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Lucia Morales
Technological University Dublin, Ireland, lucia.morales@tudublin.ie

Daniel Rajmil
Universitat Oberta de Catalunya, Spain

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Research article

Investing in virtue and frowning at vice? Lessons from the global economic and financial crisis

Lucia Morales[1,*], and Daniel Rajmil[2]

[1] School of Accounting, Economics and Finance Technological University Dublin, Ireland
[2] Law & Political Sciences Faculty, Universitat Oberta de Catalunya, Spain

*** Correspondence:** Email: lucia.morales@tudublin.ie.

Abstract: Socially responsible mutual funds (SRMF) and the "antisocially conscious", Vitium Global Fund Barrier Fund (formerly known as the Vice Fund, the term used in this paper) returns, volatility patterns, and causal effects are examined in this study within the context of the lessons learned from the 2008 Global Economic and Financial Crisis (GEFC). In times of a new and unprecedented crisis due to the COVID-19 pandemic, a look back to our recent past reveals that volatility patterns on daily stock returns presented some level of predictability on prices for both types of funds. The research findings are significant as funds' potential predictability could help market players when designing their investment strategies. More specifically, an increase in volatility persistence is found after the GEFC, together with an increase in the Vice Fund's resilience to market shocks. Although all funds, without substantial differences, take time to absorb the shocks. A noteworthy outcome relates to SRMF that was able to achieve higher returns and exhibited lower volatility levels during the crisis period. Whereas the Vice Fund revealed long-run sustainable performance offering fund managers and investors investment opportunities that are endorsed by the fund performance over the period. Furthermore, unidirectional causality was found running from the Vice Fund to the SRMF, exhibiting a clear dominance during the GEFC period. The research findings contribute to the debate on the future of socially responsible investment, indicating that SRMF appears to be driven by *"antisocially conscious"* funds signaling limited rewards for investors inclined to invest in funds that are considered socially responsible.

Keywords: performance; social responsible investment; ethical investing; vice; volatility; causality; GARCH

JEL Codes: C22, F21, G11, G15

1. Introduction

Mutual funds have experienced explosive international growth over the last twenty-five years. The Investment Company Institute (ICI) reports that by the end of 2015 the total worldwide assets invested in mutual funds were $37.2 trillion, of which $17.8 trillion were located in the United States. The year 2019 shows that the US based mutual funds worldwide have reached $21.29 trillion with a significant increase recorded by 2021 representing approximately $27 trillion (Investment Company Institute, 2022). Because of its great popularity, representativeness, and importance in trading volume, the US investment industry has attracted considerable attention among researchers and analysts. Thus, recent studies show that despite current belief, even during the COVID-19 crisis, most active funds underperformed passive benchmarks (Pástor &Vorsatz, 2020). On the other hand, Díaz et al. (2022) findings suggest that socially responsible investment (SRI) played a significant role in diversifying investment portfolios during the 2020 Global Health Crisis (COVID-19 pandemic). In this context of crisis, the striking recent development of socially responsible mutual funds (SRMF) is especially notable. These funds are considered *"non-conventional."* Once various screens have been applied to examine the tenor of the fund's composition, environmental, social and governance (ESG) criteria are incorporated into the decision-making process encompassing both commitment to social concerns and purely financial goals. As Widyawati literature review on responsible investment states, there are two sides to consider when exploring these funds: the financial and the ethical (Widyawati, 2020). According to the first, socially responsible investment (SRI) should be looked at as an instrument to pressure companies to operate more ethically and sustainably. The second one regards them as new financial services offered to a new group of investors (ibid.). Regardless of the view, the reality shows that the growth of SRI has been so remarkable in the last years that, according to the US SIF Foundation's 2016 biennial report (USSIF, 2016), the total US-domiciled assets managed under SRI strategies rose by 133 percent from 2012 to 2016 ($3.74 trillion in 2012 to $6.57 trillion in 2014 and to $8.72 trillion in 2016). Much of the growth is driven by asset managers that are considering environmental, social, or corporate governance criteria, with conflicting risks and climate change being the two issues considered by fund managers. An important aspect that emerges from registered patterns is how the 2008 GEFC might have acted as a breakpoint in terms of investors' preferences and their potential change towards favouring more environmental friendly investments.

In this context, this trend in responsible investment reflects a shift in mindset with social consequences and an impact on the fund management industry and opens a new set of questions related to ethical investment matters and recent societal trends when investing. In that sense, some authors have shown that ethical commitment is transferring to financial markets; for instance, Hong and Kacperczyk (2009), Geczy et al. (2005), Chong et al. (2006), Chang and Doug Witte (2010), among others, provide evidence on the relation between market effects and social norms. One of the most recent reviews on this debate Leins (2020), argues that ESG enables financial analysts to be a supportive narrative tool. In this sense the sophistication and normalization of ESG as morality could end up becoming a speculative practice of valuation (ibid). Overall, new prospects and relations to study how social norms

are incorporated in social responsible investment become a new set of financial products and need to review its ethical basements. Moreover, a new set of studies as the ones lead by Bursztyn et al. (2020) or Khan (2020), to mention just a few, have opened the floor to study how women's economic development could be as well affected by social norms, which opened a new field of relations that could be of interest to explore from a social responsible investment perspective. On the other hand, there are the *"antisocial"* investment funds and the so-called *"sin stocks"* which are as well studied under the possible gender bias influence of this type of products and social norms. Niszczota & Bialek (2020) presented an extensive empirical study on women's perception of "*sin*" funds adding new ethical aspects to the existing dilemmas in the relation between social norms, investment, and markets performance, suggesting that women tend to judge more harshly controversial stocks than men (ibid).

The literature around the challenges of the investment environment of *'sin'* stocks (i.e., publicly traded companies associated with alcohol, tobacco, arms and/or gaming activities) was studied by Hong and Kacperczyk (2009). The research findings revealed the potential existence of costs when investors apply their social objectives to investing as norms affect stock prices and returns. Additionally, increasing governmental regulations and the media[1] play critical roles by adding behavioral pressure in this respect. In this line, the recent scandal around Reddit-Gamestop saga confirmed how media could play a decisive role in promoting or declaring war on some industries that promote responsible and irresponsible investment.

Within this context and as previously mentioned on the line of Leinz (2020) study, funds' managers are adapting the strategies they apply to conventional funds to their investment decisions on investment alternatives with ESG considerations in pursuit of financial gain while also benefiting society. However, an early research study by Benson et al. (2006) offers critical insights on SRI investment, as the authors found little difference in stock-picking ability between SRI and conventional fund managers, leading them to question whether there is any real difference between SRI or conventional fund managers investment strategies.

Extensive debates have taken place over whether introducing the ESG criteria into mainstream investment consciousness leads to higher returns or whether its returns are comparable to those of conventional funds. Indeed, the SRMF strategy implies a reduction of the investment opportunities when vice investment is vetoed. Many academic studies and the media have echoed the importance of this matter. Thus, contradictory positions appear in academic literature on *'sin'* investment. On the one hand, authors such as Hong and Kacperczyk (2009); Statman and Glushkov (2009); Capelle-Blancard and Monjon (2014), among others, find that *'sin'* stocks have higher returns. However, Lobe and Walkshäusl (2016), Benson et al. (2006) find no abnormal returns, while Salaber (2009) and Humphrey and Tan (2014) point to a lack of any relation between *'sin'* investing and portfolio performance. Interestingly, the Barrier Fund (popularly known as the Vice Fund) as a vehicle of purely *'sinful'* investment has motivated few studies since its inception in 2002 (Chang and Krueger, 2013; Areal et al., 2013). This fund's distinctive characteristic is that its investment portfolio consists exclusively of tobacco, gambling, defense, and alcohol industries. In fact, the main dilemma centers on the potential

[1] "Responsible investment: Vice versus nice" in Financial Times (2015-06-25); "Forget socially responsible; This fund cashes in on sin" in CNBC (2015-10-30); "Sin wins investor battle of vice or virtue" in Financial Times (2015-02-11); "God vs. Satan: Who's the better investor?" in Slate (2005-07-29), among others.

of its long-run outperformance when purely vice investing activity is rewarded by the markets (Chong et al., 2006; Chang and Krueger, 2013; Soler-Domínguez and Matallín-Sáez, 2015). However, Hoepner and Zeume (2009) found no outperformance for the Vice Fund suggesting that socially responsible funds and *"sin"* funds might be exhibiting similar patterns. This study seeks to understand if socially responsible funds offer appropriate rewards to investors by examining selected funds' volatility patterns individually to gain insights on market behaviour, as there is a significant dearth of research studies examining individual funds' performance from a risk perspective.

Today, it is pertinent to revisit the literature on vice investing; there are still apparent contradictions among approaches, and this study seeks to provide insights on our recent history to help gaining a better understanding of funds' performance during the GEFC. If further support were found for the outperformance of vice investing, the investment industry's implications would be considerable. In theory, sound strategies are crucial for achieving a solid investment plan. Any rational investment decision should be based on the expectation of obtaining positive returns and awareness of the proper allocation of assets during market fluctuations. After the worldwide financial meltdown, managers should be cautious when interpreting long-term market opportunities as they need to be able to manage risk-return trade-off wisely in line with investors' preferences and by ensuring that selected assets do not end up sacrificing returns gains. Glode (2011) and Kacperczyk et al. (2011) find that managers are more active during periods that are characterised by significant uncertainty and denominated as bad economic times. In fact, managers are exposed to various levels of pressure when building up their portfolio strategy, suggesting that during periods of crises fund managers would be readjusting and rebalancing their investment portfolios more frequently than during times of economic stability.

An early view on the link between business cycles and performance was presented by Moskowitz (2000), who suggested that alphas increase during crises. This hypothesis has been further validated in subsequent studies, such as Glode (2011), Kosowski (2011), Kacperczyk et al. (2014) among others. This literature also aims to understand conventional funds' behavior during recessions and concludes that performance does vary over the business cycle. Analogously, Kosowski (2011) shows underperformance for US funds during expansion periods. Becchetti et al. (2015) investigate SRMF and conventional funds' performance, finding that SRMF played an 'insurance role', outperforming their conventional counterparts during the global financial crisis. This paper provides additional insights into how well investments respond when exposed to expansionary or contractionary economic periods. We explore volatility patterns exhibited by mutual funds during stressful market conditions as those faced during the 2008 global turmoil, at the time that we examine the Vice Fund performance and how it might differ from patterns exhibited by the socially responsible funds. This information is useful to enable investors to stay tuned and also contributes to the management literature linking performance and external pressure behavior during the decision-making process.

Our study aims to explore the behavior of a set of US funds for the period 2002–2013. The research sample is limited to the period of the global economic and financial turmoil that was defined by sluggish investment, being this a major defining feature of the period that was accompanied by long-lasting capital and total factor productivity shortfalls when compared to the precrisis period (IMF, 2019). On the one hand, we analyze performance and persistence by applying volatility measurement techniques (GARCH model). On the other hand, we examine funds' behavior when a shock affects the investment market, such as the 2008 economic and financial crisis's impact on the US economy by

introducing a causal research framework. Therefore, this study focuses on the study of volatility patterns, examination of market uncertainty, and its persistence combined with the analysis of causal relationships that would help identify if there is any potential impact running from conventional funds towards SRMF. This dual analysis lend robustness to our study and provide insights into any pattern or tendency to predict future breakpoints and to lessen the chance of a recurrence by understanding the signs given out by the financial market.

The remainder of the paper is organized as follows: section 2 describes the data and outlines the methodological framework. The empirical results are reported in section 3. Finally, concluding remarks are presented in section 4 where the connection to ethical investment and need for further research are presented.

2. Data and methodology

2.1. Data

The initial dataset consisted of 1,707 US mutual funds spanning from August 30, 2002 (Vice Fund date of inception) to June 30, 2013. The data was filtered, disaggregated, and rebalanced to consider fund size, age and sector, thus allowing the funds to be grouped according to their ethical approach. The initial data analysis and filtering process led to the selection of a small sample that comprises 15 mutual funds. The data selection process was cognizant of the need of having a homogenous sample that sought to ensure that the time period under study was consistent and that there were no issues with regard to missing observations and inconsistent time periods. The data sampling process represented a very laborious process, as each one of the 1,707 funds that were part of the initial sample were subject to an individual scrutiny process. Therefore, the final research sample comprises 15 mutual funds accordingly homogenized in order to avoid an incomplete data set that will impede the implementation of the selected econometric models, and as a result the sample is divided as follows: 12 SRMF plus the Vice Fund—as an anti-SRI fund—and two conventional funds included as control variables (proxies). Daily prices from the Morningstar database are included in the analysis; we therefore analyzed 4,930 daily observations for each one of the selected funds, in an initial stage to identify break periods and to ensure that the sample integrated the GEFC. Furthermore, the study was guided by the NBER data on US business cycle expansion and contraction to corroborate and compare market fluctuations. This research study differs from the existing literature as we propose a new approach to the analysis of mutual funds that argues the need provide evidence on funds individual patterns that helps to gain richer insights on their performance when compared to pooled analysis that is identified to be quite common on the extant literature. Therefore, this research study is not in alignment with the traditional research approach in the field where a large number of funds are considered simultaneously, as in this paper we are providing an individual insight on each one of the funds integrated in this study. We selected those funds that were considered socially responsible from the 1,707 funds collected and we kept three conventional funds for robustness. The chosen methodology was applied to the final fifteen funds that met time series requirements to allow the individual assessment of the funds regarding volatility performance. Consequently, the sample selection process was subject to a significant scrutiny level to ensure that the selected time series satisfied all methodological requirements, which led us to a final optimal sample of fifteen funds.

2.2. Methodological framework

Daily prices for the twelve selected SRMF mutual funds and three conventional funds (see the appendix for details of all the funds) are transformed into continuously compounded returns: ln (P_t/P_{t-1}), where P_t is the daily closing price. The data set analyzes the performance and causal effects of the fifteen funds before and during the Global Economic and Financial Crisis (GEFC) and as result the sample ended in June 2013 when there were clear signs of markets recovering from the global turmoil. The study starts by examining individual volatility patterns across the selected funds, to understand potential differences in behavior and market reactions that would shed light on potential differences or similarities between socially responsible funds, the vice fund and the proxies (conventional funds). The causal effects running from conventional funds to SRMF are then identified using a traditional Granger causality test and an asymmetric causal approach based on mean and variance estimations that help develop a comparative analysis over the subperiods under study, and at the same time facilitate cross checking of results. The basic methodological framework starts with the analysis of the series returns which are tested for unit roots to ensure stationarity and mean-reverting properties. Additionally, a VAR(p) framework identified the optimal number of lags to be used and ensured that the models considered were not overparameterized. The study also verifies a breakpoint around 15 September 2008, at the time that Lehman Brothers collapsed making the official start of the GEFC. We took this date as our main benchmark, as it is generally considered as the trigger of the global financial meltdown and the resulting global impact. This breakpoint was used to split the sample into two subsamples, offering a broader view of the funds' volatility behavior before and during the GEFC and excluding from the sample the period that signals the start of global markets recovery. Because the breakpoint is known, the basic Chow test (Chow, 1960) for stability is used to verify that the series are indeed affected by structural changes at the time. In its simplest form, the Chow test involves estimating a single breakpoint computed through the F-statistic and based on the comparison of the restricted and unrestricted sum of squared residuals as indicated below:

$$F = \frac{(SSR_n - (SSR_{n_1} + SSR_{n_2}))/k}{(SSR_{n_1} + SSR_{n_2})/(n_1 + n_2 + 2k)} \tag{1}$$

Table 3 presents the Chow test results confirming the existence of structural changes at the time the global financial crisis hit the world economy. Consequently, 15 September 2008 is taken as the reference point to split our sample into two periods, thus allowing close examination of the fund's patterns before and during the economic and financial crisis.

2.2.1. Volatility approach

Equation (3) models volatility persistence using a random walk approach. This model was selected to support the volatility analysis and was also used to conduct the causal research framework.

$$F_{ti} = c + \varepsilon_t \tag{2}$$

The GARCH (1,1) model is outlined below:

$$\sigma_t^2 = \omega + \alpha\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 \tag{3}$$

The mean Equations (1) and (2) were considered to analyze volatility persistence effects on the selected mutual funds. The conditional variance Equation (3) is a function of a constant term, news about volatility from the previous period that is represented by the ARCH terms and the last period's forecast variance that accounts for the GARCH term of the model.

The half-life of volatility shocks is determined by the sum of the ARCH and GARCH coefficients in the variance equation as follows: $Half - life = \frac{log(0.5)}{log\left(\sum \alpha_i + \sum \beta_j\right)}$ to help identify market uncertainty and its lasting effects across the studied funds. The half-life of volatility shocks would help understand if the funds absorbed the shock at different speeds. This has significant implications regarding sustained market uncertainty and subsequent implications for portfolio diversification and resilience (Gustafsson et al., 2022).

2.2. Causality approach

The methodological framework is complemented by implementing the traditional Granger causality test on the funds' returns. The main goal is to identify the existence of unidirectional or bidirectional effects running from the three conventional funds toward the SRMF. We check for consistency in our results with the traditional Granger causality test based on a bidirectional VAR model.

$$SRMFr_t = k_1 + \sum_{s=1}^{\partial} \emptyset_{11} SRMFr_{t-s} + \sum_{s=1}^{\partial} \emptyset_{12} CFr_{t-s} + \varepsilon_{1t} \tag{4}$$

$$CFr_t = k_2 + \sum_{s=1}^{\partial} \emptyset_{21} CFr_{t-s} + \sum_{s=1}^{\partial} \emptyset_{22} SRMFr_{t-s} + \varepsilon_{2t} \tag{5}$$

where *SRMFr* considers the returns of the twelve "green funds" analyzed, and *CFr* stands for the returns of the three conventional funds that support this study on individual basis. A second methodology based on asymmetric specification of causal relationships is also used to help cross check our findings. This approach facilitates the identification of inconsistencies in short-term relationships between conventional funds and SRMF. In this case, Fr stands for the returns of the fifteen funds studied.

$$Fr_t = \alpha + \varepsilon_t \tag{6}$$

$$h_t = \omega + \alpha \varepsilon_{t-1}^2 + \beta h_{t-1} \tag{7}$$

The simplest form of the GARCH (p, q) model, identified as the GARCH (1, 1) specification, is used in this paper to run an alternative Granger causality in mean and variance as per the approach developed by Cheung and Ng (1996). These authors propose estimating the univariate GARCH model for the stationary variables to obtain the conditional means and the conditional variances. The standardized residuals ($\hat{\varepsilon}_{it} = z_{it} - \hat{\mu}_{it})/\hat{h}_{it}$), are obtained from the GARCH model and the sample residual cross correlation functions – $\hat{\rho}_{u1u2}(k)$ are derived to test for causality. For the Granger causality in variance test the squared standardized residuals are obtained, and the sample residual cross-correlation functions between the squares of the two standardized results are derived. The

Granger causality in mean and variance tests are based on the statistic $\sqrt{T}\hat{\rho}_{u1u2}(k)$. The test statistics follow a normal distribution asymptotically. See Cheung and Ng (1996) for further details regarding the derivation of the sample cross-correlations functions. Overall, the combination of different causality tests allows to cross-check findings and identify consistence or potential inconsistencies in terms of market performance and causal relationships that are useful for understanding market dynamics in the selected funds.

3. Results

3.1. Descriptive statistics

Table 1 presents descriptive statistics for the period of study. Note that the fifteen funds recorded positive means, an interesting result considering the effect of the GEFC on the markets over several years. Overall, the research findings did not report evidence of a negative impact on the average returns of the conventional funds and SRMF. In terms of variation, the results are also quite encouraging, as in general, reported standard deviations are below ten percent for most of the funds. Only in the case of five funds (CAAPX, CSIEX, EGROWTH, MXMCX and NALFX) was the initial measure of volatility above ten percent; the CAAPX and the NALFX funds were the most volatile over the period, with return variations close to 25 percent. The results provide a clearer view, as these funds are also associated with higher returns over the period. In the specific case of two of the funds—EGROWTH and NALFX—these were associated with the lowest correlations, confirming the existence of potential opportunities for diversification. The coefficients of variation also confirmed the highest fluctuations recorded by the NALF and the VICE Fund, which were above twenty percent, and NALFX, which recorded the highest coefficient before the GEFC at 29 percent, followed by the VICE Fund with 27 percent of variation for the whole sample and also pre-GEFC. In this case, NALFX, EGROWTH, and the VICE Fund appear to behave differently to the rest of the sampled funds. VICE is the riskiest fund from the three conventional funds, while LargeCap is associated with the lowest variations over the period of study. From the SRMF, ATAFX and GCEQX have the lowest variations and exhibit more consistent properties over the three periods studied.

The correlation matrix, presented in Table 2 in the appendix, reports some initial evidence of strong positive connections between the fund returns that in all cases is above 0.5. The emerging growth fund results are associated with the lowest correlation coefficients, followed by the NALFX fund. On the other hand, the LargeCap fund and the Vice Fund registered very high correlation coefficients with the individual green funds. These initial findings are interesting, as they highlight the strong connections between the selected funds. The results suggest that only in the case of the Emerging Growth fund can investors identify potential opportunities for diversification purposes. It is of interest to highlight the strong connection between the LargeCap and Vice conventional funds that suggest that conventional funds are important to understand investment performance and provide insights on the need to carefully consider the role of traditional and SRI portfolios.

Table 1. Descriptive statistics.

Mutual fund code	Mean	Maximum	Minimum	S.D.	Skewness	Kurtosis	Jarque-Bera	Coeff. Variation (whole sample)	Coeff. Variation (before GFC)	Coeff. Variation during GFC
ATAFX	18.46	27.13	11.10	3.49	0.03	2.34	72.73	19%	16%	16%
CAAPX	104.03	177.00	47.68	24.30	0.20	2.93	26.42	23%	18%	23%
CSIEX	69.18	102.94	40.13	13.14	0.17	2.41	77.95	19%	14%	17%
DSEFX	38.91	56.63	20.86	6.83	−0.16	2.51	57.01	18%	15%	18%
EGROWTH	68.63	104.07	29.76	14.72	−0.58	2.84	225.42	21%	20%	22%
FLRUX	33.23	50.81	16.34	8.31	−0.25	1.87	251.82	25%	25%	16%
FSLEX	17.62	23.70	10.35	3.08	−0.33	2.28	158.75	17%	19%	13%
GCEQX	22.59	33.26	12.77	3.65	−0.11	2.80	14.55	16%	14%	16%
LARGECAP	27.33	40.28	15.20	4.98	0.11	2.66	27.83	18%	15%	18%
MXMCX	43.64	75.77	19.91	10.37	0.29	3.02	54.78	24%	17%	23%
MXSCX	38.70	60.89	15.02	9.10	−0.16	2.65	35.69	24%	19%	24%
NALFX	96.79	161.03	49.37	24.87	0.23	2.54	69.01	26%	29%	17%
PORIX	28.18	40.27	13.67	6.33	−0.37	2.11	218.27	22%	25%	14%
VICE	15.73	26.14	7.18	4.23	0.08	2.38	67.18	27%	27%	21%
WSEFX	12.77	19.41	7.79	2.39	0.18	2.54	55.24	19%	14%	17%

Note: *The funds associated with the highest level of risk as per their standard deviation also registered the highest returns over the period. The coefficient of variation offers an initial guideline regarding the level of volatility associated with the funds when compared to the return that might be expected. In this regard, the results show quite high variation, indicating that the mutual funds can be considered risky investments over the period studied.

Table 2. Mutual fund returns correlations.

	ATAFX	CAAPX	CSIEX	DSEFX	EGROWTH	FLRUX	FSLEX	GCEQX	LARGECAP	MXMCX	MXSCX	NALFX	PORIX	VICE	WSEFX
ATAFX	1	0.96	0.99	0.97	0.62	0.96	0.90	0.96	0.94	0.96	0.94	0.74	0.95	0.95	0.99
CAAPX	-	1	0.97	0.96	0.65	0.89	0.85	0.95	0.94	1.00	0.98	0.61	0.88	0.89	0.97
CSIEX	-	-	1	0.96	0.59	0.94	0.87	0.95	0.93	0.97	0.94	0.68	0.92	0.93	1.00
DSEFX	-	-	-	1	0.74	0.89	0.87	0.99	0.95	0.96	0.96	0.67	0.90	0.92	0.96
EGROWTH	-	-	-	-	1	0.51	0.67	0.75	0.74	0.64	0.73	0.49	0.59	0.64	0.58
FLRUX	-	-	-	-	-	1	0.92	0.88	0.87	0.89	0.86	0.83	0.97	0.94	0.94
FSLEX	-	-	-	-	-	-	1	0.88	0.81	0.84	0.86	0.87	0.95	0.87	0.87
GCEQX	-	-	-	-	-	-	-	1	0.95	0.95	0.96	0.70	0.90	0.93	0.95
LARGECAP	-	-	-	-	-	-	-	-	1	0.94	0.93	0.62	0.87	0.94	0.93
MXMCX	-	-	-	-	-	-	-	-	-	1	0.98	0.60	0.88	0.89	0.97
MXSCX	-	-	-	-	-	-	-	-	-	-	1	0.61	0.87	0.87	0.94
NALFX	-	-	-	-	-	-	-	-	-	-	-	1	0.89	0.75	0.67
PORIX	-	-	-	-	-	-	-	-	-	-	-	-	1	0.93	0.92
VICE	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0.94
WSEFX	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1

3.2. Volatility and structural break

As an initial highlight in terms of basic volatility behavior, and in line with discussions on registered standard deviations (see Table 1) the most volatile funds are the CAAPX and the NALFX, which exhibit high levels of fluctuation. Interestingly, however, the coefficient of variation seems to suggest that the level of dispersion is quite similar across the funds, with the traditional VICE Fund exhibiting large levels of variation and the emerging funds appearing to behave in a similar manner with small changes in dispersion.

Table 3. Chow test results.

Mutual fund code	Breakpoint Chow test	ARCH-LM
ATAFX	Yes	Yes
CAAPX	Yes	Yes
CSIEX	Yes	Yes
DSEFX	Yes	Yes
EGROWTH	Yes	Yes
FLRUX	Yes	Yes
FSLEX	Yes	Yes
GCEQX	Yes	Yes
LARGECAP	Yes	Yes
MXMCX	Yes	Yes
MXSCX	Yes	Yes
NALFX	Yes	Yes
PORIX	Yes	Yes
VICE	Yes	Yes
WSEFX	Yes	Yes

The results from the Chow test (see Table 3 in the appendix) confirmed the existence of a structural break at the time Lehman Brothers filed for bankruptcy. This became the largest bankruptcy filing in history and triggered the 2008 economic and financial crisis that spread across the global financial markets. The financial meltdown also affected mutual funds, as can be appreciated from the selected funds' patterns (details in Figure 1). The funds started to show signs of a change in performance around the second quarter of 2007, when the markets were already recognizing serious liquidity issues that were beginning to affect the global financial system. As our analysis aims to analyze funds' volatility performance and causal effects before and during the GEFC, we take September 15, 2008 as our point of reference and we closed the sample in June 2013 to avoid disruptions from the recovery process. Initially, the funds appear to react quite strongly to the global meltdown, offering some incipient evidence of the firm connections between the selected funds that have been found to share strong positive correlations, as discussed above. In this regard, our findings confirm that only a few funds can offer potential for diversification, where investors would be able to "pick and mix" between funds exhibiting more stable patterns and returns and those associated with higher levels of variation.

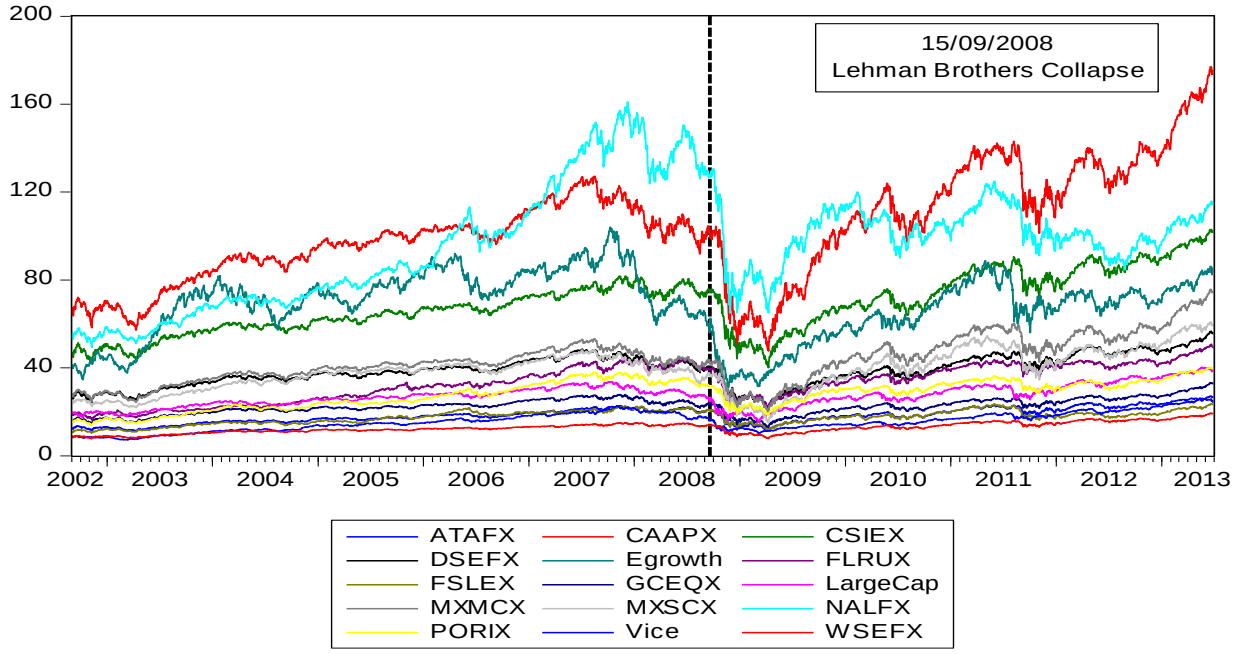

Figure 1. Mutual funds index price return 2002–2013.

3.3. Volatility persistence

Table 4 shows the funds exhibited high levels of volatility persistence before and during the GEFC. Note that before the GEFC the funds appeared to be more stable and the shocks were absorbed quite quickly compared to their performance after GEFC, when all the funds underwent a substantial increase in volatility persistence (see Figure 2 for illustrations), indicating a substantial period of time (ranging between two and three months) for funds to absorb the shocks and signaling that there were no major differences between the sampled funds. When the performances of conventional funds and Green funds are compared, there are no significant differences, which suggests that diversification possibilities are limited for investors wishing to integrate Green funds in their investment portfolios. The research findings lead to questioning how Green funds are rewarding their investors. Although diversification opportunities might be quite limited in terms of volatility persistence levels, the half-life outcomes identified three funds that absorbed market shocks fairly quickly, namely EGROWTH, FSLEX, and VICE. These three funds take the shortest time to adjust during the full sample period. The results are quite consistent for the subsample of pre-GEFC market performance, when the three funds and NALFX recorded the lowest adjustment times for this subsample. Finally, during the period examining the impact of the GEFC, the results are also fairly consistent in the case of FSLEX, NALFX and VICE, which recorded the lowest times to adjust to the massive shock. These outcomes offer valuable information to investors who might need to monitor the behavior of funds that absorb market shocks quickly, as they might be able to bring more stability to their investment portfolios. In this case FSLEX is identified as offering signs of consistency and is associated with lower levels of risk, whereas NALFX and VICE could be used as funds that are associated with higher levels of risk, that materialize on higher returns at the time that they react quite quickly to market uncertainty.

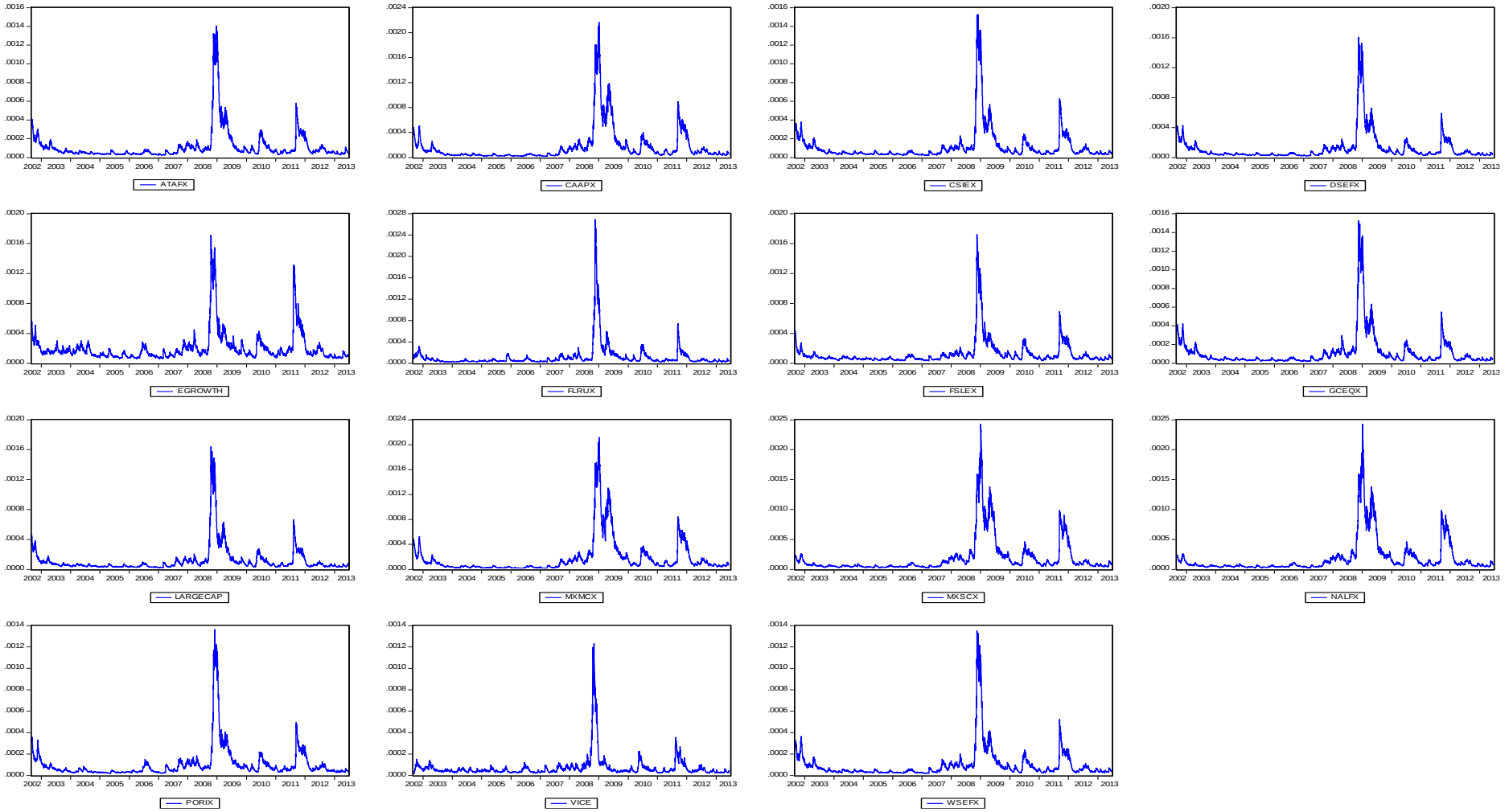

Figure 2. Volatility patterns among mutual funds.

Table 4. Volatility persistence.

Mutual fund code	Whole Sample: 09-2002 to 06-2013				Before GFC: 09-2002 to 09-2007				During GFC: 09-2008 to 06-2013			
	α	β	Volatility Persistence	Half-Life	α	β	Volatility Persistence	Half-Life	α	β	Volatility Persistence	Half-Life
ATAFX	0.046	0.945	0.991	77	0.02	0.969	0.989	63	0.059	0.931	0.99	69
CAAPX	0.051	0.944	0.995	138	0.035	0.953	0.988	57	0.061	0.933	0.994	115
CSIEX	0.047	0.944	0.991	77	0.018	0.972	0.99	69	0.061	0.931	0.992	86
DSEFX	0.047	0.945	0.992	86	0.022	0.968	0.99	69	0.061	0.932	0.993	99
EGROWTH	0.046	0.941	0.987	53	0.03	0.953	0.983	40	0.055	0.935	0.99	69
FLRUX	0.059	0.929	0.988	57	0.033	0.953	0.986	49	0.076	0.916	0.992	86
FSLEX	0.046	0.94	0.986	49	0.021	0.96	0.981	36	0.061	0.927	0.988	57
GCEQX	0.048	0.943	0.991	77	0.018	0.972	0.99	69	0.063	0.93	0.993	99
LARGECAP	0.048	0.942	0.99	69	0.0257	0.959	0.9847	45	0.061	0.93	0.991	77
MXMCX	0.047	0.95	0.997	231	0.036	0.952	0.988	57	0.052	0.942	0.994	115
MXSCX	0.045	0.95	0.995	138	0.022	0.962	0.984	43	0.055	0.939	0.994	115
NALFX	0.046	0.946	0.992	86	0.032	0.948	0.98	34	0.0581	0.93	0.9881	58
PORIX	0.044	0.948	0.992	86	0.034	0.952	0.986	49	0.051	0.941	0.992	86
VICE	0.059	0.923	0.982	38	0.049	0.916	0.965	19	0.064	0.925	0.989	63
WSEFX	0.048	0.942	0.99	69	0.022	0.967	0.989	63	0.063	0.929	0.992	86

Note: For the whole sample, the subsamples before the GEFC and during the GEFC the GARCH coefficients were significant at 1 percent. Tests were run on the residuals to ensure that the outcomes of the GARCH model were robust. A VAR(p) framework was developed to identify the appropriate number of lags to be used on the model estimation.

3.4. Causal relationships

The causal analysis of short-term associations between conventional funds and the SRMF shows evidence of conflicting results. The results from the traditional Granger causality test (Table 5) identify very weak causal relationships between the three conventional funds and the SRMF. During the whole sample, the emerging growth fund impacted CSIEX and FSLEX. The LargeCap fund offered no evidence of causation effects during the period, while the VICE fund appeared to have a major impact on the SRMF with a causal effect on three of these funds (CAAPX, MXMCX, and MXSCX). The results for the period before the GEFC affected the global markets are quite surprising, as only causal relationships were found in the VICE Fund, which affected most of the funds with the exceptions of the FSLEX, MXSCX, PORIX, and WSEFX funds. After analyzing the impact of the GEFC, the results confirm the causal effects running from the VICE Fund to the SRMF with significant evidence of short-run impact in almost all the funds, with the only exception of NALXF, which was not affected by the performance of VICE. When the results are compared to the outcomes of the asymmetric models, consistency can be observed in the VICE Fund's impact on selected SRMF, and where the emerging and LargeCap funds do not appear to have a major causal effect. A remarkable outcome is the VICE Fund's dominance, which for the causality in mean (Table 6) shows evidence of causal effects on the NALFX, PORIX, and WSEFX. The subsamples looking at the causal effects before and during the GEFC period confirmed the predominance of the VICE Fund in terms of causal effects running toward the GCEQX and WSEFX before the GEFC, whereas the impact of VICE was more evident during the GEFC with a causal impact on six of the SRMF. These results confirm the relevance and predominance of the VICE Fund, which was the fund that recorded high levels of variation and was one of the funds that most quickly adjusted to the market shock. Identifying the VICE Fund as the one that seems to dictate the funds' behavior means that investors must closely monitor it, as it can help to understand

market dynamics. The dominance of the VICE fund could be linked by the fund investment objectives and closely associated to the assets in which this fund invest and that is dominated by investment in companies with significant involvement on activities that are considered as non-ethical. The investment approach of the VICE fund is defined as a long-term growth of capital that under normal market conditions is characterised by at least 80 percent of its net assets allocated to businesses in the alcoholic beverages, defense/aerospace, gaming and tobacco industries (Financial Times, 2022). Finally, the findings for the asymmetric causality in variance (Table 7) are quite remarkable, showing that the fifteen funds have bivariate causal effects in variance that are significant at the one percent level in most cases for the three samples analyzed. These findings are not surprising as the volatility illustrations show evidence of strong market alignment among the fifteen funds, which is confirmed by the asymmetric causal in variance findings, outcomes that suggest that socially responsible funds do not seem to offer *"especial"* rewards to their investors.

Table 5. Granger causality.

Mutual Fund Code	Whole Sample: 09-2002 to 06-2013			Before GFC: 09-2002 to 09-2007			During GFC: 09-2008 to 06-2013		
	EGROWTH	LARGE CAP	VICE	EGROWTH	LARGE CAP	VICE	EGROWTH	LARGECAP	VICE
ATAFX						←***			←***
CAAPX			←***			←***			←**
CSIEX	←***		→**			↔***			←**
DSEFX						↔***			←**
FLRUX						←*			←**
FSLEX	←***	→***	→**						←***
GCEQX						↔***			←**
MXMCX			↔***			←***			←**
MXSCX			←***						←**
NALFX		→***	→***			←*			
PORIX									←**
WSEFX			→***			→***			←**

Note: *Significance at 1%, **Significance at 5%, ***Significance at 10%, ← Evidence of causal effects running from the selected conventional fund to the selected SRMF, → Evidence of causal effects running from the selected SRMF to the selected conventional fund, ↔ Evidence of bidirectional causality between the selected SRMF and the selected conventional fund.

Table 6. Asymmetric causality in mean

Mutual Fund Code	Whole Sample: 09-2002 to 06-2013			Before GFC: 09-2002 to 09-2007			During GFC: 09-2008 to 06-2013		
	EGROWTH	LARGE CAP	VICE	EGROWTH	LARGE CAP	VICE	EGROWTH	LARGE CAP	VICE
ATAFX		→***		→***					→***
CAAPX		↔***		→***		→***			
CSIEX				→***			←***		↔***
DSEFX	↔*	→***		→***				↔***	→***
FLRUX				←***					
FSLEX	→***	→**						→***	→***
GCEQX		→**		→***		←***	←***		↔***

Continued on next page

Mutual Fund Code	Whole Sample: 09-2002 to 06-2013			Before GFC: 09-2002 to 09-2007			During GFC: 09-2008 to 06-2013		
	EGROWTH	LARGE CAP	VICE	EGROWTH	LARGE CAP	VICE	EGROWTH	LARGE CAP	VICE
MXMCX		→**		→***			→***	→**	←***
MXSCX		→***						→***	←**
NALFX			↔*	→**		→***		←**	↔**
PORIX		→***	↔**						↔**
WSEFX		→***	↔**			←***			

Note: Granger causes the first variable in mean if the test statistic is significant for some lags; vice versa if the test statistic is significant for some leads. The lag and lead coefficients, and the estimated statistics and p-values are not reported in this paper for the sake of brevity. Instead, the main results for causal relationships are highlighted with the appropriate arrows and level of significance to facilitate the interpretation and analysis of the main outcomes. The complete list of tables is available from the authors upon request. *Significance at 1%, **Significance at 5%, ***Significance at 10%, ← Evidence of causal effects running from the selected conventional fund to the selected SRMF, → Evidence of causal effects running from the selected SRMF to the selected conventional fund, ↔ Evidence of bidirectional causality between the selected SRMF and the selected conventional fund.

Table 7. Asymmetric causality in variance

Mutual Fund Code	Whole Sample: 09-2002 to 06-2013			Before GFC: 09-2002 to 09-2007			During GFC: 09-2008 to 06-2013		
	EGROWTH	LARGECAP	VICE	EGROWTH	LARGE CAP	VICE	EGROWTH	LARGE CAP	VICE
ATAFX	↔*	↔*	↔*	↔*	↔**	↔*	↔**	↔*	↔*
CAAPX	↔*	↔*	↔*	↔*	↔**	↔*	↔**	↔*	↔*
CSIEX	↔*	↔*	↔*	↔*	↔**	↔*	↔**	↔*	↔*
DSEFX	↔*	↔*	↔*	↔*	↔**	↔*	↔*	↔*	↔*
FLRUX	↔*	↔*	↔*	↔*	↔**	↔*	↔*	↔*	↔*
FSLEX	↔*	↔*	↔*	↔*	↔**	↔*	↔*	↔*	↔*
GCEQX	↔*	↔*	↔*	↔*	↔**	↔*	↔*	↔*	↔*
MXMCX	↔*	↔*	↔*	↔*	↔**	↔*	↔*	↔*	↔*
MXSCX	↔*	↔*	↔*	↔*	↔**	↔*	↔*	↔*	↔*
NALFX	↔*	↔*	↔*	↔*	↔**	↔*	↔*	↔*	↔**
PORIX	↔*	↔*	↔*	↔*	↔**	↔*	↔*	↔*	↔**
WSEFX	↔*	↔*	↔*	↔*	↔**	↔*	↔*	↔*	↔*

Note: Granger causes the first variable in variance if the test statistic is significant for some lags; vice versa if the test statistic is significant for some leads. The lag and lead coefficients, and the estimated statistics and p-values are not reported in this paper for the sake of brevity. Instead, the main results for causal relationships are highlighted with the appropriate arrows and level of significance to facilitate the interpretation and analysis of the main outcomes. The complete list of tables is available from the authors upon request. *Significance at 1%, **Significance at 5%, ***Significance at 10%, ← Evidence of causal effects running from the selected conventional fund to the selected SRMF, → Evidence of causal effects running from the selected SRMF to the selected conventional fund, ↔ Evidence of bidirectional causality between the selected SRMF and the selected conventional fund.

4. Conclusions

We have investigated how the sampled SRMF and the Vice Fund react in terms of volatility performance and persistence when exposed to abnormal times like the Global Economic and Financial Crisis. The core research findings show how the Vice Fund was associated with higher return levels that rewarded higher exposure to risk. Furthermore, the Vice Fund exposure to the crisis was quite limited as it was able to absorb the shock relatively quickly and remained quite unscathed to the market

shock compared to its counterparts. The results also show some evidence of predictability patterns among the studied funds as the Vice Fund has a dominant effect on the SRMF and as such the Vice Fund could be used to infer green funds behaviour. For example, the Global Economic and Financial Crisis led to an increase in volatility persistence as market uncertainty took longer to be absorbed by the funds. The research finding is not surprising as periods of crisis would create ambiguity behaviour and confusion among investors. However, it is quite remarkable that the riskiest fund (the Vice Fund) showed a significant level of resilience to the crisis, indicating that this fund could be used to counteract higher exposure to risks during times of sustained market uncertainty. In addition, the Vice Fund exhibit interesting characteristics that can be considered by investors in terms of diversifying their portfolio and the value of integrating investments defined by higher levels of risk and how they can contribute to the revenue generating goal while integrating less risky funds that act as a hedger and provide stability to the fund. Finally, it appears that the Vice Fund achieves higher levels of variation, and greater capacity to adapt and influence the behavior of its counterparts, confirming that the Vice fund exhibits higher levels of risk but also higher returns than those associated with SRMF in the short term that took longer to absorb the shock. The Vice Fund is doing a better job by adjusting to severe market disruptions and keeping a consistent performance than those exhibited by the studied green funds. There is no doubt that the interest in SRI strategies has increased over the years. Still, three key questions should be carefully considered because of this study: Should fund managers and investors monitor the Vice Fund behavior to predict future investment opportunities? And are the rewards offered by SRMF enough to justify the levels of risks associated with this type of investment? Is ethical commitment rewarding investors, or on the contrary, their gains are being curtailed and lack matching about risk exposure? These are questions to be answered and addressed in the current COVID-19 pandemic context, whereby the lessons learned from the 2008 economic and financial crisis could be of help. In addition, the ethical and societal matters associated with the vice fund and SRI strategies will indeed limit the future of both investors and companies who deal with this kind of funds thus need to be considered in order to avoid political cleavages and possible conflict scenarios Future research could explore the role that SRI could play as market hedge and to which extent investment portfolios could become more resilient to financial and economic instability. The analysis of individual funds performance is of interest as it helps to gain a better understanding of funds idiosyncrasies that is of critical importance in the context of portfolio diversification strategies.

Conflict of interest

All authors declare no conflicts of interest in this paper.

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