health Survey (SF-12) which is designed to measure an individual's general mental health. The 12 questions included in the SF-12 are answered on 3-point and 5-point Likert scales. The responses are weighted and transformed into the SF-12 MCS which represents a score between 0 and 100, with a high score indicating that the respondent is in good general mental health

TABLE 1 | Variable descriptions.

Variable	Definition
Dependent variables	
GHQ-12	Reversed and normalized general health questionnaire (GHQ-12) score. The higher the score the better the mental health. The score's range is 0–100.
SF-12 MCS	Mental health score (MCS) of the 12-item short form health survey (SF-12). The higher the score the better the mental health. The score's range is 0–100.
Independent variables	
52-week return	52-week logarithmic return of 52 weeks before the interview based on the FTSE 100 index.
Level of stock market index	Level of FTSE 100 index on the day of the interview.
52-week volatility	Annualized FTSE 100 volatility based on standard deviation of weekly logarithmic returns 52 weeks before the interview.
Female	Dummy variable: = 1 if sex at birth is female. Coefficients are relative to male.
Age	The research participant's age in years at the time of the interview.
University degree	Dummy variable: = 1 if research participant has a higher degree (Masters, PhD), first degree (bachelors) or diploma in higher education. Coefficients are relative to research participants without a university degree.
Marital status	Dummy variables: = 1 if current marital status is single/divorced/widowed/other. Coefficients are relative to married.
Job status	Dummy variable: = 1 if current job status is self-employed/unemployed/retired/student/other. Coefficients are relative to employed.
Resident in urban area	Dummy variable: = 1 if research participant is an urban resident. Coefficients are relative to rural residents.
Country of residence	Dummy variable: = 1 if research participant is resident of Wales/Scotland/Northern Ireland. Coefficients are relative to residents of England.
Total monthly individual income	Logarithm of research participant's total monthly personal gross income in £. A constant of 1 was added to all values of the variable before applying the logarithmic transformation.
Total monthly household income	Logarithm of total gross income in £ of the research participant's household in the month before the interview. A constant of 1 was added to all values of the variable before applying the logarithmic transformation.
Annual individual investment income	Logarithm of research participant's income from interest and dividends in £ in the year before the interview. A constant of 1 was added to all values of the variable before applying the logarithmic transformation.
Monthly household investment income	Logarithm of total investment income in £ of the research participant's household in the month before the interview. A constant of 1 was added to all values of the variable before applying the logarithmic transformation.
Unemployment rate	Annual total UK unemployment rate as a percentage of total labor force.
Year	Dummy variable: = 1 based on year of interview. Coefficients are relative to research participants interviewed in 2010.
Month	Dummy variable: = 1 based on month of interview. Coefficients are relative to research participants interviewed in January.
Week	Dummy variable: = 1 based on week of interview. Coefficients are relative to research participants interviewed in week 1.
Reliance on investment income	Monthly individual investment income as a percentage of total monthly individual income.

(Ware et al. 1995). These two measures of self-reported mental health are used in this study to analyze both the individuals' general mental health and the likelihood of the respondent suffering from a psychiatric disorder.

4.2 | Independent Variables

Our independent variables, 52-week return, level of stock market index, and 52-week volatility, are based on the FTSE 100

index which is the major stock market index in the UK. We use the FTSE 100 index as we assume that the vast majority of research participants included in the Understanding Society dataset are individual investors rather than institutional investors. This assumption forms the basis for our reasoning that they may have invested in mutual funds that replicate a stock market index, such as the FTSE 100. For this reason, we base our measures of stock market performance on this index. We acknowledge that the validity of our assumption may be less applicable to older investors, who typically shift their investments from stocks to lower-risk bonds (Bali et al. 2009). This can be viewed as a limitation of our study.

To measure 52-week returns, we calculate logarithmic returns of a period of 52 weeks prior to the interview. The level of stock market index is the value of the FTSE 100 index on the day of the interview. Finally, we measure 52-week volatility as the annualized standard deviation of the FTSE 100 index based on weekly logarithmic returns over a period of 52 weeks prior to the interview. The data were obtained from Bloomberg. Our selection of the three different measures of stock market performance is informed by prior research examining the relationship between stock markets and mental health (Ratcliffe and Taylor 2015; Lin et al. 2015; Cotti and Simon 2018). Furthermore, York and Light (2017) emphasize that the timing of the independent variables of interest should align with the frequency of data collection of the dependent variables, making a 52-week period to measure stock market performance the most appropriate choice.

4.3 | Control Variables

In our regression models, we control for the variables sex at birth, age, education level, marital status, job status, resident in urban or rural area, country of residence within the UK, total monthly individual income, total monthly household income, annual individual investment income, monthly household investment income, year, month, and week dummies. We apply a logarithmic transformation to our income variables, total monthly individual income, total monthly household income, annual individual investment income, and monthly household investment income. Before applying the logarithmic transformation, we add a constant of 1 to all values of each income variable to address the problem that zero values cannot undergo logarithmic transformation. This approach is commonly applied in the literature (Ekwaru and Veugelers 2018). Our income variables are not adjusted for inflation. In our robustness analysis, we additionally control for the UK's unemployment rate which we obtain from the World Bank databank. The choice of control variables is guided by previous literature investigating the relationship between stock markets and mental health (Schwandt 2018; Cotti et al. 2015; Ratcliffe and Taylor 2015).

5 | Econometric Models

We employ a pooled ordinary least squares (OLS), standard fixed effects, and asymmetric fixed effects model for each of our measures of subjective mental health, GHQ-12 and SF-12 MCS. Using the pooled OLS model, we estimate the subjective mental health y of individual i at time t as follows:

$$y_{it} = \mu_t + x_{it}\beta + \varepsilon_{it} \tag{1}$$

In the preceding equation, y_{it} represents the subjective mental health y, measured by GHQ-12 and SF-12 MCS, of individual i at time t. μ_t represents the intercept, x_{it} is the ith independent variable, β is the slope parameter for each independent variable and ε_{it} represents the error term.

The standard fixed effects model is employed to capture the individual-specific effects. We estimate the subjective mental health y of individual i at time t as follows:

$$y_{it} = \mu_t + x_{it}\beta + \alpha_i + \varepsilon_{it} \tag{2}$$

In this model, the individual-specific effects α_i are added to the equation. The remaining model specification remains unchanged to the pooled OLS model. As one of the assumptions of the standard fixed effects model is a linear, symmetric impact of the ith independent variable on the dependent variable, we also employ an asymmetric fixed effects model to investigate asymmetry in the relationship between stock market performance and subjective mental health. Following the approach proposed by Allison (2019), we first determine the first differences of our independent variables and subsequently decompose them into positive and negative components:

$$x_{it}^{+} = x_{it} - x_{it-1}\ if\ (x_{it} - x_{it-1}) > 0, \text{otherwise } 0 \tag{3}$$

$$x_{it}^{-} = -(x_{it} - x_{it-1})\ if\ (x_{it} - x_{it-1}) < 0, \text{otherwise } 0 \tag{4}$$

In Equation (3), $x_{it}{}^{+}$ represents a positive change in the first difference of each independent variable. A negative change in the first difference of our independent variables is represented by $x_{it}{}^{-}$ in Equation (4). If time $t = 1$, x_{it}^{+} and x_{it}^{-} are set to 0 because x_{it-1} is not observed (Allison 2019). We then accumulate both positive and negative changes in the first differences of each independent variable up to time t as follows:

$$z_{it}^{+} = \sum_{s=1}^{t} x_{is}^{+} \tag{5}$$

$$z_{it}^{-} = \sum_{s=1}^{t} x_{is}^{-} \tag{6}$$

In the above two equations, z_{it}^{+} represents the accumulation of all positive changes while z_{it}^{-} represents the accumulation of all negative changes up to time t. Finally, we can estimate the following asymmetric first difference model (Allison 2019; Park and Kim 2024):

$$\Delta y_{it} = \Delta\mu_t + \beta^{+}\Delta z_{it}^{+} + \beta^{-}\Delta z_{it}^{-} + \Delta\varepsilon_{it} \tag{7}$$

To test whether the impact of stock market performance on subjective mental health is asymmetric, we perform a Wald test that determines whether the difference between the magnitude of positive and negative changes in the independent variables is statistically significant ($\beta^{+} = -\beta^{-}$). This approach is in line with the previous literature (Park et al. 2024; Park and Kim 2024;

Allison 2019). We provide robust standard errors clustered to the person level to ensure valid statistical inference (Cameron and Miller 2015).

6 | Results

6.1 | Descriptive Statistics

The complete set of descriptive statistics is presented in Table 2. The average GHQ-12 score is 68.818 with a standard deviation of 15.528. This indicates that the average respondent is in good mental health. The mean SF-12 MCS is 48.823 with a standard deviation of 10.285. It is noteworthy that male respondents report better mental health than females. The average GHQ-12 score is 70.715 for males and 67.302 for females. The same applies to their SF-12 MCS, with a mean of 50.043 for males and 47.847 for females. We conduct a *t*-test to compare the mean GHQ-12 and SF-12 MCS scores between males and females. The results indicate a statistically significant difference between the means of both scores ($p < 0.01$). The mean 52-week return is 0.036, indicating that positive 52-week returns are more likely than negative ones. The average level of the FTSE 100 stock market index is 6495.504 and the average 52-week volatility is 0.153 standard deviations based on weekly logarithmic returns. 54.3% of our sample are female and the average respondent is 48.586 years old at the time of the interview.

6.2 | Main Regression Results

Prior to running the main regressions, we test our dataset for multicollinearity between the independent variables by computing the variance inflation factors (VIF). The VIFs for our main independent variables reach from 5.23 for 52-week returns to 13.01 for the level of stock market index. Previous research suggests that a regression model has a multicollinearity problem if a VIF is greater than 5–10 (Baum 2006; Kim 2019). As all VIFs of our main independent variables of interest exceed 5, we decide to run separate regressions for each of these variables to alleviate the issue of multicollinearity. We apply this approach to all regressions included in Tables 3–7.

Before presenting the main regressions, we illustrate the regression results for the total sample with all control variables using 52-week returns in Table 8. The results show that females, individuals with a university degree, and residents of urban areas report poorer mental health, while the levels of both individual and household investment income have a positive impact on people's mental health. These results can be used to compare the magnitude of the coefficients in Tables 3–7 to the impact other control variables have on our two measures of mental health, GHQ-12 and SF-12 MCS. The main regression results for the total sample are presented in Table 3. The table shows that while 52-week returns do not affect the SF-12 MCS, they do have an impact on the GHQ-12, with a one-unit increase in 52-week returns leading to a 1.537 better GHQ-12 according to the standard fixed effects model and a 1.292 better GHQ-12 according to the pooled OLS model. The asymmetric fixed effects model does not suggest that this relationship is asymmetric. An increasing stock market index also leads to an improved GHQ-12 score. The asymmetric fixed effects model provides evidence for an asymmetric effect of both positive and negative changes in the level of stock market index on the GHQ-12, with the effect of a decreasing index being 1.8 times stronger than the effect of increases. This finding supports prospect theory and goes beyond the predictions of neoclassical economics, which are based on the diminishing marginal utility of income. This finding is in line with previous literature investigating asymmetry in the relationship between stock markets and mental health (Liu and Fan 2024; Cotti et al. 2015) and with research testing prospect theory (Watson and Osberg 2019; Boyce et al. 2013). In contrast, the difference in the effect of positive and negative changes in the level of stock market index on the SF-12 MCS is not statistically significant. Finally, 52-week volatility has a negative impact on mental health measured by GHQ-12 and SF-12 MCS, with increasing volatility leading to deteriorating mental health outcomes. The asymmetric fixed effects model confirms that this relationship is symmetric.

These results may be explained by the two mechanisms provided by previous literature, the pure wealth effect and stock markets as a barometer of economic prospects, social movements and social mood (Ratcliffe and Taylor 2015). Furthermore, we provide an explanation for the negative impact of 52-week volatility on mental health. According to Cascaldi-Garcia et al. (2023), stock market volatility is commonly used in the literature as an indicator of uncertainty in both financial and economic terms. The increasing uncertainty may cause people to worry more about the value of their financial assets, but also about their future employment due to an increasingly uncertain economic environment, which leads to a deterioration in their mental health.

6.3 | Regression Results by Gender

Still with our main results, we also divide the total sample into males and females to analyze gender differences in the effect of stock markets on mental health, the results of which are also shown in Table 3. All regression models suggest that women's mental health appears to be significantly more impacted by stock market fluctuations than that of men, measured by both the magnitude of coefficients and the level of statistical significance. According to the standard fixed effects models, women's GHQ-12 score is 1.9 times more impacted by 52-week returns, 1.8 times more by the level of stock market index, and 1.7 times more by 52-week volatility, compared to men's GHQ-12. We also find an asymmetric effect of changes in the level of stock market index on women's GHQ-12 score, with the effect of negative changes being 2 times stronger than the effect of positive ones, which demonstrates that women's reaction to losses is stronger than men's. This variation in findings between males and females has implications for prospect theory. While prospect theory is supported by the results for female respondents, our results suggest that it does not hold for male respondents in explaining the relationship between stock market fluctuations and mental health. We also note a symmetric impact of the level of stock market index and 52-week volatility on women's SF-12 MCS, as indicated by the asymmetric fixed effects model, while the SF-12 MCS of men is not affected by our measures of stock market fluctuations. We explain these results with literature suggesting that female

TABLE 2 | Descriptive statistics.

	Mean	Standard deviation	Minimum	Maximum
GHQ-12	68.818	15.528	0	100
Male	70.715	14.444	0	100
Female	67.302	16.630	0	100
SF-12 MCS	48.823	10.285	0	78.080
Male	50.043	9.699	0	78.080
Female	47.847	10.630	0	77.670
52-week return	0.036	0.112	−0.328	0.461
Level of stock market index	6495.504	699.716	4838.090	8004.360
52-week volatility	0.153	0.049	0.084	0.315
Female	0.543	0.498	0	1
Age	48.586	18.757	15	104
University degree	0.321	0.467	0	1
Single	0.298	0.457	0	1
Divorced	0.089	0.284	0	1
Widowed	0.065	0.246	0	1
Other marital status	0.024	0.154	0	1
Self-employed	0.077	0.266	0	1
Unemployed	0.046	0.210	0	1
Retired	0.244	0.430	0	1
Student	0.064	0.245	0	1
Other job status	0.100	0.299	0	1
Resident in urban area	0.756	0.430	0	1
Resident in Wales	0.070	0.255	0	1
Resident in scotland	0.086	0.280	0	1
Resident in Northern Ireland	0.066	0.249	0	1
Total monthly individual income	6.741	1.929	0	10.283
Total monthly household income	8.007	0.876	0	14.112
Annual individual investment income	1.309	2.432	0	15.251
Monthly household investment income	2.136	2.561	0	12.768
Unemployment rate	5.873	1.619	3.730	8.038
Year	2015.228	3.456	2010	2023
Month	6.329	3.338	1	12
Week	25.660	14.493	1	52
Reliance on investment income	0.080	0.255	0	40.076

investors have less confidence in the performance of their investments and react more emotionally to risky situations than male investors (Rahman and Rashidi 2021). Another explanation is that females are more inclined than men to express distress because they are more likely to internalize emotional issues than men (Simon 2002).

6.4 | Regression Results by Age Cohorts

To analyze our regression results by age group, we divide our total sample into young (aged 15–44), middle-aged (45–60) and older cohorts (aged 60 +). This approach is in line with previous literature (Frijters et al. 2015). Our regression results are presented in Table 4. Our results show that 52-week returns have a positive impact on the GHQ-12 score of young individuals. However, there is an asymmetric impact of changes in the level of stock market index, with only negative changes impacting their mental health. 52-week volatility also has an asymmetric impact on their mental health, with the impact of an increase in 52-week volatility being 1.9 times stronger than the effect of decreasing volatility. The asymmetric fixed effects model also suggests that the SF-12 MCS of young cohorts is only affected by increases in 52-week volatility, while it is not

TABLE 3 | Regression results for total sample and gender groups.

		All		Male		Female	
		GHQ-12	SF-12 MCS	GHQ-12	SF-12 MCS	GHQ-12	SF-12 MCS
52-week return	POLS	1.292***	0.242	0.916**	0.089	1.515***	0.291
		(0.326)	(0.215)	(0.444)	(0.301)	(0.467)	(0.303)
52-week return	SFE	1.537***	0.243	1.023**	−0.043	1.918***	0.453*
		(0.293)	(0.189)	(0.401)	(0.266)	(0.419)	(0.265)
52-week return (positive)	AFE	0.849	0.361	0.195	0.288	1.283*	0.371
		(0.520)	(0.336)	(0.728)	(0.477)	(0.731)	(0.470)
52-week return (negative)	AFE	−1.376**	−0.173	−0.194	0.106	−2.296***	−0.356
		(0.578)	(0.375)	(0.805)	(0.529)	(0.817)	(0.524)
p-value for $\beta^+ = -\beta^-$	Wald test	0.506	0.715	0.999	0.587	0.366	0.984
Level of stock market index	POLS	0.264***	0.031	0.124	−0.039	0.360***	0.072
		(0.088)	(0.058)	(0.120)	(0.082)	(0.126)	(0.082)
Level of stock market index	SFE	0.399***	0.065	0.270**	−0.011	0.495***	0.119*
		(0.077)	(0.050)	(0.106)	(0.071)	(0.110)	(0.070)
Level of stock market index (positive)	AFE	0.247***	0.114**	0.185*	0.035	0.295***	0.173**
		(0.078)	(0.050)	(0.110)	(0.072)	(0.109)	(0.070)
Level of stock market index (negative)	AFE	−0.436***	−0.104*	−0.245*	−0.011	−0.593***	−0.176**
		(0.091)	(0.060)	(0.127)	(0.085)	(0.129)	(0.084)
p-value for $\beta^+ = -\beta^-$	Wald test	0.056	0.880	0.662	0.796	0.032	0.971
52-week volatility	POLS	−5.370***	−0.716	−3.077***	0.220	−6.881***	−1.245
		(0.849)	(0.558)	(1.159)	(0.790)	(1.217)	(0.780)
52-week volatility	SFE	−7.459***	−1.603***	−5.216***	−0.503	−9.089***	−2.377***
		(0.764)	(0.494)	(1.037)	(0.703)	(1.098)	(0.690)
52-week volatility (positive)	AFE	−6.608***	−1.537***	−4.876***	−0.797	−7.943***	−2.076***
		(0.824)	(0.537)	(1.149)	(0.759)	(1.166)	(0.752)
52-week volatility (negative)	AFE	4.913***	1.637***	2.590**	0.445	6.634***	2.500***
		(0.944)	(0.616)	(1.305)	(0.873)	(1.339)	0.860
p-value for $\beta^+ = -\beta^-$	Wald test	0.125	0.890	0.139	0.731	0.401	0.674
N (observations)		291,208	286,608	131,223	129,285	159,985	157,323

Note: We list the results for 54 models using three different samples, all, males and females, two different dependent variables, GHQ-12 and SF-12 MCS, and three different regressions, pooled OLS, standard fixed effects and asymmetric fixed effects regression. We control for sex, age, education level, marital status, job status, resident in urban or rural area, country of residence, total monthly individual income, total monthly household income, annual individual investment income, monthly household investment income, and year, month and week dummies. Coefficients are reported. Robust clustered standard errors are in parentheses. Coefficients and standard errors for level of stock market index are multiplied by 1000. * if $p < 0.10$, ** if $p < 0.05$, *** if $p < 0.01$.

affected by 52-week returns and the level of stock market index.

The asymmetric fixed effects models do not provide any evidence for asymmetry in the impact of stock market fluctuations on the mental health of middle-aged individuals. However, the standard fixed effects models suggest that there is an impact of 52-week returns, the level of stock market index and 52-week volatility on their GHQ-12 score. The results for individuals aged 60+ suggest that there is an asymmetric effect of 52-week returns and the level of stock market index on both their GHQ-12 and SF-12 MCS, with only negative returns and negative changes in the level of stock market index negatively impacting their mental health. The asymmetric fixed effects model suggests that 52-week volatility appears to have a symmetric impact on their mental health measured by GHQ-12.

6.5 | Spillover Effects on Other Household Members

To investigate mental health spillover effects due to stock market fluctuations on other household members, we divide our dataset into three sub-samples: (1) individuals with investment income regardless of having non-investment income, (2) individuals with household investment income but no individual investment income, and (3) individuals who have neither individual nor household investment income which serves as the control group. The regression results are presented in Table 5.

TABLE 4 | Regression results by age group.

		Age 15–44		Age 45–60		Age 60+	
		GHQ-12	SF-12 MCS	GHQ-12	SF-12 MCS	GHQ-12	SF-12 MCS
52-week return	POLS	1.327**	0.477	0.657	−0.382	1.955***	0.475
		(0.516)	(0.340)	(0.611)	(0.384)	(0.560)	(0.391)
52-week return	SFE	1.657***	0.372	1.018*	0.024	2.123***	0.483
		(0.485)	(0.307)	(0.546)	(0.333)	(0.481)	(0.344)
52-week return (positive)	AFE	1.358	0.516	1.163	0.007	−0.425	−0.407
		(0.835)	(0.543)	(1.062)	(0.641)	(0.923)	(0.659)
52-week return (negative)	AFE	−2.397**	−0.538	0.570	0.947	−3.922***	−1.917***
		(0.957)	(0.621)	(1.143)	(0.695)	(1.041)	(0.724)
p-value for $\beta^+ = -\beta^-$	Wald test	0.430	0.980	0.292	0.337	0.003	0.023
Level of stock market index	POLS	0.230*	0.079	0.177	−0.102	0.472***	0.110
		(0.139)	(0.093)	(0.165)	(0.104)	(0.150)	(0.105)
Level of stock market index	SFE	0.446***	0.041	0.327**	0.030	0.458***	0.159*
		(0.128)	(0.082)	(0.145)	(0.088)	(0.125)	(0.091)
Level of stock market index (positive)	AFE	0.192	0.027	0.406**	0.155	0.111	−0.006
		(0.125)	(0.080)	(0.158)	(0.095)	(0.137)	(0.099)
Level of stock market index (negative)	AFE	−0.560***	−0.102	−0.239	−0.022	−0.657***	−0.362***
		(0.150)	(0.099)	(0.180)	(0.109)	(0.159)	(0.114)
p-value for $\beta^+ = -\beta^-$	Wald test	0.022	0.482	0.425	0.291	0.003	0.005
52-week volatility	POLS	−5.796***	−1.366	−4.007**	0.442	−5.812***	−0.588
		(1.445)	(0.952)	(1.559)	(0.973)	(1.343)	(0.934)
52-week volatility	SFE	−7.927***	−2.041**	−6.812***	−1.205	−8.036***	−1.445*
		(1.339)	(0.857)	(1.407)	(0.856)	(1.186)	(0.840)
52-week volatility (positive)	AFE	−8.562***	−2.896***	−5.720***	−1.437	−7.532***	−1.403
		(1.368)	(0.898)	(1.624)	(0.982)	(1.406)	(1.000)
52-week volatility (negative)	AFE	4.501***	0.918	4.887***	1.607	5.173***	1.227
		(1.581)	(1.025)	(1.820)	(1.147)	(1.611)	(1.137)
p-value for $\beta^+ = -\beta^-$	Wald test	0.026	0.094	0.711	0.903	0.239	0.901
N (observations)		136,177	134,020	82,606	81,542	72,425	71,046

Note: We list the results for 54 models using three different samples, age 15–44, age 45–60 and age 60+, two different dependent variables, GHQ-12 and SF-12 MCS, and three different regressions, pooled OLS, standard fixed effects and asymmetric fixed effects regression. We control for sex, age, education level, marital status, job status, resident in urban or rural area, country of residence, total monthly individual income, total monthly household income, annual individual investment income, monthly household investment income, and year, month and week dummies. Coefficients are reported. Robust clustered standard errors are in parentheses. Coefficients and standard errors for level of stock market index are multiplied by 1000. * if $p < 0.10$, ** if $p < 0.05$, *** if $p < 0.01$.

The pooled OLS, symmetric fixed effects and asymmetric fixed effects model provide evidence for the existence of a symmetric effect of 52-week returns on the GHQ-12 score of individuals with investment income, suggesting that both positive and negative 52-week returns equally affect their mental health. This result may primarily be explained by the pure wealth effect, as the respondents included in this sub-sample have income from investments, the amount of which may be affected by fluctuations in the stock market.

The asymmetric fixed effects model suggests that only negative 52-week returns have a negative impact on the GHQ-12 score of individuals with household investment income but no individual investment income. This finding cannot be explained by the pure wealth effect directly affecting the respondent, as individuals included in this sub-sample do not have any individual investment income themselves. Instead, they may either be affected by the mental health impairment of other household members due to a reduction in wealth or because stock markets act as a barometer of economic prospects. The results of both the standard and asymmetric fixed effects models suggest that the control group is not affected by 52-week returns. This eliminates the possibility of sub-sample (2) being affected because stock markets are a barometer of economic prospects, and provides strong support for the existence of a mental health spillover effect of negative 52-week returns on investors' household members, as individuals who have neither individual nor household investment income are not affected by 52-week returns. In conclusion, the results show that there is a symmetric effect of 52-week returns on the mental health of

TABLE 5 | Spillover effects regression results.

		(1)		(2)		(3)	
		GHQ-12	**SF-12 MCS**	**GHQ-12**	**SF-12 MCS**	**GHQ-12**	**SF-12 MCS**
52-week return	POLS	1.743***	0.428	1.739**	0.240	0.862*	0.167
		(0.566)	(0.373)	(0.719)	(0.471)	(0.504)	(0.335)
52-week return	SFE	2.713***	0.747**	2.959***	1.076**	0.474	−0.227
		(0.519)	(0.328)	(0.725)	(0.457)	(0.469)	(0.306)
52-week return (positive)	AFE	1.903**	1.092*	0.053	−0.078	0.666	0.069
		(0.946)	(0.593)	(1.243)	(0.791)	(0.833)	(0.539)
52-week return (negative)	AFE	−2.102**	−0.074	−3.967***	−0.640	0.083	0.066
		(1.012)	(0.653)	(1.318)	(0.869)	(0.939)	(0.601)
p-value for $\beta^+ = -\beta^-$	Wald test	0.888	0.256	0.032	0.555	0.563	0.872
Level of stock market index	POLS	0.365**	−0.020	0.164	−0.061	0.267**	0.113
		(0.151)	(0.100)	(0.190)	(0.126)	(0.136)	(0.090)
Level of stock market index	SFE	0.781***	0.199**	0.548***	0.154	0.233*	0.016
		(0.135)	(0.086)	(0.190)	(0.121)	(0.126)	(0.081)
Level of stock market index (positive)	AFE	0.585***	0.203**	0.129	0.068	0.215*	0.154*
		(0.142)	(0.090)	(0.188)	(0.119)	(0.125)	(0.080)
Level of stock market index (negative)	AFE	−0.720***	−0.106	−0.542**	−0.106	−0.368**	−0.212**
		(0.161)	(0.106)	(0.209)	(0.137)	(0.147)	(0.095)
p-value for $\beta^+ = -\beta^-$	Wald test	0.451	0.406	0.069	0.801	0.338	0.572
52-week volatility	POLS	−9.607***	−2.343**	−3.478*	0.849	−4.384***	−0.788
		(1.523)	(1.009)	(1.875)	(1.222)	(1.339)	(0.883)
52-week volatility	SFE	−12.616***	−3.899***	−8.041***	−1.268	−4.520***	−0.571
		(1.380)	(0.868)	(1.845)	(1.157)	(1.243)	(0.807)
52-week volatility (positive)	AFE	−9.931***	−1.753*	−7.234***	−1.150	−4.728***	−2.044**
		(1.517)	(0.977)	(1.904)	(1.223)	(1.327)	(0.859)
52-week volatility (negative)	AFE	9.931***	3.653***	3.179	−0.421	4.660***	1.932**
		(1.824)	(1.148)	(2.241)	(1.466)	(1.479)	(0.966)
p-value for $\beta^+ = -\beta^-$	Wald test	0.730	0.163	0.108	0.357	0.969	0.922
N (observations)		79,029	78,350	67,308	66,432	144,871	141,826

Note: We list the results for 54 models using three different samples, (1) individuals with investment income regardless of having non-investment income, (2) individuals with household investment income but no individual investment income and (3) individuals without any individual or household investment income, two different dependent variables, GHQ-12 and SF-12 MCS, and three different regressions, pooled OLS, standard fixed effects and asymmetric fixed effects regression. We control for sex, age, education level, marital status, job status, resident in urban or rural area, country of residence, total monthly individual income, total monthly household income, annual individual investment income, monthly household investment income, and year, month and week dummies. Coefficients are reported. Robust clustered standard errors are in parentheses. Coefficients and standard errors for level of stock market index are multiplied by 1000. * if $p < 0.10$, ** if $p < 0.05$, *** if $p < 0.01$.

individuals with investment income, but only the mental health impairment due to negative 52-week returns spills over on other household members, whereas these are not affected by positive 52-week returns.

The results for the models including the level of stock market index are similar to the results using 52-week returns, with the level of stock market index having a symmetric effect on the mental health of individuals with investment income, and there is an asymmetric effect of negative changes in the level of stock market index on individuals with household investment income but no individual investment income. However, the results using sub-sample (3) are different, as there appears to be a symmetric impact of the level of stock market index on the mental health of individuals included in the control group, as suggested by the asymmetric fixed effects model. These results suggest that individuals included in sub-sample (2) may either be affected due to stock market indices being a barometer of economic prospects, or mental health spillover effects from other household members, or a combination of the two. Individuals included in sub-sample (3), however, should not be affected due to mental health spillover effects, as their household members also do not have any investment income. One possible explanation for the surprising result, where the control group is affected by the level of stock market index but not by 52-week returns, is that the level of stock market index reflects the overall level of wealth. In contrast, 52-week returns capture recent changes in economic conditions (Lin et al. 2015). Even

TABLE 6 | Interaction terms between symmetric effects and reliance on investment income.

	All				Individuals with investment income			
	GHQ-12		SF-12 MCS		GHQ-12		SF-12 MCS	
	POLS	SFE	POLS	SFE	POLS	SFE	POLS	SFE
52-week return (R)	1.271***	1.460***	0.170	0.193	1.729***	2.401***	0.168	0.572*
	(0.332)	(0.296)	(0.217)	(0.191)	(0.614)	(0.539)	(0.386)	(0.341)
Reliance on investment income (I)	0.071	0.404	−0.091	0.106	0.314	0.152	0.448	−0.114
	(0.352)	(0.256)	(0.207)	(0.157)	(0.583)	(0.407)	(0.284)	(0.247)
$R \times I$	0.947	3.600**	3.252**	2.327**	0.165	4.051**	3.196**	2.281*
	(3.033)	(1.672)	(1.299)	(1.023)	(3.151)	(1.944)	(1.373)	(1.182)
Level of stock market index (X)	0.285***	0.397***	0.034	0.059	0.448***	0.782***	0.012	0.188**
	(0.089)	(0.078)	(0.059)	(0.050)	(0.154)	(0.136)	(0.101)	(0.088)
Reliance on investment income (I)	6.240**	−0.143	1.148	−1.655	6.912**	0.335	3.036**	−0.986
	(2.722)	(1.982)	(1.433)	(1.203)	(2.737)	(2.308)	(1.497)	(1.387)
$X \times I$	−0.929**	0.099	−0.172	0.277	−0.996**	−0.010	−0.372*	0.143
	(0.430)	(0.299)	(0.217)	(0.181)	(0.450)	(0.349)	(0.223)	(0.210)
52-week volatility (V)	−5.246***	−7.224***	−0.594	−1.489***	−9.461***	−11.997***	−2.069**	−3.578***
	(0.857)	(0.769)	(0.562)	(0.498)	(1.574)	(1.409)	(1.032)	(0.893)
Reliance on investment income (I)	0.930	2.115***	0.827*	0.957**	0.583	1.429*	1.057**	0.552
	(0.940)	(0.619)	(0.486)	(0.372)	(1.170)	(0.765)	(0.528)	(0.458)
$V \times I$	−5.418	−10.510***	−5.330*	−5.123**	−1.692	−7.488*	−3.178	−3.883
	(5.118)	(3.762)	(2.937)	(2.238)	(5.259)	(4.267)	(3.018)	(2.480)
N (Observations)	291,208	291,208	286,608	286,608	79,029	79,029	78,350	78,350

Note: We list the results for 24 models using two different samples, all and respondents with individual investment income, two different dependent variables, GHQ-12 and SF-12 MCS, and two different regressions, pooled OLS and standard fixed effects regression. We control for sex, age, education level, marital status, job status, resident in urban or rural area, country of residence, total monthly individual income, total monthly household income, annual individual investment income, monthly household investment income, and year, month and week dummies. Coefficients are reported. Robust clustered standard errors are in parentheses. Coefficients and standard errors for level of stock market index are multiplied by 1000. * if $p < 0.10$, ** if $p < 0.05$, *** if $p < 0.01$.

when 52-week returns are negative compared to the previous period, the level of stock market index can still remain at a high level compared to prior periods.

Finally, the pooled OLS and standard fixed effects models suggest that 52-week volatility also has an impact on the mental health of individuals included in the three sub-samples, with increasing volatility leading to inferior mental health. The asymmetric fixed effects models do not provide any evidence of an asymmetric relationship between 52-week volatility and mental health for the three sub-samples.

6.6 | Reliance on Investment Income

We introduce interaction terms to test if the effect of stock market fluctuations on mental health differs across alternative levels of a person's reliance on investment income. We measure reliance on investment income as the percentage of individual investment income in relation to total individual income. To calculate this new variable, we divide the annual individual investment income by 12 to calculate the monthly investment income which is then divided by the total monthly individual income to calculate the reliance on investment income. The higher the ratio, the more the individual is reliant on investment income. We introduce interaction terms between our stock market variables and reliance on investment income for two samples, the total sample and individuals with investment income. We present the results using the pooled OLS model and standard fixed effects regression in Table 6. The results using the asymmetric fixed effects model are presented in Table 7.

The pooled OLS and standard fixed effects regression results in Table 6 for both the total sample and individuals with investment income show that the positive effect of 52-week returns on people's mental health increases with increasing reliance on investment income. The standard fixed effects model using the total sample shows that the additional effect of 52-week returns on the GHQ-12 score is 3.5 times stronger as the reliance on investment income ratio increases by one unit from 0 to 1. This number is obtained by dividing the sum of the 52-week coefficient and the interaction coefficient by the 52-week coefficient. In essence, this is a comparison between a person who is not reliant on investment income and a person who lives solely on investment income. The results from the pooled OLS model using the level of stock market index are surprising. They show that an increasing index has a negative impact on the GHQ-12 score of individuals with strong reliance on investment income. However, the standard fixed effects model does not confirm these findings, suggesting that only individuals with low reliance on investment income are positively impacted by an increasing stock market index, while individuals who heavily

TABLE 7 | Interaction terms between asymmetric effects and reliance on investment income.

	All		Individuals with investment income	
	GHQ-12	**SF-12 MCS**	**GHQ-12**	**SF-12 MCS**
52-week return (positive) (R^+)	0.845	0.335	1.942**	1.051*
	(0.521)	(0.337)	(0.952)	(0.597)
52-week return (negative) (R^-)	−1.305**	−0.152	−1.873*	0.083
	(0.581)	(0.376)	(1.027)	(0.664)
Reliance on investment income (I)	0.704*	−0.118	0.826	0.004
	(0.419)	(0.258)	(0.581)	(0.349)
$R^+ \times I$	0.486	1.272*	−0.681	0.486
	(1.189)	(0.706)	(1.429)	(0.819)
$R^- \times I$	−2.910	−0.980	−2.674	−1.865
	(1.821)	(1.144)	(2.166)	(1.281)
p-value for $\beta^+ = -\beta^-$	0.141	0.778	0.080	0.233
Level of stock market index (positive) (X^+)	0.242***	0.106**	0.587***	0.184**
	(0.078)	(0.051)	(0.142)	(0.091)
Level of stock market index (negative) (X^-)	−0.420***	−0.099	−0.679***	−0.072
	(0.092)	(0.060)	(0.164)	(0.108)
Reliance on investment income (I)	0.555	−0.122	0.637	−0.122
	(0.353)	(0.217)	(0.495)	(0.298)
$X^+ \times I$	0.308	0.348**	−0.042	0.248
	(0.280)	(0.164)	(0.321)	(0.186)
$X^- \times I$	−0.739*	−0.253	−0.512	−0.429
	(0.407)	(0.239)	(0.459)	(0.270)
p-value for $\beta^+ = -\beta^-$	0.124	0.581	0.085	0.347
52-week volatility (positive) (V^+)	−6.382***	−1.478***	−9.178***	−1.556
	(0.828)	(0.540)	(1.539)	(0.995)
52-week volatility (negative) (V^-)	4.704***	1.515**	8.787***	3.505***
	(0.947)	(0.619)	(1.842)	(1.167)
Reliance on investment income (I)	0.431	−0.088	0.527	−0.028
	(0.330)	(0.207)	(0.476)	(0.290)
$V^+ \times I$	−10.631***	−2.972	−9.175**	−2.416
	(3.711)	(2.193)	(4.157)	(2.380)
$V^- \times I$	9.867**	5.525**	5.051	1.834
	(3.853)	(2.338)	(4.321)	(2.524)
p-value for $\beta^+ = -\beta^-$	0.778	0.130	0.183	0.756
N (Observations)	291,208	286,608	79,029	78,350

Note: We list the results for 12 asymmetric fixed effects models using two different samples, all and respondents with individual investment income, and two different dependent variables, GHQ-12 and SF-12 MCS. We control for sex, age, education level, marital status, job status, resident in urban or rural area, country of residence, total monthly individual income, total monthly household income, annual individual investment income, monthly household investment income, and year, month and week dummies. Coefficients are reported. Robust clustered standard errors are in parentheses. Coefficients and standard errors for level of stock market index are multiplied by 1000. * if $p < 0.10$, ** if $p < 0.05$, *** if $p < 0.01$.

rely on investment income are not affected. It should be noted that the pooled OLS model does not capture the individual-specific effects and is more restrictive than the standard fixed effects model (Cameron and Trivedi 2005). These results are further examined using the asymmetric fixed effects model, the results of which are shown in Table 7. Finally, 52-week volatility has a negative impact on individuals without any reliance on investment income, with the effect being much stronger for individuals who heavily rely on investment income. According to the standard fixed effects model using the total sample, the

TABLE 8 | Regression results for total sample with all control variables for 52-week returns.

	GHQ-12		SF-12 MCS	
	POLS	**SFE**	**POLS**	**SFE**
52-week return	1.292***	1.537***	0.242	0.243
	(0.326)	(0.293)	(0.215)	(0.189)
Female	−2.713***	1.511	−1.738***	0.068
	(0.108)	(1.831)	(0.073)	(1.172)
Age	−0.028***	0.031	0.054***	0.044
	(0.005)	(0.131)	(0.003)	(0.084)
University degree	−0.065	−1.351***	−0.165**	−1.149***
	(0.117)	(0.266)	(0.077)	(0.171)
Single	−1.296***	0.382**	−1.213***	0.197
	(0.148)	(0.193)	(0.098)	(0.121)
Divorced	−2.107***	0.253	−1.465***	−0.032
	(0.203)	(0.250)	(0.132)	(0.158)
Widowed	−0.242	−1.172***	−0.612***	−1.111***
	(0.253)	(0.340)	(0.170)	(0.240)
Other marital status	−3.025***	−1.855***	−2.011***	−1.265***
	(0.319)	(0.303)	(0.207)	(0.181)
Self-employed	0.398**	0.487***	0.375***	0.330***
	(0.166)	(0.175)	(0.112)	(0.110)
Unemployed	−8.139***	−4.703***	−4.753***	−2.041***
	(0.238)	(0.204)	(0.147)	(0.122)
Retired	1.547***	1.360***	0.873***	1.031***
	(0.181)	(0.165)	(0.119)	(0.106)
Student	−2.085***	−0.905***	−0.853***	0.000
	(0.195)	(0.207)	(0.133)	(0.133)
Other job status	−9.076***	−3.145***	−5.710***	−1.434***
	(0.228)	(0.176)	(0.141)	(0.108)
Resident in urban area	−0.349***	0.031	−0.529***	−0.030
	(0.125)	(0.229)	(0.083)	(0.141)
Resident in Wales	−0.273	0.798	−0.234	−0.087
	(0.231)	(0.825)	(0.156)	(0.493)
Resident in Scotland	0.417**	0.538	0.274**	0.379
	(0.204)	(0.995)	(0.137)	(0.505)
Resident in Northern Ireland	1.327***	2.385	0.852***	1.335
	(0.237)	(1.593)	(0.165)	(0.916)
Total monthly individual income	−0.430***	−0.078***	−0.326***	−0.115***
	(0.028)	(0.024)	(0.019)	(0.015)
Total monthly household income	0.832***	0.376***	0.635***	0.190***
	(0.062)	(0.054)	(0.040)	(0.033)
Annual individual investment income	0.269***	0.068***	0.186***	0.041***
	(0.019)	(0.015)	(0.013)	(0.010)
Monthly household investment income	0.176***	−0.007	0.140***	0.003
	(0.020)	(0.018)	(0.014)	(0.011)
Year dummy	Yes	Yes	Yes	Yes

(Continues)

TABLE 8 | (Continued)

	GHQ-12		SF-12 MCS	
	POLS	**SFE**	**POLS**	**SFE**
Month dummy	Yes	Yes	Yes	Yes
Week dummy	Yes	Yes	Yes	Yes
N (Observations)	291,208	291,208	286,608	286,608

Note: We list the results for four models using the total sample, two different dependent variables, GHQ-12 and SF-12 MCS, and two different regressions, pooled OLS and standard fixed effects regression. Coefficients are reported. Robust clustered standard errors are in parentheses. * if $p < 0.10$, ** if $p < 0.05$, *** if $p < 0.01$.

additional negative effect of 52-week volatility on the SF-12 MCS is 4.4 times stronger as the reliance on investment income ratio increases by one unit from 0 to 1.

The results from the asymmetric fixed effects model presented in Table 7 show that there is no statistically significant asymmetric interaction effect using 52-week returns, the level of stock market index and 52-week volatility, which confirms the existence of a symmetric interaction effect for each of our main independent variables. These findings suggest that reliance on investment income does play a role in explaining the relationship between stock market fluctuations and mental health, indicating that the impact of 52-week returns, the level of stock market index and 52-week volatility on mental health intensifies as reliance on investment income increases.

6.7 | Robustness Analysis

To ensure our results are robust, we additionally control for the UK's unemployment rate to isolate the effect of stock market fluctuations from macroeconomic conditions. We include this new control variable in all regression models and run the regressions again (results are available upon request). This approach is in line with previous literature (Cotti and Simon 2018) and is motivated by the potential correlation between stock market performance and macroeconomic conditions. We find that our results largely remain the same and hold after controlling for unemployment. This indicates that our results on the impact of 52-week returns, the level of stock market index and 52-week volatility on mental health presented in Tables 3–8 hold even after controlling for macroeconomic conditions.

6.8 | Differential Effects of Stock Market Fluctuations on GHQ-12 and SF-12 MCS

Across all regression models presented in Section 6, we observe significant discrepancies between models using the GHQ-12 score and those using the SF-12 MCS as the dependent variable. Specifically, when stock market performance impacts the GHQ-12 score, the effect on the SF-12 MCS is either weaker or does not exist, as reflected in both the magnitude of coefficients and the level of statistical significance. Given that the GHQ-12 assesses the likelihood of an individual suffering from psychiatric disorders, such as depression and anxiety, this discrepancy suggests that stock market fluctuations have a stronger impact on psychiatric illness than on general mental health, as measured by the SF-12 MCS.

To explain this finding, we suggest that poor stock market performance and increasing volatility may primarily impact someone's mental health by triggering feelings of worry, stress or anxiety. This explanation is in line with prior research. Frasquilho et al. (2015) conduct a systematic literature review, stating that there is a consensus in the literature that economic downturns and financial crises are associated with the fear of being unemployed, particularly among precarious workers facing high job insecurity. This fear alone may increase the risk of mental disorders, but since unemployment is often associated with a drop in income, additional concerns, such as mortgage payment difficulties, evictions and indebtedness, may further exacerbate symptoms of depression and anxiety (Sareen et al. 2011; Gili et al. 2013; Frasquilho et al. 2015).

In contrast, the SF-12 MCS captures an individual's general mental health status using four scales, including Social Functioning, Vitality, Mental Health, and Role Emotional, with the latter assessing difficulties in daily activities caused by emotional problems (Ware et al. 1995; Nguyen and Connelly 2018). While our results suggest that stock market fluctuations predominantly affect an individual's risk of experiencing symptoms of depression or anxiety, we propose that the four dimensions captured by the SF-12 MCS may not be affected the same way. While individuals may experience feelings of worry or anxiety, it may not be to the extent that it influences their daily functioning, including tiredness, social functioning or having difficulties with everyday tasks resulting from emotional problems. This may explain why our analysis suggests that stock market fluctuations are more strongly associated with people's likelihood of developing psychiatric disorders than with their general mental health status.

7 | Conclusion

We provide the first study to investigate the asymmetric impact of stock market fluctuations on mental health using an asymmetric fixed effects model for panel data. We provide novel evidence for an asymmetric impact of changes in the level of stock market index on mental health, with the impact of negative changes being 1.8 times stronger than the impact of positive ones, supporting prospect theory. We also find that there is a positive impact of 52-week returns and a negative impact of 52-week volatility on people's mental health, with the impact of 52-week volatility being symmetric as confirmed by the asymmetric fixed effects model. Furthermore, we suggest reliance on investment income as a moderator of the relationship between stock market fluctuations and mental health. Moreover, we provide novel evidence of a mental health

spillover effect of negative 52-week returns on household members of investors.

We make several contributions to the literature. We make a methodological contribution by providing the first study using an asymmetric fixed effects model for panel data to test prospect theory from a perspective based on the link between stock market fluctuations and mental health. Furthermore, we find that prospect theory does not hold in explaining the relationship between stock market fluctuations and mental health for males, as we observe variation in the results between males and females. Finally, we expand on previous literature investigating the relationship between stock markets and mental health, providing the first paper to investigate mental health spillover effects of stock market fluctuations on investors' household members aged 15 and over. Future research may further investigate reliance on investment income as a moderator of the relationship between stock markets and mental health, as we provide varying results in this analysis. Furthermore, we encourage future research to further develop methodologies to measure mental health spillover effects, as there is a lack of studies proposing such approaches. We also recommend this area be expanded to investigate not only the impact of stock market fluctuations on investors but also on their household members, as the impact may be wider than initial studies suggest. Lastly, we acknowledge that the asymmetric fixed effects model for panel data is constrained by how frequently data are collected (York and Light 2017). We suggest future research using symmetric regression models or databases with more frequent data collection explore alternative timings of stock market performance in greater detail to analyze its relationship with mental health.

Our findings also have important policy implications. We find that there is a spillover effect of the asymmetric negative impact of negative 52-week returns on the GHQ-12 score of investors' household members. Considering that the GHQ-12 is designed to detect psychiatric illness, including depression and anxiety, we recommend psychologists and other mental health practitioners be aware of the potential impact stock market fluctuations can have not only on investors but also other household members. They may well be aware of the direct link between stock markets and people's mental health, but may be unaware of the spillover effects on the mental health of other household members.

Author Contributions

Ruben Ruf: conceptualization, methodology, software, formal analysis, writing – original draft. **Jenny Berrill:** supervision, conceptualization, methodology, writing – review and editing. **Damien Cassells:** supervision, conceptualization, methodology, software, writing – review and editing.

Disclosure

The authors have no financial and personal relationships with other people or organizations that could inappropriately influence their work.

Ethics Statement

The University of Essex Ethics Committee has approved all data collection on Understanding Society main study.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from University of Essex, Institute for Social and Economic Research. Restrictions apply to the availability of these data, which were used under license for this study. Data are available at http://doi.org/10.5255/UKDA-SN-6614-19 with the permission of University of Essex, Institute for Social and Economic Research.

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