



Testing the animal spirits theory for ethical investments: further evidence from aggregated and disaggregated data

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Abstract

This study aims to test the animal spirits theory by Akerlof and Shiller (Animal spirits - how human psychology drives the economy, and why it matters for global capitalism? Princeton University Press) for ethical stock markets using Islamic and sustainable stock indexes during calm and crisis periods. This question helps determine whether ethical finance is driven more by its specific rules or determined by animal spirits. We used data covering January 1996–September 2021, which includes both calm periods and crisis periods (dot-com bubble of 2000, subprime crisis of 2007, global financial crisis of 2008–2009, and COVID-19 recession). Accordingly, we applied different time series tests, ran a quantile regression, and built an econometric framework to empirically test the animal spirits theory. We provide two key findings. First, investor sentiment and consumer confidence significantly affect the dynamics of both ethical stock returns, suggesting further evidence of animal spirits. This finding supports the assumption that investors' emotions and sentiments affect their behaviors and related feelings, for example, spontaneous instinctive that urge to action than inaction, optimism, and so forth, might help to apprehend some investment actions. Second, and interestingly, animal spirit effects enter asymmetrically and nonlinearly as their effects on ethical stock returns are time-varying and vary with the quantile under consideration.

Keywords Animal spirits · Ethical investments · Quantile regression · Nonlinearity

JEL Classification C22 · G15

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1 Introduction

Unlike conventional finance, ethical finance, also known as unconventional or alternative finance, refers to more moral, ethical, and responsible investment. The latter normally yields a moderate risk and involves investors who deal with less risk-taking positions. Hence, regulating ethical finance relies on specific rules, norms, and criteria, which aim to better control, evaluate ethical investment, regulate its related financial risk, and hedge the positions (Arouri et al., 2013).

Ethical finance includes at least two different forms of finance: Islamic finance, socially responsible, and sustainable finance. Islamic finance, which was presented in the 70 s as a way to capitalize on the benefits of the oil market in compliant Sharia text,¹ is estimated to value around 1000 billion US \$ and is present in more than 60 countries (Jawadi, Jawadi, et al., 2015b). Islamic finance is considered an ethical investment as it offers an alternative financial service governed by specific *Sharia* principles such as the prohibition of interest rate, the prohibition of speculation, the prohibition of uncertainty, and short selling (Jawadi et al., 2014). Their rules allow only *Sharia*-compliant financial products and fair and moral relationships between managers, shareholders, and debt holders, which repose the sharing principle of profits and losses and the deal with a high proportion of tangible assets (Jawadi, Idi Cheffou, et al., 2015a; Jawadi, Jawadi, et al., 2015b).

Alternatively, the second form of ethical investment refers to sustainable and socially responsible investments. The latter differs with the implementation of specific rules and measures regarding environmental, social, and governance (ESG) criteria. Particularly, these rules apply extra-financial criteria and use negative and positive screening. A negative screening aims to exclude sectors that have harmful effects on society, such as tobacco, alcohol, casino, pornography, and arms. Further, a positive screening applies environmental, social, and governance (ESG) criteria and considers more firms that have been engaged in sustainable and lasting development (Jawadi et al., 2022).

Hence, convergence or divergence between conventional and Islamic finance has been questioned by several authors (Arouri et al., 2013; Beck et al., 2013; Jawadi, Jawadi, et al., 2015b; Khan, 2010) and has yielded a real challenge. Indeed, while some authors showed that conventional and ethical finance are only marginally different, other scholars defended the particularity of the business model for ethical investments. This challenge has simultaneously considered the real difference between conventional and ethical finance and the specific drivers of ethical investments. However, the rules specific to ethical investments and their fundamentals do not appear sufficient enough to explain the dynamics of their returns. Rather, the evolution of ethical finance appears to deal with trends driven by market opinions and animal spirits.

Animal spirits were introduced many years ago in Philosophy in the works of Descartes and Newton. However, animal spirits were introduced in Economics by Keynes (1936) to explain how emotions and sentiments affect the behavior of human persons (consumption, saving, investment, and so on). Particularly, Keynes (1936) considers that some feelings related, for example, to spontaneous instinctive that urge to action than inaction, optimism, etc., might help to apprehend some investment actions. Akerlof and Shiller (2010) recently considered the theory of animal spirits to characterize the dynamics of stock markets, particularly during the recent global financial crisis (2008–2009).

Regarding this theory of animal spirits, Akerlof and Shiller (2010) suggested that an agent's confidence might be instrumental in driving their behaviors. When considering ethical

¹ The *Sharia* text is the basis of the Islamic Law.

finance, one can assume that if investors (e.g., of ethical projects) trust the market and the ethical financial system, they might buy and decide to invest strongly and put aside their apprehension; if not, they will liquidate their portfolios and be less active. This intuition, which is our central assumption, if confirmed, suggests that ethical finance might be driven by more animal spirits than by market fundamentals.

This study aims to investigate the theory of animal spirits in line with Akerlof and Shiller (2010) for the two main classes of ethical finance in the US stock market: Islamic finance and sustainable investment. This is relevant, particularly, to check whether the dynamics of ethical finance are benchmarked on its specific rules and fundamentals, which might suggest the robustness and independence of its own business model, or rather driven by market opinions, collective mimetic behaviors, and simple animal spirits.

To empirically test the assumption of animal spirits for ethical investments, we investigate the relationship between ethical finance and confidence. A significant relationship between confidence and ethical finance might validate this theory, while the absence of a significant impact of confidence on ethical finance can be seen as a rejection of the theory by Akerlof and Shiller's (2010).

In the literature, confidence appears instrumental for consumers and investors, further supporting the animal spirit theory. Indeed, Matsusaka and Sbordone (1995) and Utaka (2003) showed a significant causality between the Gross Domestic production (GDP) and confidence. In fact, retroactive effects between consumption and confidence push consumers to consume more, firms to invest and produce more, and, therefore, the GDP to increase. Berg and Bergstrom (1996) also found evidence of a significant correlation between confidence and household consumption. Akerlof and Shiller (2010) showed that animal spirits and investor confidence explain an important part of financial asset price dynamics. Additionally, confidence shocks may cause structural breaks and switching regimes in stock price dynamics (Bourghelle et al., 2022). Recently, Luzzetti and Ohanian (2010) used historical data to estimate the impact of animal spirits and found evidence of animal spirits on investment decisions, particularly during the glorious thirty. Moreover, Lainé (2014) tested the theory of animal spirits and found evidence of significant effects of instincts, proclivities, and emotions on the financial decisions taken by human behavior. Indeed, he showed that prices are driven more by spontaneous optimism than by mathematical expectations. De Grauwe and Macchiarelli (2015) also introduced a new behavioral macroeconomic model that includes a banking sector and for which agents have limited cognitive abilities. The authors showed that their model can endogenously yield self-fulfilling actions of optimism and pessimism and therefore animal spirits. The authors justified these animal spirits by the existence of banks, which intensify these movements, creating a greater scope for booms and busts. Interestingly, the authors showed that the actions of central banks might impact the equity ratios of banks and therefore control the importance of animal spirits over the business cycle.

Otherwise, several recent studies have focused on different forms of ethical finance (responsible finance, sustainable finance, Islamic finance) with references to macroeconomic and financial drivers. For example, Ben Ameur et al. (2018) analyzed financial performance for both conventional and Islamic stock markets and pointed out further measurement errors in traditional performance models. According to the authors, taking into account extreme values and systemic risk would improve the traditional performance models. Jawadi et al. (2019) developed a nonlinear model to estimate the market beta for sustainable investment. They have also improved the volatility modeling while exploring asymmetry, regime-switching, and nonlinearity with reference to the market risk as the main driver. Their model does not include behavioral variables. Recently, Kumar et al. (2022) focused on sustainable finance and proposed several suggestions/recommendations for future sustainable finance research,

while suggesting developing innovative sustainable financing instruments, improving sustainable finance, thinking morale values, and so forth.

It appears that the animal spirit hypothesis has not yet been tested widely to explain the dynamics of ethical finance and its development. Our study contributes to the related literature by proposing, to our knowledge, a first essay to test whether animal spirits drive ethical finance or not. Therefore, we contribute by quantifying the animal spirits in the amplification of ethical finance over the last decade. Tackling this question would also be helpful to better forecast the dynamics of ethical stock indexes taking into account the episodes of investor's emotions and sentiments.

To this end, among the five most well-known animal spirit's forms discussed by Akerlof and Shiller (2010): confidence, fairness and the setting of wages and prices and fairness, corruption and antisocial behavior, the money illusion, and the stories,² we test the first theory/form of animal spirits for ethical finance. Accordingly, we investigate the impact of confidence on the stock returns of two classes of ethical investments: Islamic stock market and sustainable investments. Interestingly, to double check the robustness of our specification and results, we also rely on disaggregated data to better examine the relationship between ethical finance investments and the main components of confidence, as listed by Michigan University. This is relevant to enable us to better specify the sensitivity of ethical finance to the distinct components of this form of animal spirits (confidence).

This study makes a novel contribution to the related literature. Indeed, in the operations of modern finance, portfolio management is one of the keys to investment survival. Ethical finance serves as good benchmarks for portfolio diversification, but they have not been tested against some well-known theories, particularly the animal spirits theory. Given the relevance of financial crises today (such as that prompted by the COVID-19 pandemic) and its importance in global stock markets, this study is definitely pertinent in today's scenario. It contributes through its investigation of the impact of confidence on the stock returns on Islamic stock market and sustainable investments and the specification of the drivers of these investments. Our main findings point to further evidence of animal spirits when considering ethical investments suggesting their relevance and showing that fundamentals of ethical finance are not enough to apprehend the dynamics of these ethical stock indexes.

The remainder of this paper proceeds as follows. The data are presented in Sect. 2. Section 3 discusses preliminary results. Section 4 discusses the main empirical results and provides some economic and managerial implications. The final section concludes the study.

2 Data

Our data includes two major US ethical stock indexes: The Dow Jones Islamic Index market US (DJIM) and the Dow Jones Sustainability US Index (DJISU), and their respective transaction volumes. We also considered the conventional Dow Jones Industrial Average index and its transaction volume.³ Data are in monthly intervals, covering January 1996–September 2021, and contain both calm and crises periods (dot-com bubble of 2000, subprime crisis of 2007, global financial crisis of 2008–2009, COVID-19 recession). This is particularly relevant because investors' confidence and market opinions have been time-varying with regard

² See Akerlof and Shiller (2010) for more details about these animal spirits.

³ We thank an anonymous referee for this suggestion. Results of the conventional stock index are not reported in detail, as this study focuses more on the ethical indexes. However, the results are available upon request.

to the market state and the occurrence of these crises. Data on conventional and ethical stock indexes and their trading volumes were obtained from Bloomberg.

As a proxy for market opinions, we collected the VIX index from Fed St Louis, which captures both investor sentiment and anxiety. We also collected the index of consumer sentiment computed by Michigan University and noted the consumer confidence/sentiment index (CSI). CSI results from a survey aiming to measure the degree of optimism or pessimism of householders and consumers on their expected financial situation. Excessive optimism is believed to push consumers to spend more and therefore stimulate the economy, while extreme pessimism can reduce their consumption and provoke further recession. Particularly, increased CSI suggests a higher perception of the current business, income, and employment conditions for the next 6 months. For example, when this index is higher than the threshold of 100, consumers appear more confident than they were in 1985, and vice versa.

Finally, in addition to the aggregated data related to consumer sentiment (CSI), we relied on more disaggregated data using three other specific indexes. First, we used the Business Condition Index for the next 12 months (BC12 index), which provides information on the future development of businesses. For example, when this index is high, it suggests that companies would invest and spend more, yielding a higher future payoff. Second, we use the expected inflation index (noted exp_inf), which captures investors' expectations about future inflation and the action of the central bank. For example, an increase in expected inflation may push investors to expect a rather less expansive monetary policy. Third, we used the personal finance expected (PFE) index, which captures the expectations of consumers of their income or finance in the future. Interestingly, these three disaggregate indexes might be seen as the major components of the confidence index and are useful to better check the further drivers of animal spirits for ethical investments.

3 Preliminary analysis

First, we focus on the dynamics of the two ethical stock indexes, the VIX and CSI, to provide an overview of their evolution over time. We plotted the dynamics of these variables in Fig. 1 that shows two interesting results. On the one hand, both ethical indexes show similar dynamics and have been continuously increasing since the aftermath of the 2008 global financial crisis despite the short braking induced by COVID-19. On the other hand, while the VIX index appears to be negatively correlated with the ethical indexes, the latter appears to be more supported by the dynamics of the consumer confidence index, at least since the aftermath of the 2008 global financial crisis.

Second, we check the stationarity of the time series under consideration. Our analysis shows that the two ethical stock indexes, the conventional stock index and the consumer confidence index are not stationary in level but stationary in first difference, suggesting that they are integrated in one order, while the series of logarithms of the VIX index and trading volume series are stationary.⁴ To better characterize these time series, we compute and report their main statistical properties (Table 1). From Table 1, we note that the ethical stock indexes show further evidence of close levels of return in mean and volatility. Their volatilities are slightly higher than the volatility of the conventional stock index. Further, distributions are asymmetrical and non-normal. The negativity of skewness coefficients is an indication of nonlinearity and asymmetry in the data. This is more relevant when analyzing the significant differences between the returns in the mean and median values. Furthermore, confidence and

⁴ We do not report the results of unit root tests to save space but results are available upon request.

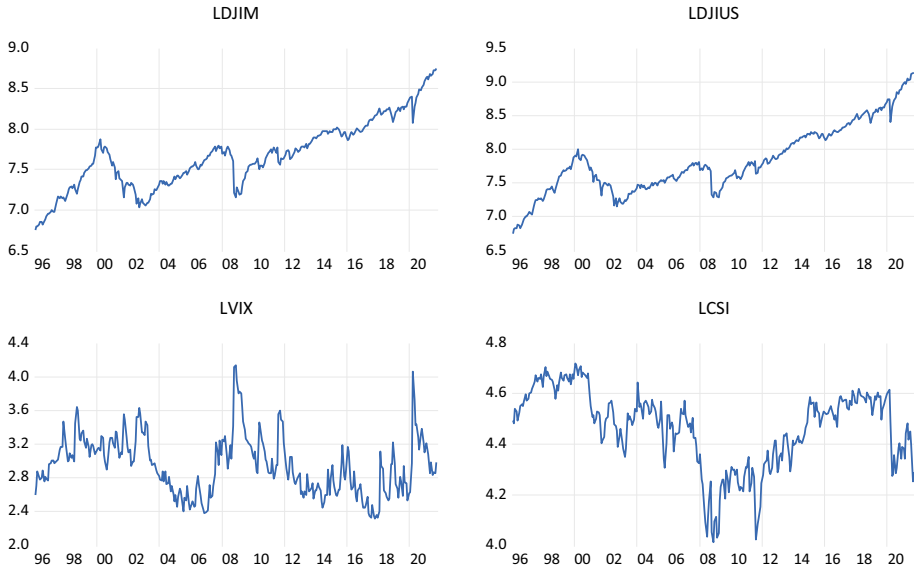


Fig. 1 Dynamics of ethical indexes versus consumer confidence/sentiment indexes in logarithm *Note* LDJIM and LDJIUS indicate the logarithm of Islamic and sustainable stock indexes respectively. LVIX and LCSJ refer to the logarithms of the VIX index and the Confidence Sentiment index of Michigan University respectively

Table 1 Main descriptive statistics and normality test

	RDJIM	RDJIUS	RDJI	DLCSJ	LVIX
Mean	0.0064	0.0077	0.0061	− 0.0006	2.9481
Median	0.0133	0.0152	0.0119	0.0020	2.9480
Maximum	0.2071	0.2302	0.2345	0.1408	4.1378
Minimum	− 0.3879	− 0.3462	− 0.4134	− 0.2158	2.3150
Std. Dev	0.0547	0.0561	0.0544	0.0494	0.3463
Skewness	− 2.2297	− 1.9188	− 2.339	− 0.6413	0.5646
Kurtosis	16.141	13.646	18.732	5.1281	3.3269
Jarque–Bera	2471.4	1643.7	3457.4	79.237	17.741
Probability	0.0000	0.0000	0.0000	0.0000	0.0001

RDJIM and RDJIUS denote the stock returns of Islamic and sustainable markets, respectively. RDJI denotes the stock return of the conventional stock index. DLCSJ refers to changes in consumer confidence, whereas LVIX is a sentiment index. Jarque–Bera denotes the statistics of Jarque–Bera normality test.

sentiment indexes show further evidence of high volatility, suggesting that consumer confidence experiences significant changes. This result might indicate that investors’ emotions are also subject to time-variations with regard to market episodes and states.

Fourth, we computed the unconditional correlations between the returns of two ethical stock markets, the sentiment index (LVIX), and the consumer confidence index (Table 2). Accordingly, we noted a strong positive correlation between the two ethical stock indexes. We also highlighted a positive connection between the changes in the confidence index and

Table 2 Unconditional correlation matrix (whole sample)

	RDJIS	RDJIM	DLCSI	LVIX
RDJIS	1			
RDJIM	0.9725	1		
DLCSI	0.2341	0.2307	1	
LVIX	− 0.2542	− 0.2650	− 0.1507	1

ethical stock returns, while we found a negative effect of the VIX index on these returns. As for the conventional stock index, we also found that it is positively correlated with the confidence index, while it is negatively correlated with the sentiment index (LVIX).

To better characterize this interaction between the ethical stock indexes and sentiment/confidence index, we re-computed these unconditional correlations during crisis and turbulent times: global financial crisis versus COVID-19 recession (Tables 3 and 4). We found that while the VIX still has had a negative effect on conventional and ethical stock returns even during the 2008 global financial crisis and the COVID-19 outbreak, the confidence sentiment index was positively correlated with the two ethical stock returns only during the global financial crisis. In addition, unconditional correlations have significantly increased during the global financial crisis. Overall, the identification of further connections between stock returns and the confidence index might highlight evidence of animal spirits, which suggests the important role played by animal spirits in driving the dynamics of ethical stock returns. This suggests that these ethical investments are sensitive and even driven by some forms of animal spirits: investor confidence and psychology forces, which is in line with Akerlof and Shiller (2010) and related references. Interestingly, these animal spirits seem to be more activate during turbulent times.

Table 3 Unconditional correlation matrix (global financial crisis: Jan 2007–December 2009)

	RDJIUS	RDJIM	DLCSI	LVIX
RDJIUS	1			
RDJIM	0.9717	1		
DLCSI	0.4797	0.4706	1	
LVIX	− 0.3749	− 0.3442	− 0.0594	1

Table 4 Unconditional correlation matrix (COVID-19: Jan 2020–September 2021)

	RDJIUS	RDJIM	DLCSI	LVIX
RDJIUS	1			
RDJIM	0.9922	1		
DLCSI	0.0044	0.0224	1	
LVIX	− 0.3302	− 0.3144	− 0.3456	1

To better characterize these interactions between ethical stock returns and sentiment/confidence indexes, in Tables 5, 6, and 7, we conduct a Granger causality test and report the main results.

Accordingly, when considering the whole sample, we can observe that neither LVIX nor the sentiment/confidence index does Granger cause ethical stock indexes. However, during the 2008–2009 global financial crisis, the confidence index had a Granger causality effect

Table 5 Unconditional correlation matrix (whole sample)

Null hypothesis	F-statistic	Prob
RDJIM does not Granger cause RDJIUS	7.3925	0.0007 ***
RDJIUS does not Granger cause RDJIM	7.1131	0.0010 ***
DLCSI does not Granger cause RDJIUS	0.1790	0.8361
RDJIUS does not Granger cause DLCSI	8.8297	0.0002 ***
LVIX does not Granger cause RDJIUS	1.4789	0.2295
RDJIUS does not Granger cause LVIX	1.9651	0.1419
DLCSI does not Granger cause RDJIM	0.3137	0.7310
RDJIM does not Granger cause DLCSI	7.3752	0.0007 ***
LVIX does not Granger cause RDJIM	1.0487	0.3517
RDJIM does not Granger cause LVIX	1.5471	0.2145
LVIX does not Granger cause DLCSI	11.196	2.E–05 ***
DLCSI does not Granger cause LVIX	0.2908	0.7478

***, **, and * denote the rejection of the null hypothesis of no causality at the 1%, 5%, and 10% levels, respectively

The bold values denote significant results

Table 6 Unconditional correlation matrix (global financial crisis: Jan 2007–December 2009)

Null hypothesis	F-Statistic	Prob
RDJIM does not Granger cause RDJIUS	5.1795	0.0115 ***
RDJIUS does not Granger cause RDJIM	3.4145	0.0457
DLCSI does not Granger cause RDJIUS	1.5894	0.2202
RDJIUS does not Granger cause DLCSI	1.8658	0.1717
LVIX does not Granger cause RDJIUS	0.4267	0.6564
RDJIUS does not Granger cause LVIX	0.2425	0.7861
DLCSI does not Granger cause RDJIM	2.2759	0.1196
RDJIM does not Granger cause DLCSI	1.4690	0.2457
LVIX does not Granger cause RDJIM	0.2261	0.7989
RDJIM does not Granger cause LVIX	0.4492	0.6422
LVIX does not Granger cause DLCSI	1.3171	0.2825
DLCSI does not Granger cause LVIX	2.2306	0.1244

***, **, and * denote the rejection of the null hypothesis of no causality at the 1%, 5%, and 10% levels, respectively

The bold values denote significant results

Table 7 Results of Granger causality test (COVID-19: Jan 2020–September 2021)

Null hypothesis	F-statistic	Prob
RDJIM does not Granger cause RDJIUS	0.5943	0.5637
RDJIUS does not Granger cause RDJIM	0.6185	0.5511
DLCSI does not Granger cause RDJIUS	0.3330	0.7216
RDJIUS does not Granger cause DLCSI	3.0938	0.0731*
LVIX does not Granger cause RDJIUS	4.5364	0.0275**
RDJIUS does not Granger cause LVIX	2.2869	0.1338
DLCSI does not Granger cause RDJIM	0.4046	0.6738
RDJIM does not Granger cause DLCSI	3.6093	0.0508*
LVIX does not Granger cause RDJIM	3.9567	0.0402**
RDJIM does not Granger cause LVIX	1.6489	0.2233
LVIX does not Granger cause DLCSI	5.1482	0.0188***
DLCSI does not Granger cause LVIX	0.6858	0.5179

***, **, and * denote the rejection of the null hypothesis of no causality at the 1%, 5%, and 10% levels, respectively

The bold values denote significant results

on the Islamic stock index at the 11% statistical level. Furthermore, we show that during the COVID-19 outbreak, the LVIX Granger causes both ethical stock markets. As for the conventional stock index, the null hypothesis of no-Granger causality is not rejected.

Overall, our preliminary results do not reject the assumption of animal spirits in ethical investment. Further, we provide further evidence to support the time-varying effect of the sentiment index on ethical stock returns. Moreover, it seems that investor's sentiment and confidence and therefore animal spirits might play, during crisis periods, an instrumental role in driving the dynamics of ethical stock indexes.

4 Empirical analysis

To double check the effects of animal spirits on ethical stock returns, we estimate the dynamics of ethical and conventional stock returns while assessing the impact of the VIX and consumer sentiment indexes. Interestingly, we propose a flexible and time-varying econometric framework enabling us to capture the linear and nonlinear effects of the sentiment effect on ethical stock returns. Particularly, we performed a nonlinear regression and we specify a quantile regression enabling us to measure the possible impact of confidence indices on the ethical stock returns not only around the mean but also around the quantiles. This framework enables us to capture the effects of animal spirits per quantile according to the market state and contains two advantages. First, unlike a linear model, this specification allows animal spirits to enter nonlinearly and capture the asymmetry characterizing our data (Table 1). Second, even nonlinear, this model captures different types and forms of nonlinearity, and running them together enables us to capture the main forms of nonlinearity in the relationship between confidence (animal spirits) and ethical stock indexes.

4.1 Quantile regression

To model the relationship between ethical stock returns and changes in confidence sentiment, we specify a quantile regression in line with Koenker and Hallock (2001). This specification is justified by the rejection of asymmetry and distribution of stock returns (Table 1). Furthermore, this specification allows us to characterize this relationship between stock returns and sentiment/confidence differently when considering several quantiles. Indeed, our quantile specification enables us to not only test the assumption of animal spirits but also check whether the impact of the sentiment/confidence index on ethical stock returns is stronger (or weaker) when ethical stock returns are unusually high (or low). Unlike a standard time series approach, this methodology has the advantage to take into account further extreme values in the data and it enables the distribution to vary per quantile. This offers more flexibility to our modeling.

We specify the following quantile model:

$$\begin{aligned}
 q_\alpha(R_t^i \setminus \Omega_t) &= \Phi_{1\alpha} DLC SI_t + \Phi_{2\alpha} LVIX_t + \Phi_{3\alpha} LV_t + \varepsilon_t, \quad \alpha \in [0, 1] \\
 \text{where : } q_\alpha(R_t^i \setminus \Omega_t) &\text{ is the conditional quantile of ethic stock return,} \\
 R_t^i &\text{ denotes the ethic stock return,} \\
 \Phi_{1\alpha}, \Phi_{2\alpha} \text{ and } \Phi_{3\alpha} &\text{ are the slope coefficients that vary per quantile,} \\
 \Omega_t &\text{ denotes the information available on } t, \quad LV_t \text{ denotes the trading volume,} \\
 \varepsilon_t &\text{ is an error - term.}
 \end{aligned}
 \tag{1}$$

Our quantile regression allows us to provide an estimation of a time-varying distribution of ethical stock returns. This can help us test the hypothesis of animal spirits in a flexible econometric framework that reproduces the dynamics of the relationship between sentiment and stock returns, not only around the mean but also at the tails of the ethical stock return distributions.

In practice, the above parameters are estimated while replacing the conventional quadratic loss function with the so-called tick loss function as follows:

$$L_\alpha(e_{t+1}) = (\alpha - 1)\mathbf{1}\{e_{t+1} < 0\}e_{t+1},
 \tag{2}$$

where $\varepsilon_t = R_t^i - \widehat{q}_{\alpha,t}$ is the forecast error, $\widehat{q}_{\alpha,t} = q_\alpha(R_t^i \setminus \Omega_t)$ is the conditional quantile forecast computed at time t , and $\mathbf{1}\{\cdot\}$ is the indicator function.

As per Koenker and Hallock (2001), we use a rank test to compute the related confidence intervals, while the first-order condition associated with minimizing the expected value of (2) with respect to the forecast, $\widehat{q}_{\alpha,t}$, is the α -quantile of the return distribution. This implies that the optimal forecast corresponds to the conditional quantile, $\widehat{q}_{\alpha,t} = F_\varepsilon^{-1}(\alpha)$, where F_t denotes the conditional distribution function of the ethical stock returns.

We first estimated the quantile regression (Eq. 1) for both ethical stock indexes as well as the conventional stock index and then we reported the main results for the Islamic stock index (Table 8) and the sustainable stock index (Table 9).

Our OLS estimation, for which the standard errors and covariance are robust to heteroscedasticity and are provided using Bartlett Kernel and Newey-West approaches, shows that changes in the confidence and the VIX indexes have a significant effect on Islamic stock returns (Table 8). Particularly, while an increase in consumer confidence has a positive impact on Islamic stock returns, an increase in the VIX index (investor anxiety) negatively impacts Islamic stock returns. Furthermore, when considering quantile regression, we find that both the confidence and sentiment indexes have significant effects on Islamic stock returns only

Table 8 Results of quantile regression for the Islamic stock index

Quantile	DLCSI	LVIX	lvdjim	Constant	R ²	QLR test (<i>p</i> -value)
2.5%	0.671***	− 0.134***	0.002	0.227	0.601	0.000***
25%	0.095	− 0.072***	0.010	− 0.075	0.123	0.000***
50%	− 0.005	− 0.020	0.011	− 0.208	0.022	0.150
75%	0.094	0.017	0.009	− 0.238	0.038	0.039**
97.5%	− 0.115	0.075***	0.044***	− 1.21***	0.288	0.000***
OLS	0.183***	− 0.044***	0.011	− 0.138	0.115	−

*, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. *lvdjim* denotes the trading volume in logarithm. R² denotes the adjusted R-squared value. The QLR test denotes the *p*-value of the Quasi Likelihood ratio test of Koenker and Machado (1999)

Table 9 Results of quantile regression for the sustainable stock index

Quantile	DLCSI	LVIX	lvdjius	Constant	R ²	QLR test (<i>p</i> -value)
2.5%	0.352	− 0.166***	− 0.029	1.011	0.545	0.000***
25%	0.094	− 0.070**	− 0.017	0.556	0.147	0.000***
50%	− 0.144	− 0.018	− 0.010	0.278	0.028	0.249
75%	− 0.132	0.025	− 0.004	0.070	0.021	0.473
97.5%	− 0.308	0.076***	0.031	− 0.806*	0.474	0.000***
OLS	− 0.129	− 0.031	− 0.025*	0.641**	0.074	−

*, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. *lvdjius* denotes the trading volume in logarithm. R² denotes the adjusted R-squared value. The QLR test denotes the *p*-value of the Quasi Likelihood ratio test of Koenker and Machado (1999)

for low quantiles (2.5%). This result is quite relevant, suggesting that for low quantiles, the dynamics of Islamic stock returns are driven more by animal spirits and investors' sentiment than by their own fundamentals and rules of Islamic Law. However, when considering the highest quantiles, the effect of trading transactions becomes positive and significant. Interestingly, the slope coefficient for the confidence index is highest for the low quantile, suggesting that the animal spirits are actively more significant when the Islamic stock returns are at their low distribution tail. This result means that the Islamic stock market is more sensitive to the consumer confidence index and, consequently, to animal spirits during periods of low returns.

Finally, according to the quasi-likelihood ratio tests, the estimators of the quantile regressions are valid, as all slope coefficients at all quantiles are statistically different from zero. Overall, our findings point to the existence of time variation and asymmetry in animal spirit effects on the dynamics of Islamic stock returns.

Figure 2 plots the dynamics of the quantile process estimates to better characterize this time variation. Interestingly, the graph related to the slope of the confidence index confirms this time-variation while showing that confidence has had a positive and significant impact on the dynamics of stock returns for low quantiles, while the effect is close to zero for middle and high quantiles. Furthermore, the VIX has negatively impacted on the dynamics of Islamic returns for low quantiles, while it becomes positive for high quantiles. Overall, this finding confirms the time-varying impact of animal spirits on Islamic stock returns.

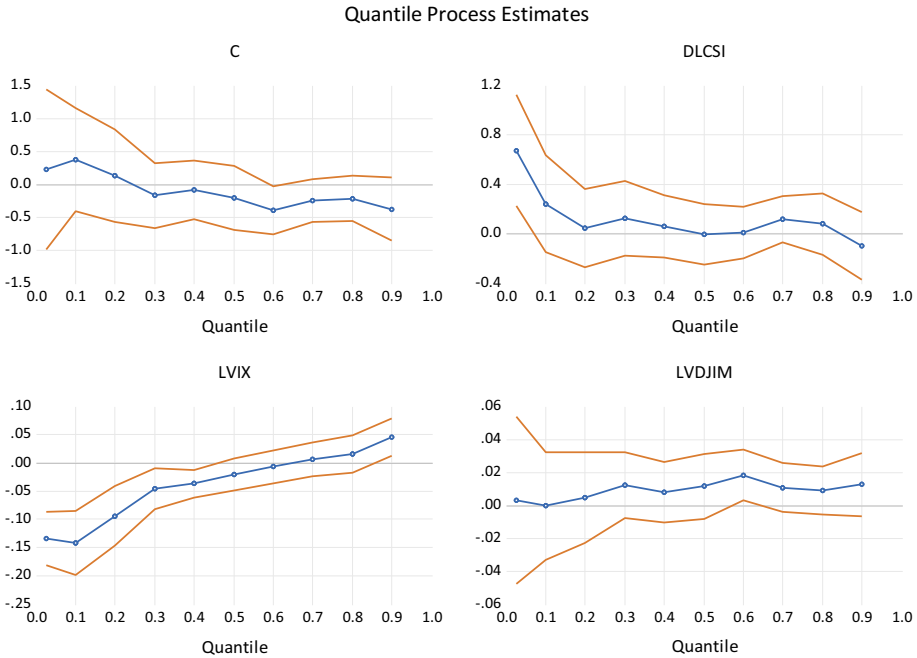


Fig. 2 Analysis of the quantile process estimates

Considering the sustainable stock index (Table 9 and Fig. 3), we identify similar effects of sentiment and confidence on sustainable stock returns as for Islamic stock returns, but they are more pronounced. Particularly, while we find evidence of animal spirits impacting sustainable stock returns around the low quantile, the size of this effect is more important for sustainable than Islamic stock returns. However, the negative impact of the VIX is higher for sustainable than for Islamic stock returns.

Overall, our analysis of quantile regressions points also to the time-varying and asymmetrical effects of the sentiment and confidence indexes on both ethical stock returns. This finding suggests the presence of significant effects of animal spirits on ethical stock price data. This result is quite relevant as it suggests that the consideration of animal spirits might help to better analyze and forecast the dynamics of ethical stock returns. Furthermore, validating the quantile regression also implies that, according to the level of the stock return, ethical indexes might be driven by their own fundamentals or by exogenous strengths associated with animal spirits.

As for the conventional stock index, confidence index has a linear, significant and positive effect, while the LVIX has a negative impact on the US conventional stock returns. These effects disappear when considering the quantile regression, suggesting less evidence of time variation in animal spirits for the US conventional index.

However, it is important to mention that the data related to the consumer sentiment index introduced by the University of Michigan is an aggregate index and that its construction relies on a survey concerning different aspects of the householder. For a matter of robustness to double check our findings, we re-tested the assumption of Animal Spirits using rather disaggregated data.

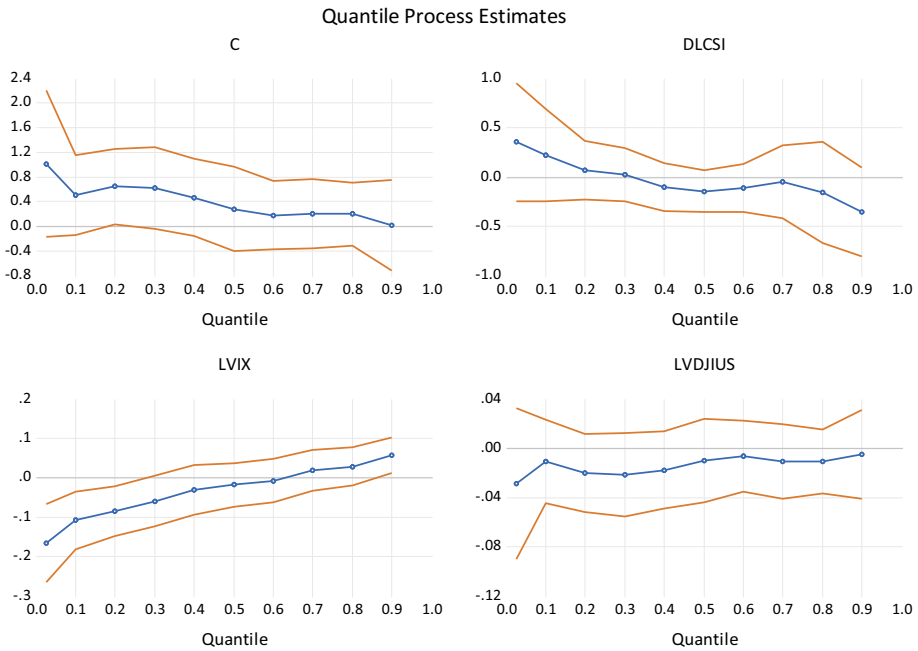


Fig. 3 Analysis of the quantile process estimates

4.2 Robustness tests

To double check our findings and to specify the real drivers of the animal spirits, we re-ran the above quantile regressions using disaggregated data rather than aggregate data. Mostly, we re-estimated our model (Eq. 1) while considering—rather than the aggregate measure of the consumer confidence index—three proxies associated with the Michigan University index. First, we used the personal finance expected (*PFE*) index, which provides the expectations of householders on their future financial income and situation. Second, we used the business condition’s 12 month’s index (hereafter referred to as *BC12*), which captures the expectations of consumers and investors about the financial conditions for their investment during the 12 future months. Third, we used the expected inflation index (*ex_inf*), which assesses the consumer’s perception of future inflation. Interestingly, considering these three indexes, we capture different aspects related to consumers’ perceptions of current and future economic and financial conditions for investment and business. We also apprehend further optimism or pessimism on payoff from investment.

Before moving to estimate the regression with disaggregate data, we checked for the presence of a unit root in the three indexes above. Accordingly, while the *PFE* index is $I(1)$, both the *ex_inf* index and *BC12* index are stationary. Therefore, we introduced the two latter indexes in level (the index *BC12* was logarithmically transformed using the Box-Cox transformation to reduce its variance (hereafter referred to as the *lBC12* index), while we introduced the *PFE* index in its first difference (hereafter referred to as the *dl6PFE* index).

Accordingly, our extended quantile regression with disaggregate data is specified as follows:

$$q_\alpha \left(R_t^i \setminus \Omega_t \right) = \Phi_{1\alpha} DLpf e_t + \Phi_{2\alpha} LBC12_t + \Phi_{3\alpha} \exp_inf_t + \Phi_{4\alpha} LVIX_t + \Phi_{5\alpha} LV_t + \varepsilon_t, \quad \alpha \in [0, 1]$$

where : $q_\alpha \left(R_t^i \setminus \Omega_t \right)$ is the conditional quantile of ethic stock return,

R_t^i denotes the ethic stock return,

$\Phi_{1\alpha}$, $\Phi_{2\alpha}$, $\Phi_{3\alpha}$, $\Phi_{4\alpha}$ and $\Phi_{5\alpha}$ are the slope coefficients that vary per quantile,

Ω_t denotes the information available on t ,

LV_t is the trading volume, $DLpf e_t$ denotes changes in expected personal finance,

$LBC12_t$ is the index of business conditions in log arithm,

\exp_inf_t measures expected inflation, ε_t is an error-term.

(3)

Tables 10 and 11 report the main results of the estimation of (3).

Table 10 provides some interesting results. First, expected personal finance has a positive and significant effect on Islamic stock returns, which is higher for low quantiles. Second, both expected inflation and business condition indexes have negative, time-varying, and significant effects on Islamic stock returns. Finally, information provided by trading volume seems to drive stock returns only for high quantiles. Overall, these findings confirm our previous results, wherein animal spirits appear to drive investment in Islamic stocks. Particularly, from Fig. 4, we note that while the increase in LVIX (therefore, investor anxiety) always negatively impacts Islamic stock returns, the effect of expected personal finance is not only time-varying but also alternates between positive and negative according to the quantile level of the distribution tail.

On the sustainable stock index, based on our results (Table 11), we do not reject the hypothesis of animal spirits. Changes in investor anxiety captured by the VIX have a negative and significant effect on sustainable stock returns. Furthermore, the latter is also sensitive to changes in business conditions and trading volume is not significant, unlike in the Islamic stock index. Finally, Fig. 5 also highlights the time-varying effects on the perception of expected personal finance that varies with the quantile under consideration.

Overall, our robustness tests confirm previous empirical analysis wherein significant animal spirits characterize both the Islamic stock market and sustainable investments. Indeed, both investor sentiment and consumer confidence appear to drive the dynamics of both ethical stock indexes. This result, which is in line with Akerlof and Shiller (2010) and related literature, is relevant and implies that according to the level of stock returns and in particular to the low quantile related to the distribution tails of these returns, investors might be guided more by animal spirits than by ethical markets fundamentals.

These findings are relevant and might have different economic and managerial implications. They confirm the relative difference between US conventional stock returns and ethical stock returns and also point to the relevance of animal spirits. Investors when focusing or preferring ethical investments to hedge their portfolios, reduce risk positions and diversify their portfolios, they behave less in line with their rationality principle than with their animal spirits. In particular, their confidence levels and the degree of their anxiety do not only play a key role but also might be revised according to the level of stock returns and therefore market state. Accordingly, our findings show the importance of multifactor approaches and suggest the importance of considering behavioral factors and animal spirits to better explain the underlying forces of ethical investments and forecast their future dynamics.

5 Conclusion

This study investigates the dynamics of two ethical stock indexes: Islamic and sustainable stock indexes. In particular, we question whether the animal spirits introduced by Keynes

Table 10 Results of quantile regression for the Islamic Stock index using disaggregate data

Quantile	DLpfe	LBC12	Vexp_inf	LVIX	Lvdjmm	Constant	R ²	QLR test (p-value)
2.5%	0.311**	- 0.124*	- 1.879	- 0.251****	- 0.026	1.891**	0.573	0.000****
25%	0.023	- 0.061**	- 1.936*	- 0.093****	0.010	0.338	0.179	0.000****
50%	- 0.027	- 0.075****	- 2.278**	- 0.068****	0.025****	0.003	0.080	0.001****
75%	0.135	- 0.078****	1.231	- 0.037*	0.018**	0.072	0.086	0.001****
97.5%	0.0268	- 0.135*	- 1.727	0.006	0.053**	- 0.575	0.279	0.000****
OLS	0.234*	- 0.113****	- 3.090**	- 0.116****	0.028**	0.246	0.246	-

*, **, and **** denote significance at the 10%, 5%, and 1% levels, respectively. Lvdjmm denotes the trading volume in logarithm. R² denotes the adjusted R-squared value. The QLR test denotes the p-value of the Quasi Likelihood ratio test of Koenker and Machado (1999). DLpfe denotes changes in expected personal finance, LBC12 is the index related to business conditions, and Vexp_inf denotes the value of the expected inflation rate

Table 11 Results of quantile regression for the sustainable stock index using disaggregate data

Quantile	DLpfe	LBC12	Vexp_inf	LVIX	Lvdjitus	Constant	R ²	QLR test (<i>p</i> -value)
2.5%	-0.045	-0.003	4.33**	-0.186***	-0.024	0.872	0.600	0.000***
25%	0.011	-0.073**	0.353	-0.083***	-0.008	0.727	0.207	0.000***
50%	0.089	-0.105***	-1.207	-0.042*	0.009	0.444	0.080	0.061**
75%	0.264*	-0.073***	-0.679	-0.009	-0.013	0.710**	0.075	0.110
97.5%	0.335	-0.154	-0.489	0.053	-0.007	0.827	0.465	0.030***
OLS	0.248	-0.135**	0.176	-0.076**	-0.006	0.978**	0.235	-

*, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively. Lvdjitus denotes the trading volume in logarithm. R² denotes the adjusted R-squared value. The QLR test denotes the *p*-value of the Quasi Likelihood ratio test of Koenker and Machado (1999). Dlpfe denotes changes in expected personal finance, LBC12 is the index related to business conditions, and Vexp_inf denotes the value of the expected inflation rate

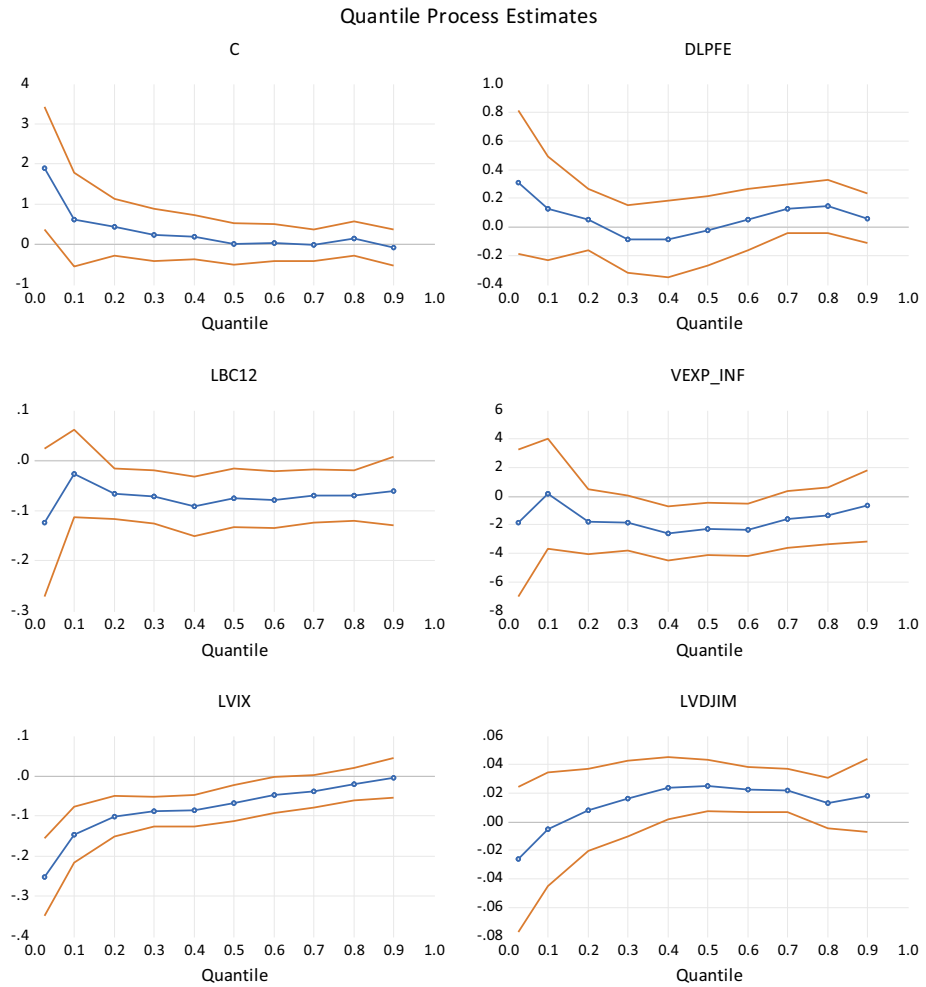


Fig. 4 Analysis of the quantile process estimates for Model (3) for Islamic index

(1936) and developed later by Akerlof and Shiller (2010) have had an impact on the dynamics of stock returns. Hence, we rely on data covering the period January 1996 to September 2021, which is relevant because this sample covers both calm periods and crisis periods (dot-com bubble of 2000, subprime crisis of 2007, global financial crisis of 2008–2009, and COVID-19). To test this theory of animal spirits, we apply different time series tests and run a quantile regression. Our findings provide two key findings. First, investor sentiment and consumer confidence have significant effects on the dynamics of both ethical stock returns, suggesting further evidence of animal spirits. Second, animal spirit effects enter asymmetrically and nonlinearly as their effect on ethical stock returns varies with time and the quantile under consideration. This finding suggests that forces of human psychology are instrumental in trading and risk-taking, even when considering ethical investments. Accordingly, considering animal spirits is relevant to better explain and forecast the dynamics of these investments.

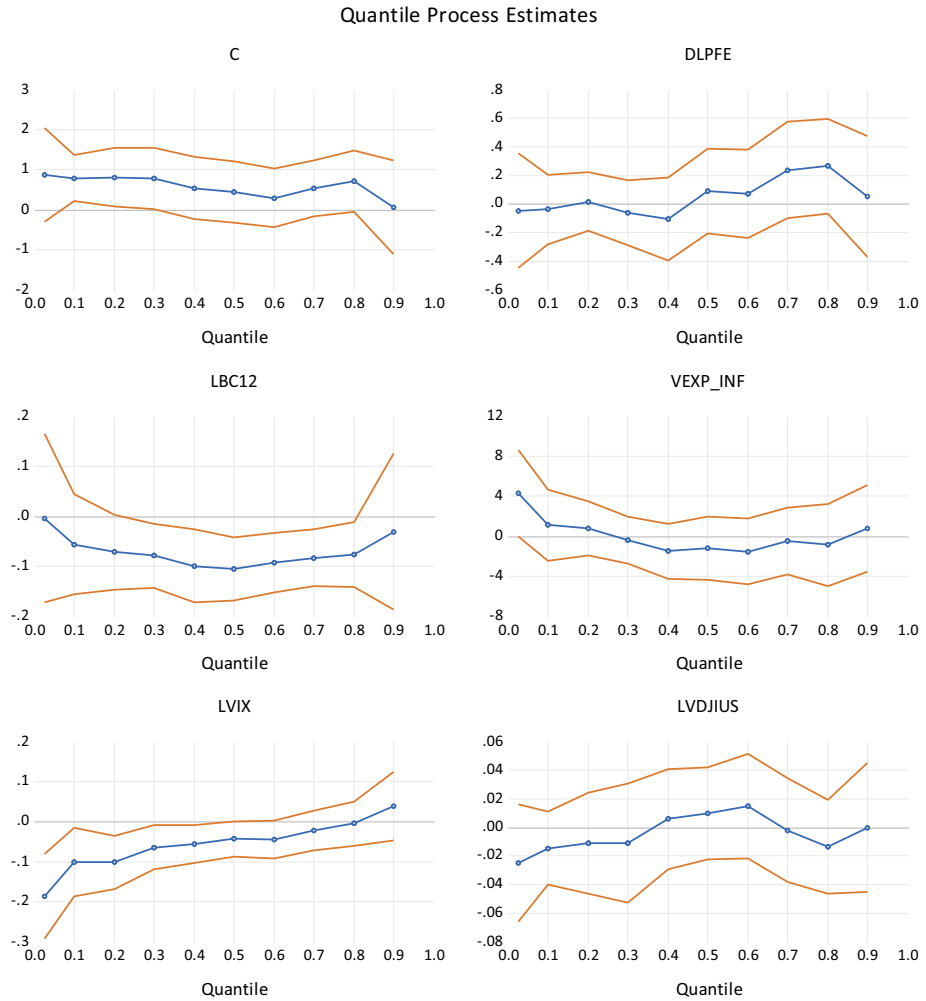


Fig. 5 Analysis of the quantile process estimates for Model (3) for sustainable index

A future extension of this study would be to test different forms of animal spirits for ethical investments and check the forecasts of models including animal spirits.

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