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Amin Zokaei Ashtiani Marc Oliver Rieger David Stutz

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Amin Zokaei Ashtiani¹

Marc Oliver Rieger²

David Stutz³

Abstract:

A typical behavioural pattern of investors is to reduce stock market exposure after a crash. This leads to a typical "buy high, sell low" strategy that is detrimental to long-run wealth accumulation. We suggest a simple nudge based on the IKEA effect and the endowment effect that reduces this problem substantially: actively involving investors in the selection process of the risky investments, while restricting their selections in a way that preserves a large degree of diversification. The "self-assembled" portfolio is, indeed, less likely to be sold off: in an experiment with N=219university students, we show that this nudge reduces panic selling significantly. In fact, it makes a difference that is at least as big as the difference between experienced and inexperienced investors.

Key words:

IKEA effect; endowment effect; "I designed it myself" effect; familiarity bias; household finance; strategic asset allocation; behavioural biases; nudging.

JEL classification number: D14, D91, G11, G41, G5.

¹ LUISS Guido Carli, Rome, Italy, azokaei@luiss.it

² Trier University, FB IV, Germany, mrieger@uni-trier.de

³ Commerzbank, Luxembourg, David.Stutz@commerzbank.com

1 Introduction

Traditional models in economics and finance assume individuals to be rational and their decisions regarding risk taking to depend on estimates of expected return and its variance rather than influenced by individual experiences and emotions. In contrast, behavioural finance literature suggests that willingness to take risks is closely influenced by individuals' emotions (Elster, 1998; Ozmete & Hira, 2011), such as the emotions they experience during stock market crashes and financial crises (Weber at al., 2013; Hertwig et al., 2004; Glaser and Weber, 2005; Sahm, 2007; Hoffmann et al., 2013).

A stock market crash is a sudden dramatic decline of stock prices accompanied by wide-scale selling of stocks—panic selling. The most recent market crash happened in March 2020, triggered by COVID-19 during which in four trading days—March 9, 12, 16 and 23—Dow Jones Industrial Average (DJIA) dropped by roughly 26%.

Panic selling not only can increase the magnitude of market crash through spiralling effect (Maharani, 2008), but also has a significant effect on the balance sheets of stock market participants through the allocation of risk (Lei and Yao, 2015). Zhou (2020) claims households that sell their stock and exit the market during a fit of panic, are less likely to reenter the stock market in future. Limited participation in stocks impedes individuals' wealth accumulation in the long run (Calvet and Sodini, 2014) and leads to welfare losses both for the households (Bagliano et al., 2014) and the financial systems (Brav et al., 2002; Thomas et al., 2014; Thomas and Spataro, 2016). The importance of households' stockholding behaviour is better understood if we take into account the fact that households are increasingly obliged to take responsibility for building up retirement wealth (Clark-Murphy and Soutar, 2004). In addition, several studies show that there is a considerable disparity among households in terms of probability of dropping out of the market after a market crash (Lei and Yao, 2015). For instance, Zhou (2020) finds that the likelihood of dropping out of the market is higher among poor and less-educated households and those who belong to a minority. This untimely exit from the market depraves them of a chance to accumulate more wealth as they will lose the possible profits that could have been made after the recovery of the market. In another study, Calvet et al. (2007) find that during the crises, more educated investors are more likely to buy and less likely to sell risky assets. In the long run, this can contribute to greater wealth inequality.

There is a growing body of literature that explores the causes of panic selling and investors' behaviour during bear market. In this regard, attention has been mainly concentrated on two causes—loss aversion (Kahneman & Tversky, 1979) and overconfidence (Lichtenstein & Fischhoff, 1977). Loss-averse investors tend to overreact to their short-term losses, evaluate their portfolio more frequently, trade more excessively, and therefore, less likely to stick with their portfolio during a down market (Benartzi & Thaler, 1995; Shalev, 2000). Overconfident investors also tend to trade more excessively (Glaser and Weber, 2007) and exhibit poorer performance (Trinugroho & Sembel, 2011). Other behavioural biases, such as regret aversion (Beach & Rose, 2005), trend-following bias (Goetzmann & Kumar, 2008), and confirmation bias (Park et al., 2010) have also been explored in literature as causes for panic selling during a down market.

Considering the overall negative impacts of panic selling on both the households' wealth and the financial systems, identifying the causes of panic selling is of great importance. Yet, since this kind of financial behaviour is triggered mainly by deep-rooted cognitive biases, exploring the causes will not necessarily help solve the problem. According to Thaler & Sunstein (2008), an intervention should be made in order to affect individuals' decision making process in a way that investors would be more likely to make a rational decision. They call this intervention a *nudge*.

This study contributes to the existing literature by introducing and testing a nudge to prevent panic selling. By conducting a lab experiment, we find that when participants are given the chance to choose their own regional ETFs⁴, they are more likely to stick with their asset allocation as compared to a situation where the asset allocation has been carried out by a financial advisor. In this scenario, a combination of IKEA effect and endowment effect is used as a nudge.

To the best of our knowledge, a practical method for preventing panic selling has not been introduced yet. Most solutions in this regard concentrate on ways that can minimize loss during a market crash, namely portfolio diversification and long horizon investments. Although these instructions can have a significant impact on the possible degree of loss, they do not in any way contribute to the prevention of panic selling in cases where investors are actually facing a market crash feeling that their investment is at a high risk and, thus, tend to behave irrationally.

1.1 Endowment effect and IKEA effect

The endowment effect, introduced by Thaler (1980), is the phenomenon whereby "people often demand much more to give up an object than they would be willing to pay to acquire it" (Kahneman et al., 1991). The endowment effect is an example of a status quo bias, a situation

⁴ A regional ETF is any exchange traded fund that invests particularly in a group of foreign based securities.

where there is a higher preference for remaining at the current state. This preference biases people against trade and exchange (Samuelson & Zeckhauser, 1988). Several studies have documented endowment effect with goods (Kahneman et al., 1991; van Dijk & van Knippenberg, 1998) and monetary assets (Knetsch & Sinden, 1984). Endowment effect is also used as evidence for prospect theory (Kahneman & Tversky, 1979) and reference-dependent preferences (DellaVigna 2009; Barberis 2013). Several studies also explain the linkage between endowment effect and loss aversion—an asymmetric attitude towards loss as opposed to gain (Kahneman et al., 1991; Thaler, 1980).

Norton et al. (2012) defined the IKEA effect as "the increase in valuation of self-made products". Prior to that, Franke et al. (2010) had called this phenomenon the "I designed it myself" effect. According to Mochon et al. (2012), the increased valuation stems from the satisfactory fulfilment of a psychological need to signal capability to oneself and to others.

A similar attitude of attaching extra value can also be discerned when individuals happen to win something, such as winning a lottery. Anagol et al. (2018) studied the winners of a randomly assigned initial public offering (IPO) lottery and found that they are less likely to sell their stocks in case of a market crash or negative news about the stocks.⁵ Hence, we can argue that this effect—which is slightly different from the IKEA effect, but possibly responds to similar needs fulfilled by the IKEA effect—also applies to real-life financial situations. This extra value can be categorized under the impacts of the endowment effect.

This paper is related to the literature on household finance (Guiso et al., 2002; Campbell, 2006; Calvet et al., 2009; Guiso & Sodini 2013). More precisely, it is related to the literature on household behaviour during financial crises. Several studies show how individuals' behaviour (Thaler & Johnson, 1990; Choi et al., 2009; Vissing-Jorgensen, 2003) and their willingness to take financial risks (Odean, 1998) are affected by a market crash. Guiso et al. (2013) find that after the financial crisis, risk aversion increased substantially among the clients of an Italian bank. Using data from 1960 to 2007, Malmendier & Nagel (2010) find that market crash has a long-lasting impact on the behaviour of US American investors. Individuals who have lived through a crisis are less likely to participate in the stock market and if they do participate, they tend to opt for less risky portfolios. Conversely, Ampudia & Ehrmann (2017) find that individuals who have experienced high stock market returns are more likely to take financial risks in the future. Zhou (2020) finds that after the stock market crash in 2008, the rate of stock market participation among American households

⁵ One of the potential issues in natural experiments is that shareholders—winners of the lottery in Anagol et al. (2018)—may confront trading costs. These costs could include transaction costs, such as taxes and brokerage commissions. In a laboratory setting, we minimize these costs.

dropped significantly. By using Health and Retirement Study data, Hudomiet et al. (2011) find that average uncertainty and cross-sectional heterogeneity in expected returns increased substantially after the same market crash. There are also several studies that explore the impact of the 2008 market crash on investors' behaviour in other countries, e.g., the UK (Weber et al., 2013), the Netherlands (Hoffmann et al., 2013), and Germany (Bucher-Koenen and Ziegelmeyer, 2014; Necker and Ziegelmeyer, 2016). Their findings are also in line with the findings of the studies on American stock markets.

In addition, our study is also related to the literature that studies nudges as a means for diminishing irrational behaviour. According to Bauer and Capron (2019), what makes a nudge an effective intervention is "understanding what possible biases may be interfering with rational thinking and then creating nudges that target those biases directly". Using nudges has been proven effective in different research fields as a means for behaviour alteration, such as retirement savings (Carroll et al., 2009), college enrollment (Bettinger et al., 2012), energy conservation (Allcott, 2011), influenza vaccinations (Milkman et al., 2011), life-cycle financial decisions (Agarwal et al., 2009), consumer financial products regulation (Agarwal et al., 2015), safer financial investment (Tereszkiewicz, 2016), on-time tax payment (John and Blume, 2018), improvement in public health (Quigley, 2013), pension plan (Choi, 2015; Nunes, 2018), retirement provision (Van Zyl and Van Zyl, 2016), and inertia in health insurance markets (Handel, 2013)

As mentioned before, in our experiment we let the participants choose their own portfolio within regional areas and we interpret the possible commitment to a self-chosen portfolio as a consequence of the combination of endowment effect and IKEA effect. We also argue that, in this context, familiarity bias might affect participants' decisions, and, therefore, our study contributes to the literature on familiarity bias as well.

In finance, familiarity bias refers to individuals' preference to invest in assets that are more familiar to them (Huberman, 2001; Baker & Nofsinger 2002; Speidell 2009). According to Merton (1987), familiarity does not necessarily imply being knowledgeable about assets, but it can also mean only knowing about or being aware of them.

Several studies show that different aspects of familiarity bias could influence individuals' investment decisions. Aspects such as home bias, i.e. individuals' tendency to invest in local assets as opposed to foreign assets (French and Poterba 1991; Tesar and Werner 1995; Foad 2010) and home bias within a country (Coval and Moskowitz, 1999), bias in favor of their employers' company or companies that are located in their hometown (Massa & Simonov 2005; Doskeland and Hvide, 2011), positive attitudes towards the company's product brand (Aspara and Tikkanen,

2008, 2010), or company name (Itzkowitz and Itzkowitz, 2016) have been frequently explored in literature.

Most researches in this area—the above-mentioned researches among them—focus on the negative effects of familiarity bias. While this is, of course, of practical relevance, e.g., for debiasing strategies, we want to explore a very different application of familiarity bias. More precisely, by understanding investors' potential regional interests and familiarities, we attempt to investigate how the familiarity bias may help individuals to stick with their asset allocation after a market crash. Our argument is that familiarity can help reduce ambiguity aversion among potential investors and can help them overcome their fears and concerns in the time of a market crash.

1.2 Mechanism and hypothesis

The endowment effect states that people tend to attach an additional value to what they own – without a rational justification for this. The IKEA effect states that people tend to attach an additional value to what they *make* – again, without rational justification. In stock markets, this effect can make people unwilling to sell the stocks they already own and it might be stronger when the relevant portfolio is "self-made".

We exploit this idea by letting people choose their own portfolios by simply using regional areas to invest in. We hypothesize that they are subsequently more likely to be committed to their portfolio compared with the ones whose portfolios were chosen by financial advisors. We interpret this commitment and the attachment of an additional value to a self-chosen portfolio as the consequence of a combination of endowment effect and IKEA effect. Our hypothesis is:

Hypothesis I: In case of a market crash, stockholders who have chosen their own portfolios are more likely to stick with their investment choices. In cases where they decide to sell, they sell a smaller part of their stocks as compared to investors who have had no active role in their asset allocation.

According to List (2003), extensive market experience tends to diminish the impact of endowment effect. His finding has been documented in other studies as well (List, 2004; List, 2011; Engelmann & Hollard, 2010). Following the aforementioned studies, we formulate our second hypothesis. We conjecture that:

Hypothesis 2: The more market experience investors gain, the less they will be impacted by endowment effect.

Finally, although it seems likely that a portfolio consisting of fewer regional ETFs might still be a better choice on the long run as compared to keeping the money in a bank account, given the

limited diversity of regional ETFs, one possible concern is the loss of diversification and the resulting increased risk for the investors. For instance, French & Poterba (1991) and Tesar & Werner (1995) suggest that individuals usually benefit from diversifying their portfolios, and, therefore, a limited self-chosen portfolio can pose an obstacle to holding well-diversified portfolios by individuals. In Section 4, we will assess whether the potential gain from an increasing commitment to self-chosen stocks, as compared to a broadly diversified passive investment, can outweigh the potential costs of lower diversification.

The remainder of this paper is structured as follows. In the next section, we will describe our experiment. Section 3 summarizes the results. In Section 4, we will discuss the potential problem of loss in diversification. Finally, conclusions are presented in Section 5.

2 Experimental design

The experiment was computer-based and N=219 students participated in this project. The experiment was conducted at the University of Trier and consisted of two parts: an asset allocation game and a questionnaire to elicit participants' demographic and financial characteristics.

2.1 Asset allocation game

This game consisted of three parts. In the first part, we asked the participants to allocate their imaginary assets into risky and risk-free assets. Participants were asked the following question: "Imagine that you have won 10,000 euros in the lottery. You want to invest this amount in a portfolio with a long-term investment strategy of 30 years. The portfolio invests in a broad range of asset classes such as equities, bonds and alternative investments. How much of the 10,000 euros will you invest in equities?" Participants could choose any number between 0 and 10,000.

In the second part, we divided the participants into two groups. In group 1, namely non-advised group (N=95), we let the participants choose their own regional portfolio. They were asked to do the following: "Imagine you invest in an equity portfolio that is diversified into different regions worldwide. Please create your optimal investment portfolio by selecting at least 4 out of the 8 regions mentioned. Note that you are investing on a long-term basis of 30 years. Please select those regions that you believe have a long-term investment horizon of generating attractive returns and are future-oriented." The participants could choose among the following regions: Africa & Middle East; Asian developed markets; Asian emerging markets; Latin America; North America.

Figure 1 shows the popularity of each regional ETF. Broadly speaking, four regions, namely European developed markets, North America, Asian developed markets, and Asian emerging

markets are more popular than the other four regions—European emerging markets, Africa & Middle East, Australia & Oceania, and Latin America. The results are not surprising since many investors probably anticipated the future prosperity of these markets, as compared to the second four. Home bias could also be a possible explanation for the popularity of European developed markets. This point will be discussed further in Section 3.



Figure 1. Popularity of regional ETFs

In group 2, namely in the advised group (N=124), we did not let the participants choose their own regional portfolio. They were asked to do the following: "You decide how much of the 10,000 EUR you will invest in stocks. Imagine that you are not familiar with investments. Therefore, contact your bank advisor and have a stock portfolio put together. Afterwards you will invest exactly according to the recommendation of the bank advisor. The bank advisor selects a stock portfolio for you that is diversified worldwide."

Finally, in the third part, by using several questions, we observed the reactions of the participants to a market crash. To this aim, the first participants were told the following: "One year after your investment, the total value of your share portfolio falls by 20%". Then, we asked them whether they would increase or decrease their equity exposure, and how much they want to change it in each case.

2.2 Questionnaire

The questionnaire contained several questions about the participants' savings and investment behaviour, loss aversion, regret aversion, risk preferences, Need for Cognition (NFC), and their experience in the stock market, as well as questions about the participants' demographic characteristics such as age, gender, income, education, etc. In Appendix A, we describe the methodology we used to measure different indicators by evaluating the answers taken from the questionnaire.

2.3 Dependent variables

As mentioned before, during the experiment, the participants were informed that the total value of their share portfolio had fallen by 20%. In order to get a better understanding of individuals' investment behaviour following the crash, we define two dependent variables.

The first dependent variable, which we call "Asset seller", is a dummy variable that equals 1 if the participant decides to sell all or a portion of their risky assets after the market crash. To elicit "Asset seller" variable, we use the following question: "Will you increase or decrease your equity exposure?". Individuals could choose from one of the following two options: (i) Increase; (ii) Decrease.

The second dependent variable, called "Asset allocation alteration", shows the change in the share of risky assets in a participant's portfolio after the market crash. To elicit "Asset allocation alteration", we use two different questions: if a participant answered the first question with "Increase", we use the following question: "By what amount will you increase your equity exposure? (Note: your initial stock investment has lost 20% of its value)". Individuals could choose a number between 1000 to 10000 EUR; if a participant answered the first question with "Decrease", we use the following question: "By what amount will you decrease your equity exposure? (Note: your initial stock investment has lost 20% of its value)". Individuals could choose a number between 1000 to 10000 EUR; if a participant answered the first question with "Decrease", we use the following question: "By what amount will you decrease your equity exposure? (Note: your initial stock investment has lost 20% of its value)". Individuals could choose a number between 0 to 9000 EUR. The value of "Asset allocation alteration" could be a number between -9000 to 10000. A negative number shows a reduction of risky assets and a positive number shows a rise of risky assets in the portfolio.

We use two dummy variables as our main explanatory variables. The first one is "Bank advised Dummy", which equals 1 if the participant is advised by a bank advisor, and 0 otherwise. The second one is "Experience Dummy", which equals 1 if the participant has any experience in the stock market, and 0 otherwise.

We also elicit other related variables widely used in literature to explain panic selling. Variables such as saver/spender, loss aversion, ambiguity aversion, regret aversion, NFC score.

All variables are presented in Table 1, where each of them is explained in more detail.

3 Results

In total, 219 participants took part in the experiment. A summary of the descriptive statistics is presented in Table 2: 56% of the participants were male and 85% were between 20 to 30 years old.

Overall, 95 participants were included in the non-advised group and 124 participants were included in the advised group.

Variable	Description
Bank advised Dummy	Dummy variable equals 1 if a bank advisor advises the participant.
Experience Dummy	Dummy variable equals 1 if the participant has any experience in stock market.
Female Dummy	Dummy variable equals 1 if the participant is a woman.
Age Dummy	Dummy variable equals 1 if the participant is younger than 30 years old.
Income Dummy	Dummy variable equals 1 if the participant earns less than 1000 euros (net) per month.
Degree Dummy	Dummy variable equals 1 if the participant has a university degree.
Business Dummy	Dummy variable equals 1 if the participant has a university degree in Business, Economics, or Finance.
Saver Dummy	Dummy variable equals 1 if the participant is a saver.
Loss Aversion	Loss aversion score
Regret aversion	Regret aversion score
NFC Score	Need For Cognition (NFC) scale

Table 1. List of variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Asset seller	219	0.22	0.41	0	1
Asset allocation alteration	219	183	217.57	-800	1000
Bank advised Dummy	219	0.57	0.5	0	1
Female Dummy	219	0.44	0.5	0	1
Age Dummy	219	0.05	0.22	0	1
Income Dummy	219	0.19	0.39	0	1
Degree Dummy	219	0.4	0.49	0	1
Business Dummy	209	0.68	0.47	0	1
Saver Dummy	219	0.84	0.37	0	1
Loss Aversion	219	1.65	0.84	0.86	6
Regret aversion	219	7.06	2.23	1	10
NFC Score	219	2.55	0.76	1	4.4
Experience Dummy	219	0.34	0.47	0	1

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Table 3 provides a deeper insight into the investors' behaviour after a market crash. Column A shows the differences in the proportion of participants who sell their risky assets after the crash based on (a) advised vs non-advised groups, (b) experienced vs inexperienced groups, (c) gender, (d) age, (e) income, (f) education, (g) business vs non-business major, (h) saver, (i) loss aversion, (j) regret aversion, and (k) NFC score.

After the market crash, the investors who choose their own portfolios, male investors, and investors majoring in business are, on average, less likely to sell their risky assets and are more committed to their initial asset allocation. More precisely, while 31% of the participants in the

advised group decided to sell their risky assets, only 10% of the participants who had chosen their own portfolio wanted to reduce the share of risky assets. In addition, whereas 36% of female participants decided to sell all or a share of their risky assets, only 11% of male participants made the same decision. Finally, while 31% of the participants not majoring in business decided to sell their risky assets, only 17% of the participants majoring in business sold their risky assets after the market crash.

We found statistically significant differences in the proportion of stock sellers between nonadvised and advised groups (p-value=0.001), between male and female groups (p-value=0.0005), and between non-business and business majors (p-value=0.020). However, the differences between the means of sellers across other groups were not statistically significant.

Column B shows the differences between the means of amounts of risky assets sold after the crash comparing the same groups as in Column A. The results reveal that after a market crash, investors who have not chosen their own portfolio, investors without stock market experience, female investors, and investors not majoring in business sell a higher portion of their risky assets.

We found statistically significant differences in the means of assets sold between non-advised and advised groups (p-value=0.088), inexperienced and experienced groups (p-value=0.027), male and female groups (p-value=0.029), and participants with and without a business major (p-value=0.067). However, the differences of the means of assets sold between other groups were not statistically significant.

	Column A	Column B
	Proportion of Asset seller	Asset allocation alteration
Difference between	Difference (in %)	Difference (in value)
Advised and Non-advised	21***	-51*
Non-Experienced and Experienced	7	-69**
Female and Male	25***	-64**
Older than 30 and Younger than 30	5	-36
Low income and High income	4	-58
Non-degree and Degree	2	-27
Non-Business student and Business student	14**	-57*
Low saver and High saver	3	-7
High loss Averse and Low loss Averse	4	-37
Low regret aversion and High regret aversion	8	-8
High NFC Score and Low NFC Score	1	-47

Table 3. Differences between proportion of asset sellers (Column A) and the value of asset allocation alteration (Column B) between different groups (significance levels of t-tests: *** p<0.01, ** p<0.05, * p<0.1). The effect of our nudging strategy is similarly or more effective in preventing panic selling than previous stock market experience or being a business student.

We conclude that, as compared to other variables, the effect of our nudge is strong. It is of a similar or even larger magnitude than the difference between an inexperienced and an experienced investor or the difference between those majoring in business-related subjects and others. It also has a by far stronger effect than differences in behavioural preferences that might contribute to panic selling like loss aversion, regret aversion or (lack of) need for cognition.

This result already supports Hypothesis 1, but we will refine the analysis on the impact of the endowment effect and IKEA effect on participants' commitment to their asset allocation by using OLS regressions (Table 4). In Panel A, the dependent variable is "Asset seller". Model 1 presents the estimate of the basic specification. We found that individuals who were advised by an advisor are, on average, more likely to sell their risky asset after the market crash. In Model 2 and 3, we control for demographic characteristics such as gender, age, income, and education, and behavioural variables such as saver/spender, loss aversion, regret aversion, and NFC score. In both models, the results remain statistically significant at the 1% level. Moreover, we find that females are more likely to sell their risky assets after the market crash.

In Panel B, the dependent variable is "Asset allocation alteration". In all the three models of this panel, the coefficient of our explanatory variable, Bank advised dummy, is negative. It shows that participants who did not choose their own portfolio, on average, are more likely to reduce the share of risky assets in their portfolio after the market crash. In Model 5 and 6, the results are statistically significant at the 5% level.

The results strongly confirm Hypothesis 1. It seems that when participants choose their own portfolio to invest in, they are much more likely to stick to their asset allocation than in cases where somebody else does it for them. This holds even though the portfolio choices in our experiment were quite constrained. We interpret this commitment to asset allocation as a consequence of the combination of endowment effect and IKEA effect or, alternatively, the familiarity bias.

Finally, the important point is, regardless of what it is called, this nudge (engaging the participants in the process of asset allocation) can practically increase their commitment to their investment. In particular, during a market crash, these investors are less likely to sell their assets and if they do, the share of the risky assets sold by them is significantly less as compared to passive investors who have used the services of a bank advisor.

		Panel A		Panel B			
	(1)	(2)	(3)	(4)	(5)	(6)	
VARIABLES		Asset seller		Asset	allocation al	teration	
Bank. advised Dummy	0.209***	0.203***	0.213***	-50.688*	-65.458**	-66.251**	
	(0.055)	(0.054)	(0.055)	(29.534)	(29.291)	(29.574)	
Female Dummy		0.257***	0.258***		-58.731**	-57.045*	
		(0.055)	(0.056)		(29.646)	(29.993)	
Age Dummy		0.118	0.087		-78.449	-103.085	
		(0.185)	(0.189)		(99.818)	(101.625)	
Income Dummy		-0.017	-0.005		25.631	43.295	
		(0.080)	(0.082)		(43.205)	(44.220)	
Degree Dummy		0.047	0.047		6.430	0.784	
		(0.058)	(0.059)		(31.368)	(31.700)	
Business Dummy		-0.087	-0.077		42.348	28.171	
		(0.058)	(0.062)		(31.519)	(33.044)	
Saver Dummy			0.038			0.899	
			(0.074)			(39.847)	
Loss Aversion			0.013			-28.796	
			(0.038)			(20.529)	
Regret aversion			-0.014			-3.065	
			(0.012)			(6.588)	
NFC Score			0.019			26.191	
			(0.037)			(19.788)	
Constant	0.105**	0.033	0.014	30.526	26.321	35.964	
	(0.042)	(0.068)	(0.175)	(22.223)	(36.832)	(94.216)	
Observations	219	209	209	219	209	209	
R-squared	0.062	0.185	0.192	0.013	0.064	0.084	

Table 4. OLS regression across participants. Standard errors in parentheses. Significance levels of t-tests: *** p<0.01, ** p<0.05, * p<0.1.

We continue our analysis by testing Hypothesis 2, exploring how participants having experience in the stock market react to the market crash. To do so, we add "Experience Dummy" variable to the model. Table 5 presents the result. Similar to Table 3, here too, the dependent variable in Panel A is "Asset seller" variable and in Panel B is "Asset allocation alteration" variable. In Panel A, after controlling for "Experience Dummy" in Model 2, the main explanatory variable (i.e. Bank advised dummy) remains statistically significant. That is, having experience in the stock market is not able to explain the differences between advised and non-advised groups in terms of commitment to asset allocation after a market crash. In Panel B, where the dependent variable is "Asset allocation alteration", the results are slightly different. In Model 4, not only the "Advised dummy" but also the "Experience dummy" variables are statistically significant (although, at the 1% level). In other words, we observe that after the market crash (i) participants in the advised group on average tend to sell a higher portion of their risky assets, as compared to the non-advised group, and (ii) experienced participants are, on average, less likely to sell their risky assets, as compared to the inexperienced participants.

Therefore, we can partially confirm Hypothesis 2, which states that people with trade experience are more likely to stick with their stocks during a crash.

	Pan	el A	Panel B			
	(1)	(2)	(3)	(4)		
VARLABLES	Asset	seller	Asset allocat	ion alteration		
Bank advised Dummy	0.213***	0.214***	-66.251**	-62.453**		
	(0.055)	(0.055)	(29.574)	(29.487)		
Experience Dummy		0.014		58.181*		
		(0.061)		(32.497)		
Constant	0.014	0.009	35.964	14.929		
	(0.175)	(0.177)	(94.216)	(94.429)		
Controls	Yes	Yes	Yes	Yes		
Observations	209	209	209	209		
R-squared	0.192	0.192	0.084	0.099		

Table 5. OLS regression across participants. Standard errors in parentheses. Significance levels of t-tests:*** p < 0.01, ** p < 0.05, * p < 0.1.

Finally, as we mentioned in the introduction, we would like to explore to what extent home bias affects decisions regarding panic selling. To test this—considering that the experiment was conducted in Germany, and all participants were from Germany—for each participant we computed the portion of his or her portfolio that would be invested in European developed markets and check whether this would affect their decision after the crash.

For this aim, we define two new variables:

(1) "EU developed dummy", is a dummy variable that equals 1 if the participant chooses to invest in European developed markets.

(2) "EU developed portion", is a variable that shows the portion of participant's investment in European developed markets. For instance, if the participant invests in five different regions, one of which one is a developed EU market, then the *EU developed portion* is 20%.

The results of the regression analysis are presented in Table 6. In all models, we estimate the potential effect of home bias on participants' behaviour during a market crash for the subjects in

the non-advised group (i.e., the ones who could actually choose). The results show that both "EU developed dummy" and "EU developed portion" are not statistically significant, and, therefore, we conclude that home bias is not an explanation for the results of our experiment.

	(1)	(2)	(3)	(4)
VARLABLES	Asset s	seller	Asset allocatio	on alteration
EU developed dummy	67.406	-0.016		
	(80.705)	(0.102)		
EU developed portion			1.172	0.004
			(2.182)	(0.003)
Constant	-25.977	0.098	-4.257	-0.004
	(169.258)	(0.214)	(166.854)	(0.207)
Controls	Yes	Yes	Yes	Yes
Observations	90	90	90	90
R-squared	0.097	0.156	0.092	0.181

Table 6. Testing home bias. Standard errors in parentheses. Significance levels of t-tests: *** p<0.01, ** p<0.05, * p<0.1.

4 Loss of diversification

As mentioned earlier, given the limited diversity of regional ETFs, one possible concern is the loss of diversification and, therefore, increased risk for the investors. In our experiment, this concern is obviously not valid for the advised group. However, since the participants in the non-advised group had a chance to choose 4 to 8 regional ETFs, one might wonder whether the gains by avoiding panic selling are overcompensated by losses due to a lack of diversification.

The minimum number of regions to be picked was indeed a constraint for the subjects, as can be seen from the fact that 76% picked exactly four regions.⁶ This underlines the importance of a setup for the nudge that guarantees a certain amount of diversification, like in our experiment, since investors might otherwise end up picking just their one favourite stock—which would certainly not be a good asset allocation.

In this section, we attempt to show that although loss of diversification could be a potential issue for our nudge, when it comes to investing in regional ETFs, this loss hardly translates into measurable extra risks for the investors.

⁶ Eight subjects chose only three regions and six even fewer. We have repeated the subsequent data analysis without these subjects, but all the results were essentially the same.

First, it is worth noting that in the matter of investing in foreign capital markets, loss of diversification is widespread. Findings in behavioural finance suggest that investors tend to invest in domestic assets. As mentioned earlier, this tendency is called home bias (French and Poterba, 1991; Coeurdacier and Rey, 2013), a special case of the familiarity bias. Moreover, studies in international finance suggest that even when investors decide to invest in foreign financial assets, they tend to choose markets where returns are highly correlated with their home country (Portes and Rey, 2005). This tendency, or anomaly, is called correlation bias (Barberis and Thaler 2004; Aviat and Coeurdacier, 2007) because potential gains of diversification will weaken or even disappear in case of a high correlation.

Now assume that investors overcome home bias and correlation bias, by for example relying on an investment advisor. The next question is, when it comes to investing in foreign capital markets, does increasing diversification necessarily lead to a higher benefit?

In order to answer this question, we have to understand to what degree international capital markets are linked. The benefits of diversification could only be enjoyed if the financial markets across countries and regions are not highly correlated. That is, if there are long-run and strong relationships among capital markets of the countries, the existence of potential diversification benefits will be smaller.

As regards the co-movement between returns, or the so-called spillover of the first moment, although there are some studies that show low correlation across different international capital markets (Kiymaz, 2002; Rezayat and Yavas, 2006; Bekaert et al., 2009), there is substantial evidence supporting the idea of co-integration and high financial contagion across different capital markets (Yavas & Dedi, 2016; Li & Giles, 2015; Kumar, 2013; Yavas & Rezayat, 2016). As regards the transmission of volatility, measured by the conditional second moments, several studies suggest that volatility in one financial market tends to be followed by volatility in financial markets of the same trading zone both in the short run (Fleming and Lopez, 1999; Savva et al., 2005) and in the long run (Andersen et al., 2001; Andersen et al., 2003). Findings suggest that realized volatility has a fractional order of integration (Baillie, Bollerslev, 1994; Shimotsu, 2012; Sakthivel et al., 2012; Clements et al., 2016). In conclusion, although findings on co-integration in international capital market returns and volatility are not conclusive, there is more evidence in support of strong correlation.

In case of a financial crisis, the degree of integration and the pace of transmission across international capital markets become even more significant. Over the past two decades, several studies have documented financial contagions and co-integration of international markets during financial crises (e.g. Claessens et al. 2001; Lane, 2013; Kaminsky, Reinhart, 2000; Van Rijckeghem, Weder, 2001; Li and Giles, 2015; Boameh, 2017; Pyun and An, 2016).

In international ETFs, as well, a wide majority of studies show the presence of spill-overs of stock market returns among country and regional ETFs. For instance, Levy and Lieberman (2013) find a significant impact of the US market on country ETFs in the short run. In this regard, several other studies have documented co-integration and positive correlations between short-run return of the US market and country ETFs (Hughen and Mathew, 2009; Zhong and Yang, 2005). In another study, Yavas and Rezayat (2016) find a significant co-movement of returns among ETFs in their study in the US (S&P 500), Europe (iShares), BRIC countries (Brazil, Russia, India and China), although in the MIST countries (Mexico, Indonesia, South Korea and Turkey) and South Africa, their findings on transmission of volatility are less consistent. This means, for example, that although US market volatility is likely to be transmitted to the sample countries, the volatility of country ETFs would hardly be transmitted to the US market. Levy and Lieberman (2013) also find the dominant impact of the S&P 500 on country ETFs.

To conclude, when it comes to regional ETFs, academic research on the long-term effect of loss of diversification—increased risk for the investors—is not yet conclusive. Although there is some evidence that indicate partial independence of international ETFs, it seems that in the long run, and especially during financial crises and market crashes, international ETFs show a considerable co-integration. Therefore, the potential profit of diversification could be reduced.

Despite all this, in order to estimate the variation of risk, we also measure 1-year and 3-year returns and volatilities for each portfolio selected by the participants in the non-advised group. We then compare these values to the "anti-nudging" portfolio (advised group).

Since the experiments were conducted in late 2017, the 3-year calculation is the realized performance of the portfolios chosen by the participants after their hypothetical investment and thus, not biased by the perception of previous returns.

To measure the returns, we chose the biggest ETF (according to investment volume) in each region (Africa & Middle East; Asian developed markets; Asian emerging markets; Australia & Oceania; European developed markets; European emerging markets; Latin America; North America) and elicited their historical data. The list of ETFs is presented in Appendix B.

The results, presented in Table 7, reveal that there is no significant decrease in risk-adjusted performance through nudging. In fact, we can even observe increases in risk-adjusted performance in the non-advised group. More precisely, while the means of 1-year and 3-year risk-adjusted performance among the advised group are -0.32 and -0.09 respectively, in the non-advised group,

these	numbers	increase	to -0.15	and 0.0	2. We	conclude	that	loss	of c	liversific	ation	has	not	led	to
an inc	creased ris	sk for the	investo	rs.											

Variable	Obs	Mean	Std. Dev.	Min	Max
RETURN_1Y_NonAdvised	95	-5.05	6.39	-22.38	15.93
RETURN_1Y_Advised	124	-11.38	0.00	-11.38	-11.38
RETURN_3Y_NonAdvised	95	2.40	9.10	-18.20	34.62
RETURN_3Y_Advised	124	-5.42	0.00	-5.42	-5.42
DISK 1V Non Advised	05	20 47	1.00	22.00	24.60
DISK_1V_A_1 i 1	104	20.47 20.51	1.99	22.00 20.51	34.00 20.51
KISK_IY_Advised	124	30.51	0.00	30.51	30.51
RISK_3Y_NonAdvised	95	20.06	1.21	17.96	23.75
RISK_3Y_Advised	124	21.51	0.00	21.51	21.51
RETURN/RISK_1Y_NonAdvised	95	-0.15	0.21	-0.66	0.69
RETURN/RISK_1Y_Advised	124	-0.32	0.00	-0.32	-0.32
RETURN/RISK_3Y_NonAdvised	95	0.02	0.14	-0.28	0.45
RETURN/RISK_3Y_Advised	124	-0.09	0.00	-0.09	-0.09

Table 7. Return, risk, and return/risk in advised and non-advised groups

While, on average, the selection of assets by non-advised subjects is showing no inferior performance as compared to the broadly diversified global portfolio, this might simply be caused by experienced subjects choosing the right regions, while less experienced ones would indeed have a worse performance after picking the regions themselves. We therefore test the performance of inexperienced investors and also those without a business degree. In other words, we want to know whether they were worse off and lost money after having made their decisions themselves.

To this aim, we construct another table similar to Table 7, with the difference that we measure risk-adjusted performance once among inexperienced investors and once among the investors without a business major. We then compare these values between advised and non-advised groups. The results, presented in Table 8, confirm the previous results, i.e., not only there is no significant decrease in risk-adjusted performance in the non-advised group, but also the risk-adjusted performance in both 1-year and 3-year periods shows a slight increase when using a nudge.

We conclude that loss of diversification has not led to an increased risk for the investors, and even for inexperienced investors and those not majoring in business, the two investor groups that might be most vulnerable to mistakes caused by their own investment decisions.

		Variable	Obs	Mean	Std. Dev.	Min	Max
Non-experienced	Advised	RR_1Y	87	-0.32	0	-0.32	-0.32
	Non-advised	RR_1Y	58	-0.12	0.23	-0.49	0.69
	Advised	RR_3Y	87	-0.09	0	-0.09	-0.09
	Non-advised	RR_3Y	58	0.04	0.14	-0.2	0.45
Non-business	Advised	RR_1Y	37	-0.32	0	-0.32	-0.32
	Non-advised	RR_1Y	29	-0.16	0.21	-0.59	0.1
	Advised	RR_3Y	37	-0.09	0	-0.09	-0.09
	Non-advised	RR_3Y	29	0.01	0.13	-0.28	0.19

Table 8. Return/risk in advised and non-advised groups among non-experienced investors and those without a business major

5 Conclusion

The main subject of this article can be understood as fighting fire with fire: potentially harmful behavioural biases (a combination of IKEA effect and endowment effect) are recruited to fight an even more dangerous problem – panic selling.⁷ Our experimental data clearly shows that this seems to work: we can reduce panic selling by using a simple nudge that strengthens the psychological connection between a portfolio of assets and its owner: to achieve that, we simply let subjects contribute to the selection process of the assets. Too much of this, however, might do more harm than good: people might "assemble" a portfolio that they like and stick to it, but it may actually bad because it offers too little diversification. Therefore, we designed a setup where the overall diversification of the resulting portfolios is not worse than the globally diversified benchmark portfolio. We measured this using the *actual performance* of the selected portfolios *after* the experiment. This is also the case when we only consider inexperienced investors, thus the nudge does not make investors worse-off regarding their portfolio quality while reducing panic selling. Although the results are very clear and also their magnitude is significant, there are, of course, some limitations to our work.

First, we use a student sample and not a sample of actual investors. While this might lead to certain differences, we have no reason to believe that students are particularly susceptible to biases. Nevertheless, follow-up studies with other demographic groups, and maybe also a broader geographic reach would be interesting.

Second, we analyse only hypothetical investment decisions. This is certainly a more severe limitation. As much as we wished, however, to use real-world data to test our nudge, this is

⁷ The fundamental concept shows some resemblance with Rieger et al. (2020).

infeasible, not only because it seems unlikely that we could conduct an experiment in a situation where a client gets advised on the long-term strategic asset allocation of his wealth. (Privacy and reputational concerns do not allow experiments in such situations.) There is also the problem with the necessary follow-up observations, since the beginning of the next stock market crash would be unpredictable. For these reasons, an experiment with hypothetical investment decisions is the best feasible alternative.

Third, we tested only one possible nudge. Many other implementations of the idea could be possible, so we do not want to argue that the suggested method (using regional portfolios) is the best one. We have, however, selected it with care, as it seems to yield a good ratio between increased commitment and reduction in diversification benefits. As it turned out, this was indeed the case: the nudge worked well, and the small loss in diversification turned out to have no negative impact on performance, even when controlling for risk.

Besides the obvious potential for applications, our results also have some theoretical implications. First, they suggest that the involvement of investors in the selection of assets can have surprising beneficial effects, even if the investors do not possess good asset selection abilities. Second, the general idea of "fighting fire with fire", i.e. utilizing one behavioural bias to counterbalance the effects of others, can be a useful idea for other situations as well, in finance or in other areas.

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