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Twitter‘s happiness sentiment index impacts on financial markets: an integrated overview of empirical findings

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Abstract
This survey paper investigates the empirical findings of academic work that explores the nexus between the highly innovative Twitter happiness sentiment index and a range of financial assets. An integrated overview of econometric outcomes and the relevant investment policy implications are provided. It is revealed that investor happiness reinforces the safe haven abilities of gold. Moreover, major stock indices are highly influenced by the happiness index especially at higher quantiles. Reverse causality between the happiness index and stock indices is also detected but in a weaker level. This survey contributes to better understanding investment decisions based on behavioural finance and provides evidence about the nexus of investor sentiment estimation with the financial sector nowadays.

JEL Classification numbers: G15, G40, Q02.
Keywords: Investor happiness, Investor sentiment, Twitter, Survey, Gold, Stock prices.

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1 Introduction

There has been a rapidly proliferating bulk of academic research in economics and finance supporting that studying psychological factors is essential in order to understand the tendencies in the real economy and financial markets. This is the reason why investor sentiment has been at the epicenter of efforts for better discriminating the influence of personal beliefs on the fluctuations in market values of conventional as well as more sophisticated financial assets. Up to the present, a number of important papers have examined the impact of investor sentiment on stock returns (Baker and Wurgler, 2006; Yu and Yuan, 2011; Stambaugh et al., 2012; Seo and Kim, 2015; Li et al., 2020).

Recent research has focused interest on sentiment data that are concentrated by large platforms which accumulate lots of data and provide the opportunity to assess the complex dynamics of information from all around the world. One of the largest media platforms in a worldwide level is Twitter, which enjoys the participation of approximately 330 million active users. Among the most frequent topics discussed by Twitter users through this platform are financial issues of major importance. Twitter users tend to express freely their opinions on specific financial investments as well as their overall impression about the current status and the future perspectives of hotly-debated investment plans. This has enabled Dodds et al. (2011) to construct the Twitter-based daily happiness index that is made by employing a post text analysis technique and is based on twits posted on the Twitter microblog platform.

This happiness index originates from the Twitter Gardenhose feed database which is a randomly selected sample with 50 million (10%) of total Twitter posts. To be more precise, this happiness index is constructed by using sentiment words such as love, happy, laugh, joy, etc. with the natural language process that is available by the Amazon's mechanical Turk service. This enables the quantitative expression of the happiness sentiment of the enormous volume of Twitter posts. This is the reason why it constitutes one of the most popular and representative happiness indices created up to the present. This follows the early work on sentiment indices by Baker and Wurgler (2007). The millions of tweets about financial markets take the form of commentaries, recommendations or rumors and represent the collective view of investors towards the markets of stocks, commodities, cryptocurrencies and other investment tools.

For the purposes of covering the bibliography about the Twitter's happiness sentiment index and its impact on financial assets, a selective search of the relevant academic papers has been conducted. To be more precise, the terms ''Twitter sentiment index'' and ''financial'' have been applied to Sciencedirect and Google Scholar search engines. Even though the relevant bulk of literature was not large a selection was made in order to distinguish which studies focused on the Twitter sentiment index specifically and not on other similar measures such as the twits about specific financial assets like gold, stocks or cryptocurrencies. Our selection criteris focused on tracing empirical papers that examined the precise nexus between this innovative index and quantitative measures of conventional or modern financial assets. Almost half of the papers initially traced remained as the primary studies employed. Further exclusion criteria applied is that no earlier version of a paper was included in the primary studies used.

This review is a systematic survey based on previous academic work in monetary and financial issues such as Tranfield et al. (2003), Fisch and Block (2018), Corbet et al. (2019), Kyriazis (2019a; 2019b; 2020a; 2020b; 2021a; 2021b; 2021c), Kyriazis et al. (2020), Papadamou et al. (2019; 2020), Xiao and Watson (2019). It constitutes the first study that provides an integrated overview of empirical findings of the specific highly innovative measure of investor happiness, the Twitter daily happiness sentiment index. Our study casts light on a range of different perspectives concerning the impacts of investor happiness on the performance of exchange-traded funds (ETFs), gold and stock markets. Such insights into the effects of behavioural finance expressions on markets of traditional and innovative financial assets could provide a compass for investors in a worldwide level and spur further academic interest on this still embryonic domain of research.

The remainder of this survey is organized as follows. Section 2 provides relevant academic research that focuses on impacts of the Twitter's happiness index on exchange-traded funds and commodities. Section 3 presents the empirical findings about the nexus of this happiness index with returns and volatilities in stock markets. Moreover, in Section 4, comparison takes place between effects of happiness on the alternative

investments under scrutiny. Furthermore, the economic underpinnings of results and policy implications for investment decision-making are analyzed. Finally, Section 5 concludes and proposes avenues for further research. Table 1 reveals the main characteristics of the studied investigated. Moreover, graphs in the Appendix display the evolution of the investor happiness index during the COVID-19 disease as well as provide some metrics of the readability of the relevant studies examined in this overview. It is easily seen in the graph of Twitter sentiment in the Appendix (Figure 1A) that investor sentiment decreases in an abrupt manner when unpleasant events take place such the outburst of the COVID-19 disease in March 2020 and the murder of the African-American George Floyd in the US.

2 Studies about investment decisions linked with happiness and the linkages of the Happiness index with ETFs and commodities

The development of behavioural finance has led to a large increase in the popularity of academic research that examines how behavioural factors affect the market values and volatility characteristics of financial assets. Consequently, a significant amount of theoretical and empirical work has centered their interest on the examination of behavioural factors effects on performance in financial markets (Fama, 1998; Thaler, 1999; Barberis and Thaler, 2003; Stracca, 2004; De Bondt et al., 2008; Shiller, 2008; Hirshleifer, 2015; Königstorfer and Thalmann, 2020). One of the most important strand of literature concerning behavioural finance is investor happiness that has attracted increasing interest since 2019.

An early work about investor happiness has been the study of Merkle et al. (2015). To be more precise, they use a panel survey of brokerage clients at a UK bank for the purposes of examining investor happiness. They support that investor experienced happiness is not affected by the same parameters that influence investor anticipated happiness. Overall, it is presented that the level of happiness about portfolio performance is subjective and portfolio risk, investment objectives and investment horizons, gender, wealth, knowledge about financial markets, anxiety and overconfidence constitute important determinants. They document that when investors have successfully predicted market tendencies and achieve profitability due to their own skills they render happier. The same is found to happen when they outperform other people's capacity for profit-making.

2.1 Studies investigating the nexus of the Happiness index with modern financial instruments

Moreover, there has been research conducted about the impacts of investor happiness on sophisticated financial instruments. More specifically, Lee and Chen (2020) adopt quantile regressions for looking into whether the Twitter-based happiness index and country-level happiness indices impact cross-border ETFs performance. The period considered spans from 9 September 2008 until 31 December 2018. Findings provide evidence that the Twitter-based and the US happiness indices are powerful predictors of ETFs returns in a much larger extent than the corresponding indices of their home countries. It is revealed that factors such as freedom to make life choices, no perception of corruption as well as confidence to national government in the US and home countries influence ETFs returns in a positive manner. It is emphasized that happiness in home countries exerts non-linear effects on subsequent performance. These impacts follow an asymmetric pattern across different quantiles. It is also underlined that country ETFs at higher quantiles can work as a safe haven during downwards tendencies in the US market.

2.2 Studies that examine the nexus of the Happiness index with oil and the safe haven gold asset

Oil has been one the most crucial indicators of economic activity in advanced as well as in developing economies (Huang et al., 2008). Bonato et al. (2020b) look into the nexus of the Twitter sentiment index

with the realized volatility of crude oil. Specifications of the heterogeneous autoregressive realized volatility (HAR-RV) model are adopted in order to conduct estimations. Evidence reveals that when the forecast horizon is short the realized volatility of oil is significantly connected with investor happiness in a negative manner. Out-of-sample estimations reveal that forecast accuracy improves due to investor sentiment at short forecast horizons. Nevertheless, medium and long forecast horizons present no trustworthy findings.

There is also little doubt that precious metals such as gold have been at the epicenter of financial debate during extreme economic conditions due to their ability to act as hedges or safe havens (Hood and Malik, 2013; Beckmann et al., 2015; Bredin et al., 2015; Wen and Cheng, 2018; Dutta et al., 2020) according to the definition of Baur and McDermott (2010). When it comes to investigating the nexus of investor happiness with gold, Bonato et al. (2020a) and Byström (2020) constitute relevant academic papers. Therefore, Bonato et al. (2020a) employ the HAR-RV methodology in order to detect whether investor happiness could constitute a predictor of realized volatility of gold. Intraday (5-minute) as well as daily data are used in order to estimate daily realized volatility during the period from 9 September 2008 to 30 May 2017. In-sample econometric estimations reveal a negative nexus between realized volatility and investor happiness. Moreover, based on out-of-sample estimations it is argued that this happiness index ameliorates in a significant level the accuracy of forecasts of realized volatility both in short- and long-run horizons.

By focusing on similar academic purposes, Byström (2020) employs the Twitter-based Hedonometer Happiness index in order to investigate the nexus between happiness and alterations in gold prices during the period 15 September 2018- 6 December 2019. The extreme value theory is employed for the purposes of modeling the tails of the distribution and testing for non-normality. When the entire correlations are taken into consideration, no significant correlation between happiness and gold prices is traced. Nevertheless, outcomes based on Extreme Value Theory reveal a negative linkage between gold market values and investor happiness. Thereby, it is argued that gold serves as a safe haven against extreme unhappiness.

3 Studies that put the nexus between the Happiness index and stock indices under scrutiny

The examination of stock markets has been of primordial interest in financial economics as these traditional forms of investments attract the highest investor interest. A great and still proliferating volume of studies related to stock markets combined with investor sentiment (Lee, 2002; Brown, 2004; Tetlock, 2007; Mian and Sankaraguruswamy, 2012; Pan, 2020) has been created and has enriched knowledge about investor decision-making. The investor happiness index in combination with stock markets has been the axis of research of a number of studies and aspires to further fortify the arsenal of economic agents in order to conduct profitable investment choices.

Firstly, Li et al. (2017) center their research interest on the contemporaneous and the lead-lag connection between the Twitter's happiness index and stock returns of Chinese companies that are listed in the US. The period under consideration covers from 10 September 2008 until 27 May 2015. The Granger estimations undertaken reveal that the sub-group with the highest daily happiness displays the largest skewness. Moreover, the nexus between happiness sentiment and returns, volatility as well as trading volume denotes a bi-directional character. Additionally, evidence indicates that positive stock returns, higher excess trading volume and higher range-based volatility appear during days of high sentiment happiness. Moreover, Naeem et al. (2020) conduct linear and non-linear causality estimations in order to make out whether nexus exists between the Twitter happiness index and future market volatility of VIX indices in a spectrum of advanced and emerging economies. The data employed span the period from 16 March 2011 to 27 June 2019. Econometric results give credence to the notion that higher happiness generates higher next day implied volatility in almost all the countries investigated. Strong evidence is presented that the linkage between investor sentiment and future volatility in the stock markets presents

a non-linear pattern.
When it comes to Zhao (2019), Vector Autoregression and non-linear quantile Granger causality methodologies are employed in order to investigate the predictive correlations between the Twitter-based happiness index and the value-weighted Singapore Straits Times Index (STI) indicators. The Spearman and Kendall correlation coefficients are adopted. The period under scrutiny covers from 9 September 2008 to 12 December 2018 and is divided into two sub-periods. It is argued that the happiness index is a trustworthy predictor of STI returns while the same is not valid as concerns the relevant volatilities. On the other hand, this Singapore stock index is not a good predictor for the happiness index. In a somewhat similar vein, Zhao (2020a) looks into the linkages between investor daily happiness and twenty-two US industries by focusing interest on cross-sectional return skewness correlations. The whole period spans from 20 September 2012 to 29 July 2018. Five sub-samples are created and different values of skewness are traced among sub-groups. The Fisher-Pearson coefficients are adopted. Skewness in the majority of indices is found to exhibit negative values. Findings of Zhao (2020b) strongly corroborate the findings of Zhao (2020a).
Thereby, Zhou (2020b) adopts correlation coefficients and Granger causality methodologies in order to detect the linkages between the Twitter happiness index and its cross-sectional correlations with twelve US indices. Micro-cap, small-cap, mid- cap, large-cap, mega-cap and total market indices are employed. The Pearson, Spearman and Kendall coefficients are used. The period examined covers from 31 March 2011 to 29 July 2018. Results reveal that contemporaneous as well as long- term interactions between the happiness measure and these indices appear. Emphasis is put on the differences concerning returns across alternative quantiles. By following a similar perspective, You et al. (2017) focus their interest on the investigation of dynamic causal connection between worldwide major stock returns and the Twitter's happiness index. The methodology preferred is the Quantile Granger non- causality model and the period under scrutiny spans from 9 September 2008 to 15 November 2016. Evidence is provided that causal linkages vary across different quantiles. It is found that investor happiness is not a giver of impacts on the S&P/ASX200, S&P/TSX, FTSE100, Hang Seng and the S&P500 indices. Emphasis is put on that the higher quantiles display causal effects of the happiness index on stock indices while the reverse causality is detected only at low or high quantiles of the sentiment index.

4 Economic underpinnings and policy implications of findings

Based on findings from primary studies, it could be argued that empirical papers provide evidence about the significance of the Twitter-based Happiness index on financial assets even though evidence about the extent and direction of these the impacts are not unanimous. Econometric outcomes support that this index displays significantly stronger nexus with exchange-traded funds than happiness indices of home countries. Moreover, non-linear and asymmetric patterns are detected on impacts of happiness representations on ETFs that constitute one of the most sophisticated financial tools for profit-making. The ETFs being able to counteract crises renders the measurement of happiness an important indicator of the potential for confronting such downwards tendencies in markets.
As regards the connection of the happiness indicator with gold, a spectrum of fruitful conclusions also emerges despite the small bulk of relevant literature. Mixed results about how investor happiness influences gold prices have been brought to the surface but it should be stressed that negative linkages mostly emerge. Thereby, happiness does not favour investors' interest about gold. This corroborates the financial theory supporting that investors' high confidence does not abide by investments in precious metals since these are considered to be safe haven assets. Notably, the volatility of gold market values is also negatively connected with investor happiness. It can be derived though that better conditions in financial markets –which are reflected in investor happiness measurement- do not favorite larger profit-making opportunities by investing in precious metals. This is the reason why gold preserves only a very small difference between its fundamental value and its nominal value during elevated investor happiness which mainly prevails during flourishing periods.

Intriguingly, the largest part of academic literature about investor happiness focuses on the nexus between this Twitter-based index and stock markets. Large levels of non-linearity are revealed regarding such impacts. This indicates that the influence of happiness sentiment on stock market performance is not easily identifiable by conventional methodologies. Overall, it can be argued that both returns and volatility of stock indices are influenced by investor happiness. To be more precise, higher returns combined with larger levels of trading volume as well as higher fluctuations in market values appear when investors feel happier than usually. Higher profitability is found to be more intense during periods of very high happiness sentiments as can be noticed by results in upper quantiles. Although powerful impacts do not hold about all the indices examined it can be supported that the majority of indices investigated are indeed influenced. Moreover, it should be highlighted that reverse causality also holds in a significant portion of cases. Namely, goodperformance in stock markets strengthens investor happiness and generates a beneficial cycle concerning investment in financial markets. Thereby, a flourishing period as concerns economic activity in financial markets could emerge and last for a considerable time if investor happiness remains at high levels.

5 Conclusions and avenues for further research

This survey provides a bird's-eye view on the impacts of investor happiness –as measured by the Twitter-based happiness index, also known as hedonometer- on financial market performance. The embryonic but rapidly proliferating bulk of relevant empirical academic studies is taken into consideration for the purposes of this paper. The eleven studies examined reveal that the happiness index mainly exerts non-linear causal effects at extreme quantiles (primarily the upper ones) of the financial assets under scrutiny. The non-linear character of such impacts is investigated by non-linear quantile causality specifications as well as by the adoption of autoregressive volatility schemes.

Empirical outcomes provide support to precious metals –such as gold- being negatively linked with investor happiness. Thereby, lower gold returns and volatility are brought about during flourishing periods when investors enjoy high levels of happiness. Besides that, gold is found to constitute a hedge against investor pessimism during downwards tendencies in financial markets. When it comes to impacts of happiness on more sophisticated financial products such as exchange-traded funds, happiness is also found to be influential regarding these assets. Notably, ETFs could work as safe havens as well against pessimism during bear markets. It is remarkable that apart from economic factors a wide spectrum of social and political factors become determinants of investor happiness impacts on ETFs. Intriguingly, powerful nexus is estimated between investor happiness and a large array of stock indices -that constitutes an important portion of the cases investigated- is also characterized by causality from these indices towards happiness. Generally, higher levels of investor happiness (as expressed by higher quantiles in the distribution of each index) are revealed to be more influential towards stock returns and volatility. These linkages display positive signs so equity indices present higher returns, trading volume and fluctuations during bull periods. On the other hand, the stock indices that prove to be receivers of effects are also found to be givers of impacts during extreme periods, thereby during bear or bull markets.

The endeavor of this overview is to cast light on yet unknown aspects of the newly-developed but increasingly popular investor happiness index and its impacts on traditional and modern financial assets. To the best of our knowledge, no prior study has investigated how the innovative Twitter-based investor happiness index influences financial markets. This study enlightens even to the slightest level the interested investor by developing some insightful implications into the impacts on investor decision-making through the lens of the most up-to-date behavioural finance expression. This Twitter-based index is particularly useful nowadays that information has invaded every aspect of life. Notably, this newly-created specific field could provide a crucial benchmark for further development of empirical research on behavioural indices and their connections with the financial sector. Avenues for further research could include the use of future and more advanced behavioural indices in a larger range of assets by employing complex econometric methodologies.

Table 1: Main characteristics of the studies investigated

	Journal	Data source	Variables	Data period	Methodology	Findings
Bonato et al. (2020a)	FRL	Hedonometer.org www.disktrading.com www.kibot.com	Twitter daily happiness index Gold futures traded on NYMEX (5-min frequency)	9/9/2008-30/5/2017	Heterogeneous Autoregressive Realized Volatility (HAR-RV) model as in Corsi (2009)	Negative nexus is detected between investor happiness and realized volatility Investor happiness predicts well the realized volatility at the short- and medium-run
Bonato et al. (2020b)	Sustainability	Hedonometer.org www.disktrading.com www.kibot.com	Twitter daily happiness index West Texas Intermediate (WTI) oil futures (volatility)	9/9/2008-26/5/2017	Heterogeneous Autoregressive Realized Volatility (HAR-RV) model as in Corsi (2009)	Only in short forecast horizons the realized volatility of oil is significantly connected with investor happiness negatively, otherwise not connected.
Byström (2020)	FRL	Hedonometer.org Datastream	Twitter daily happiness index Gold	15/9/2008-6/12/2019	Extreme Value Theory (EVT) modeling of the tails of the non-normally distributed happiness index	No significant correlation between happiness and gold prices is revealed. Extreme Value Theory though documents a negative nexus between gold market values and investor happiness. Gold could be used as a safe haven against extreme unhappiness.
Lee et al. (2020)	NAJEF	Hedonometer.org World Happiness Report Yahoo Finance	Twitter happiness index Country-level happiness sentiments GDP per capita Social support Health life expectancy Freedom to make life choices Generosity Corruption perception Positive/negative effect Confidence in the national government Global X MSCI Argentina ETF iShares MSCI-Australia ETF Invesco CurrencyShares® Australian Dollar Trust First Trust Australia AlphaDEX Fund iShares MSCI Austria Capped	9/9/2008-31/12/2018	Ordinary Least Squares (OLS) Quantile regressions	Twitter-based and the US happiness indices predictors of ETFs returns much better than the corresponding indices of their home countries. Freedom to make life choices, no perception of corruption as well as confidence to national government in the US and home countries positively affect ETFs returns. Happiness in home countries non-linearly impacts subsequent performance. These effects are asymmetric pattern across different quantiles. Country ETFs at higher quantiles prove to be safe havens during US bear markets.

			ETF iShares MSCI Belgium Capped ETF iShares MSCI Brazil ETF Direxion Weekly Brazil Bull 3X Shares First Trust Brazil AlphaDEX Fund VanEck Vectors Brazil Small-Cap ETF iShares MSCI Brazil Small-Cap ETF ProShares Ultra MSCI Brazil iShares MSCI Canada ETF Sprott Gold Miners ETF Invesco CurrencyShares® Canadian Dollar Trust First Trust Canada AlphaDEX Fund iShares MSCI Chile ETF iShares China Large-Cap ETF iShares MSCI China ETF Xtrackers Harvest CSI 300 China A-Shares Fund KraneShares CSI China Internet ETF SPDR S&P China ETF KraneShares Bosera MSCI China A Share ETF Invesco China Technology ETF Direxion Weekly China 3x Bull Shares Xtrackers Harvest MSCI All China Equity Fund Invesco Golden Dragon China ETF Global X MSCI China Consumer Discretionary ETF			

			WisdomTree China ex-State-Owned Enterprises Fund Global X MSCI China Financials ETF Direxion Weekly China 3x Bear Shares VanEck Vectors ChinaAMC CSI 300 ETF Invesco China Small Cap ETF Xtrackers Harvest CSI 500 China-A Shares Small Cap ProShares Ultra FTSE China 50 VanEck Vectors ChinaAMC SME-ChiNext ETF WisdomTree Chinese Yuan Fund iShares MSCI China Small-Cap ETF KraneShares E Fund China Commercial Paper ETF First Trust China AlphaDEX Fund Market Vectors-Renminbi/USD ETN VanEck Vectors ChinaAMC China Bond ETF Invesco CurrencyShares® Chinese Renminbi Trust KraneShares CSI China Five Year Plan ETF Global X MSCI China Materials ETF Global X MSCI China Energy ETF Global X MSCI China Industrials ETF Global X MSCI Colombia ETF iShares MSCI Colombia ETF iShares MSCI Denmark ETF			

			VanEck Vectors Egypt Index ETF iShares MSCI Finland ETF iShares MSCI France ETF iShares MSCI Germany ETF iShares Currency Hedged MSCI Germany ETF First Trust Germany AlphaDEX Fund WisdomTree Germany Hedged Equity Fund iShares MSCI Germany Small-Cap ETF Global X DAX Germany ETF Global X FTSE Greece 20 ETF iShares MSCI Hong Kong ETF iShares MSCI India ETF WisdomTree India Earnings Fund iShares India 50 ETF iShares MSCI India Small-Cap ETF Invesco India ETF VanEck Vectors India Small-Cap Index ETF Columbia India Consumer ETF Direxion Weekly India Bull 3x Shares Columbia India Infrastructure Index Fund Columbia India Small Cap Fund Market Vectors-Rupee/USD ETN iShares MSCI Indonesia ETF VanEck Vectors Indonesia Index ETF iShares MSCI Ireland ETF			

			iShares MSCI Israel ETF VanEck Vectors Israel ETF iShares MSCI Italy ETF iShares MSCI Japan ETF WisdomTree Japan Hedged Equity Fund WisdomTree Japan SmallCap Dividend Xtrackers MSCI Japan Currency-Hedged Equity Fund iShares Currency Hedged MSCI Japan ETF iShares MSCI Japan Small Cap ETF Invesco CurrencyShares® Japanese Yen Trust First Trust Japan AlphaDEX Fund iShares JPX-Nikkei 400 ETF WisdomTree Japan Hedged SmallCap Equity Fund iShares Edge MSCI Min Vol Japan ETF Direxion Weekly Japan Bull 3x Shares ProShares Ultra Yen ProShares Ultra MSCIJapan iShares MSCI Malaysia ETF iShares MSCI Mexico ETF iShares MSCI Netherlands ETF iShares MSCI New Zealand ETF Global X MSCI Nigeria ETF Global X MSCI Norway ETF iShares MSCI Norway ETF iShares MSCI Peru ETF iShares MSCI Philippines ETF			

			iShares MSCI Poland ETF VanEck Vectors Poland ETF Global X MSCI Portugal ETF VanEck Vectors Russia ETF iShares MSCI Russia ETF Direxion Weekly Russia Bull 3x Shares Direxion Weekly Russia Bear 3x Shares iShares MSCI Singapore ETF Invesco CurrencyShares® Singapore Dollar Trust iShares MSCI South Africa ETF iShares MSCI South Korea ETF Direxion Weekly South Korea Bull 3X Shares Xtrackers MSCI South Korea Hedged Equity Fund First Trust South Korea AlphaDEX Fund iShares MSCI Spain ETF iShares MSCI Sweden ETF Invesco CurrencyShares Swedish Krona Trust iShares MSCI Switzerland ETF First Trust Switzerland AlphaDEX Fund Invesco CurrencyShares® Swiss Franc Trust iShares MSCI Taiwan ETF iShares MSCI Thailand ETF iShares MSCI Turkey ETF iShares MSCI UAE ETF iShares MSCI United Kingdom ETF			

			Invesco CurrencyShares® British Pound Sterling Trust iShares MSCI United Kingdom Small-Cap ETF WBI Bull|Bear Rising Income 2000 ETF First Trust United Kingdom AlphaDEX Fund Xtrackers MSCI United Kingdom Hedged Equity Fund VanEck Vectors Vietnam ETF			
Li et al. (2017)	EM	Hedonometer.org Wind Economic Database	Twitter daily happiness index 99 stocks in NASDAQ 58 stocks in NYSE 5 stocks in AMEX	10/9/2008-27/5/2015	Examination of lead-lag relationship based on Granger (1988)	The highest daily happiness sub-group presents the largest skewness. The connection between happiness sentiment and returns, volatility and trading volume is bi-directional. High sentiment happiness leads to positive stock returns, higher excess trading volume and higher range-based volatility.
Merkle et al. (2015)	JEP	Answers from UK bank clients	Brokerage clients at a UK bank	9/2008-9/2010	Panel survey	Investor experienced happiness is not influenced by the same factors that affect investor anticipated happiness. Happiness about portfolio performance is subjective and portfolio risk, investment objectives and investment horizons, gender, wealth, knowledge about financial markets, anxiety and overconfidence are important determinants. Abilities for achieving profitability and for out-performing other people makes investors happier.
Naeem et al. (2020)	RIBAF	Hedonometer.org Thomson Reuters Datastream	Twitter daily happiness index Stock markets implied volatility (VIX) indexes	16/3/2011-27/6/2019	Linear causality based on Granger (1969) and non-linear causality as in Diks and Panchenko (2006)	Higher happiness results in higher next day implied volatility in the great majority of economies examined. Investor sentiment and future volatility in the stock markets display a non-linear pattern

You et al. (2017)	FRL	Hedonometer.org Yahoo Finance www.oanda.com	Twitter daily happiness index S&P500 S&P/TSX CAC40 DAX FTSE100 Hang Seng KOSPI Nikkei225 S&P/ASX200 NZX50 CAD/USD EUR/USD GBP/USD HKD/USD KRW/USD JPY/USD AUD/USD NZD/USD	9/9/2008-15/11/2016	Quantile Granger non-causality test based on Granger (1969) and Koenker and Bassett (1978) as in Koenker and Massado (1999) and Chuang et al. (2009)	Causal linkages vary across different quantiles. Investor happiness does not affect the S&P/ASX200, S&P/TSX, FTSE100, Hang Seng and the S&P500 indices. Higher quantiles present larger causal impacts of the happiness index on stock indices whereas reverse causality only exists at low or high quantiles of the sentiment index.
Zhao (2019)	Physica	Hedonometer.org Yahoo Finance	Twitter happiness index Value-weighted Singapore benchmark index (Singapore Straits Times Index (STI))	9/9/2008-12/12/2018	Spearman and Kendall correlation coefficients Linear Quantile regression VAR model as in Shen et al. (2019) Non-linear causality as in Diks and Panchenko (2006)	The happiness index is positively correlate with the future STI index but this does not hold about the volatility
Zhao (2020a)	JBEF	Hedonometer.org Wharton Research Data Services	Twitter daily happiness index US real estate investment trusts price only index US oil and gas price only index US materials price only index US industrials price only index US consumer goods price only index US health care price only index US consumer services price only	20/9/2012-29/7/2018	Fisher-Pearson coefficients Cross-sectional analysis of return skewness with quantile sub-groups	The happiness index is positively correlate with the future STI index but this does not hold about the volatility

			index US telecom price only index US utilities price only index US financials price only index US technology price only index US real estate investment trusts return only index US oil and gas return only index US materials return only index US industrials return only index US consumer goods return only index US health care return only index US consumer services return only index US telecom return only index US utilities return only index US financials return only index US technology return only			
Zhao (2020b)	Physica	Hedonometer.org Wharton Research Data Services	Twitter daily happiness index US total market price index US mega-cap price index US large-cap price index US mid-cap price index US small-cap price index US micro-cap price index US total market return index US mega-cap return index US large-cap return index US mid-cap return index US small-cap return index US micro-cap return index	31/3/2011-29/7/2018	Pearson, Spearman, Kendall correlation coefficients Granger causality estimation in quantiles	Contemporaneous but also long-term interactions between the happiness sentiment index and micro-cap, small-cap, mid-cap, large-cap, mega-cap and total market indices are revealed

Note: EM, FRL, JEP, JBEF, NAJEF, RIBAF, and Physica represent Economic Modelling, Finance Research Letters, Journal of Economic Psychology, Journal of Behavioral and Experimental Finance, Research in International Business and Finance, and Physica A, respectively

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APPENDIX

Figure 1A: Average Happiness for Twitter during 2020 in the US (all tweets in English) (graph extracted from: https://hedonometer.org)

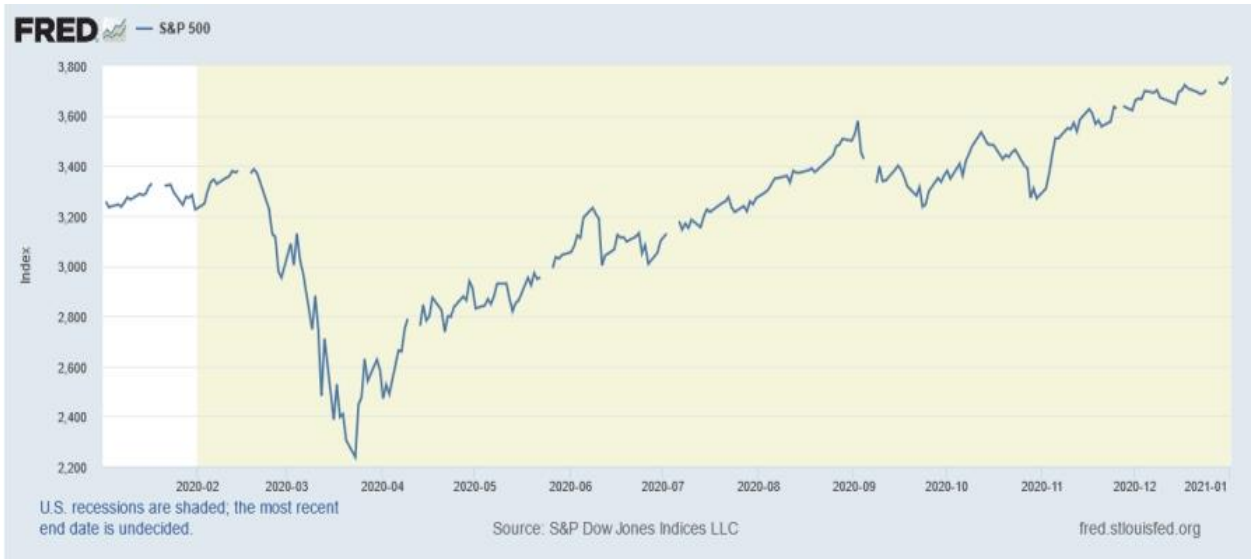

Figure 2A: Market values of the representative S&P500 index

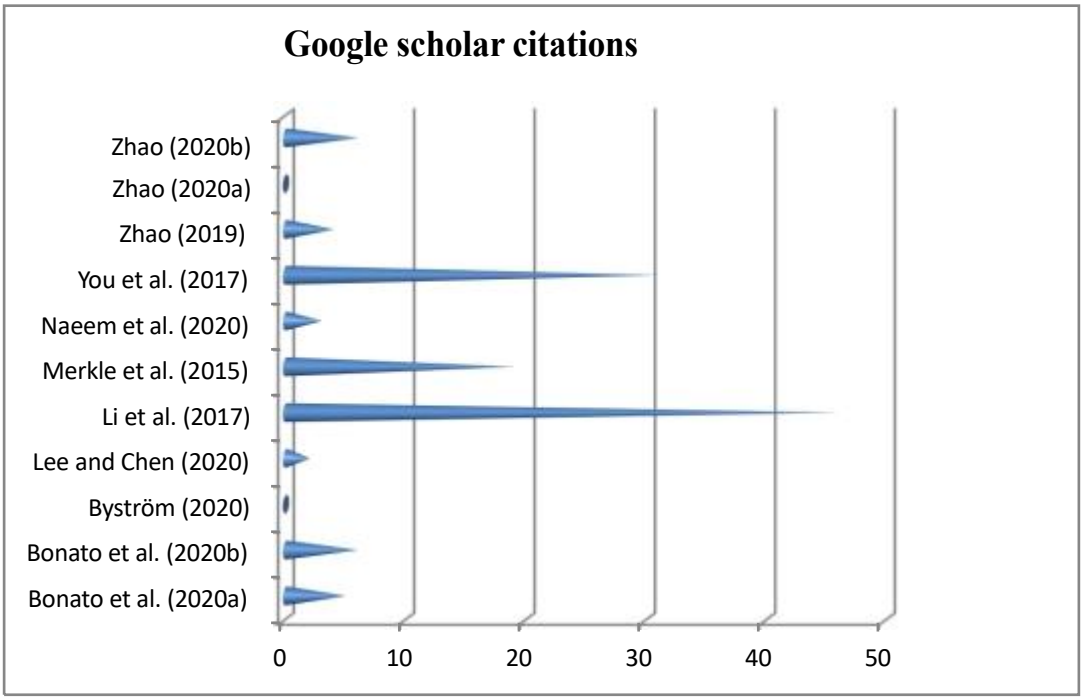

Figure 3A: Google Scholar citations per study (as of 4 June 2021)

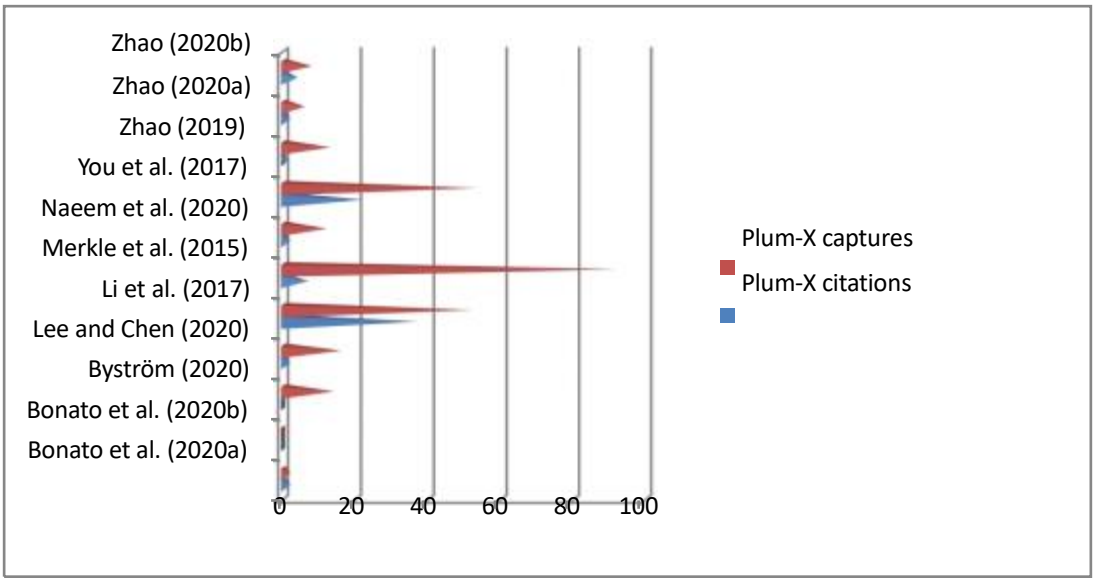

Figure 4A: Plum-X captures and Plum-X citations per study (as of 4 June 2021)