Feedback trading: a review of theory and empirical evidence

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Purpose: The purpose of this paper is to comprehensively review a large and heterogeneous body of academic literature on investors' feedback trading, one of the most popular trading patterns observed historically in financial markets. Specifically, we aim to synthesize the diverse theoretical approaches to feedback trading in order to provide a detailed discussion of its various determinants, and to systematically review the empirical literature across various asset classes to gauge whether their feedback trading entails discernible patterns and the determinants that motivate them.

Design/methodology/approach: Given the high degree of heterogeneity of both theoretical and empirical approaches, we adopt a semi-systematic type of approach to review the feedback trading literature, inspired by the RAMESES protocol for meta-narrative reviews. The final sample consists of 243 papers covering diverse asset classes, investor types, and geographies.

Findings: We find feedback trading to be very widely observed over time and across markets internationally. Institutional investors engage in feedback trading in a herd-like manner, and most noticeably in small domestic stocks and emerging markets. Regulatory changes and financial crises affect the intensity of their feedback trades. Retail investors are mostly contrarian and underperform their institutional counterparts, while the latter's trades can be often motivated by market sentiment.

Originality/value: We provide a detailed overview of various possible theoretical determinants, both behavioural and non-behavioural, of feedback trading, as well as a comprehensive overview and synthesis of the empirical literature. We also propose a series of possible directions for future research.

JEL classification: F21; G4; G11; G15; G23

Keywords: feedback trading; behavioural finance; market efficiency; retail investors; institutional investors; foreign investors; momentum; contrarian

1. Introduction

"[…] when the prices rise, we think that they fly up high and, when they have risen high, that they will run away from us." - Joseph de la Vega, *Confusion de Confusiones*, 1688, para. 322

Vega's *Confusion de Confusiones*, world's seminal primer on the pitfalls of investors' behaviour written well over 300 years ago, aimed to warn investors (via discursive allegories) against the errors of judgement often bred by speculation; it is probably fair to state, however, that the evolution of financial history raises doubts as to whether these warnings were heeded. Take, for instance, the popular practice of investors extrapolating from historical prices – which is suggested by the opening quote above. Trading on past prices (which came later to be more formally known as "feedback trading") can lead people to end up chasing trends, culminating in (regular, over time) rallies and slumps or (the far less regular, yet more seismic in effect) bubbles and crashes; this has been amply demonstrated in financial history (Neal, 1982; Galbraith, 1994; Kindleberger and Aliber, 2005; Dale et al.; 2005; Bassino and Lagoarde-Segot, 2015), from the 17th century bubbles to more recent episodes (dot-com bubble; cryptocurrency frenzy; Robinhood investors of the COVID-pandemic).

The above highlight the popularity of feedback trading over time and have motivated a sizeable volume of academic research; nevertheless, a detailed review of the extant literature offering an integrated (theoretical and empirical) overview of this topic has not been produced to date. We aim at filling this gap by offering the first comprehensive survey of feedback trading[1], both in terms of its theoretical foundations and its extant empirical evidence. Our main goals are:

1) to synthesize the extant heterogeneous body of theoretical approaches to feedback trading in order to provide a detailed discussion of its various determinants,

2) to systematically review the empirical literature across various asset classes to gauge whether their feedback trading entails discernible patterns and the determinants that motivate them, and

3) to identify open questions and potential avenues for future research in the field.

Having reviewed a large volume of literature, we find that empirically, feedback trading is detected across all asset classes and investor-types, internationally and over time. Although feedback trading is often associated with unsophisticated investors chasing price-trends due to behavioural factors (biases and heuristics), the propensity to feedback trade is not necessarily a function of sophistication. Indeed, retail traders (whose level of sophistication is relatively low) tend to overwhelmingly contrarian trade in equities motivated largely by behavioural forces - and consistently underperform their institutional counterparts. Sentiment would be expected to motivate trend-chasing (i.e., positive feedback trading) and evidence from domestic institutional investors' equity investments, equity market indices, derivatives and ETFs does confirm this for optimistic sentiment periods; however, we also find that those trading on sentiment negative feedback trade, likely due to speculative motives (they try to counter sentiment). What is more, the presence of feedback trading is associated with inefficiencies (e.g., autocorrelation in equity markets) and mispricing (e.g., premiums/discounts in ETFs).

Agency reasons lead fund managers to exhibit herding in their (positive, in most cases) feedback trading patterns; the latter are also found to be driven by style investing and style-momentum (i.e., chasing the best performing styles). Informational payoffs motivate (positive, in most cases) feedback trading in emerging/frontier markets (as observed at the

micro level for foreign institutional investors' equity trades, and at the macro level for equity market indices and currencies), small capitalization stocks (among domestic institutional investors) and under institutionally less transparent conditions (given the dissipation of feedback trading following regulatory changes associated with enhanced transparency/sophistication internationally). Hedging reasons (reflective of risk aversion) have been found to strongly motivate (mainly positive) feedback trading in equities, bonds, derivatives and commodities. What is more, crisis-episodes tend to constitute turning points for the sign, magnitude and significance of feedback trading internationally and across asset classes, without, however, returning any discernible patterns. Overall, the empirical evidence denotes that (with the exception of retail investors) feedback trading internationally is largely associated with non-behavioural motives. This demonstrates that, although its practice does not conform to strict rationality, it is nevertheless often pursued for rational reasons by institutional (i.e., sophisticated) investors, who, as a result, project trading patterns that would, theoretically, be expected to fall within the remit of noise traders.

The remainder of this paper is structured as follows. We first present the methodological design of our investigation in section 2. We then outline the theoretical part (definitions and theoretical determinants of feedback trading) of this study in section 3; empirical evidence on feedback trading per asset class is offered in section 4. Section 5 summarizes the study's key findings and offers a discussion of potential topics for the consideration of future research.

2. Data and Methods

The body of literature on feedback trading is rather broad and heterogeneous, as its concept has been modelled, both theoretically and – primarily - empirically via a variety of frameworks, contingent on the aspect of feedback trading studied as well as the availability of data (types). To that end, we follow the recommendation by Snyder (2019) and pursue a

semi-systematic type of approach to review the feedback trading literature, as this approach is judged to be optimal under these circumstances: it allows us to come up with an overview of the overall research area; analyse how research has evolved over time and across its different aspects; identify common themes; and provide a synthesis of the findings as well as recommendations for future research.

In collecting and analysing the data, we broadly follow the RAMESES protocol for meta-narrative reviews proposed by Wong et al. (2013), as and when appropriate.[2] To begin with, all four researchers involved in this project have extensive prior knowledge of the specific (feedback trading and, overall, behavioural finance) as well as the broader finance literature, therefore the scoping of the literature was embedded in our individual and collective expertise; hence, we could initially identify diverse terms and areas as well as individual publications relevant to this review. This was additionally supported by "informal browsing of the literature" and conversations with peers, as recommended by Wong et al. (2013) and in line with the RAMESES principle of peer review. As a result, we established several sub-areas within the literature relevant to feedback trading, falling under the remit of both micro research (including studies on the feedback trading behaviour of domestic institutional, foreign institutional and retail traders), and macro research (including studies at the aggregate level from equity, fixed income and derivatives markets, among other asset classes). The subsequent search process involved allocation of two researchers to each of those areas, with each researcher conducting independent search first, with the results being triangulated to identify unique and duplicated findings. The search terms were initially not agreed on among researchers; in this way, we aimed to assure that diverse individual search strategies were deployed to capture as many heterogeneous outputs as possible at that stage, in line with the RAMESES principle of pluralism. Subsequently, search results and the underlying search terms were revealed to the whole team to discuss if the net was thrown

wide enough to capture all potential sub-branches of the relevant literature, in line with the RAMESES principle of reflexivity. In general, we drew on a host of electronic data bases such as Scopus, Google Scholar, and Web of Science, using a series of common search terms, including “feedback trading”, “momentum”, “contrarian” and “reversal”.

This process resulted in the identification of 243 potentially relevant empirical papers.[3] For each empirical output, information on publication year (and other bibliographic data), countries and sample period covered, type of data and empirical methods used, as well as core results and further implications, were collected. Based on this information, further analysis of papers in light of their relevance and usefulness to this review was conducted, and we followed Wong et al. (2013) by not treating the review as a technical process but rather a sense-making exercise requiring a series of professional judgements. This resulted in further narrowing down the number of relevant studies to 209.[4] These were subsequently divided into clusters according to their shared features, primarily by asset class and subsequently by other criteria strongly apparent from the data (primarily by investor type).

We observe that the overwhelming majority of studies deal with feedback trading in equities (146, i.e., 70% of all papers), while trading in derivatives is dealt with by 16 papers (whereof 14 are purely derivatives-orientated and 2 analyse a mix of assets including derivatives) and the commodities market is captured by 13 studies. All other asset classes comprise a minuscule proportion (<5%) of the total body of the literature identified (fixed-income: 6 papers, exchange-traded funds: 6 papers, currencies: 7 papers, depository receipts: 1 paper, property: 7 papers, cryptocurrencies: 3 papers, and investment styles: 5 papers). Within the equity market research, most papers (113) deal with micro-level aspects, including domestic institutional (28), domestic individual (30, plus 13 papers on other aspects where these investors are also investigated) and foreign investors (55). Macro-level issues are captured by

33 papers, mostly for market indices (23, plus one mixed study covering indices as part of a broader design) but also individual stocks (10).

The popularity of feedback trading as a topic for empirical research can be inferred by observing the time trend in the publications of papers in our sample, as depicted in Figure 1 in the appendix. Empirical work started to appear in the early 1990s, likely as a result of the seminal theoretical research by Shiller (1984) and De Long et al. (1990a; 1990b), gaining momentum following the 1997 Asian crisis, with a delay due to the time-consuming nature of empirical work and publication processes; as a result, the average number of publications on feedback trading per year was almost four times higher in the 2000-2007 period than in the 1990s (7.4 vs 1.9). Interest in investor irrationality, including feedback trading, accelerated further following the outbreak of the global financial crisis in mid-2007, with the average number of papers published per year in the 2008-2017 period being 11.3. However, starting in 2018, feedback trading research features less prominently in journals (7 papers published per year, on average), although new areas of research (such as cryptocurrencies) and new events to be investigated (the Covid-19 pandemic) have emerged in this period. Overall, as the field appears to have stabilised in terms of publications but is also expected to branch out into new and exciting research avenues, we find it helpful and appropriate to "take the stock" now and review this very heterogeneous area of the literature.

3. Theoretical background

3.1 Definitions

Feedback trading is an overarching term engulfing a wide cross-section of investment patterns that rely on historical prices (Koutmos, 2014), as well as other forms of aggregate trading data (such as volume and sentiment; see, e.g., Kurov, 2008 and Chau et al., 2011). Contingent on how feedback traders respond to historical trends, they are classified as

positive (if they track the trend) or negative (if they buck the trend) feedback traders.[5] Feedback trading can be reflected via a variety of trading strategies and practices, including momentum/contrarian trading[6] (Galariotis, 2014), technical analysis[7] (Nazário et al., 2017), stop-loss/take-profit orders (Osler, 2005), portfolio insurance (Balduzzi et al., 1995), window-dressing (Lakonishok et al., 1991; Agarwal et al., 2014) and margin trading (Watanabe, 2002; Hirose et al., 2009), to mention but a few.

The practice of feedback trading is founded upon the belief that past price sequences accommodate discernible and recurrent patterns, which, if successfully identified, can be profitably exploited by assisting investors in predicting future price trends. This suggests that feedback trading is at odds with the neoclassical finance paradigm in several respects. To begin with, feedback patterns cannot be reconciled with the weak form of market efficiency, which postulates that past prices are neither of informational value, nor can they predict future prices (Fama, 1991).[8] In addition, to the extent that feedback traders treat prices as the sole variable of interest and assume them to entail inter-temporal dependence in their distribution, this implies that they do not subscribe to the rational expectations' framework.[9]

The above suggest that a growing presence of feedback traders can amplify noise trading in capital markets and foster the evolution of potentially destabilizing outcomes (De Long et al., 1990a). Indeed, by trading on past (and amplifying existing) price trends, feedback traders can motivate horizon-dependent return autocorrelations (Cutler et al., 1990; 1991)[10], which can interact significantly with volatility (LeBaron, 1992) and volume (Campbell et al., 1993)[11] and generate excess volatility and fat tails in return distributions (Lux, 1997; 1998; Lux and Marchesi, 1999; Brock and Hommes, 1997; 1999; Farmer; 2002; Farmer and Joshi; 2002; Tambakis, 2009), over- and underreaction (Galariotis, 2014) and bubbles and crashes (Baur and Glover, 2014; da Gama Batista et al., 2017; Barberis et al., 2018; Tokic, 2020).

Such phenomena imply that feedback traders can distort fundamental valuations, engage in trend-chasing speculation (aiming at buying assets with the intention of selling them to other investors with higher valuations; Scheinkman and Xiong, 2003) and boost the trading volume in the process (Kodres, 1994; Ofek and Richardson, 2003; Hong and Stein, 2007; Miwa and Ueda, 2011), something that has been observed regularly in financial history.[12]

As a result, feedback traders can foment deviations of prices from their fundamental values, and can amplify risk in the marketplace (Saacke, 2002; Kogan et al., 2006). In the context of the neoclassical finance paradigm any such mispricing would be expected to be short-lived, with rational arbitrageurs tackling it immediately and leading prices to revert to fundamentals (Friedman, 1953; Fama, 1965); nevertheless, an extensive body of literature demonstrates that this need not necessarily be the case. On the one hand, rational investors may choose to launch new (or ride on existing) trends in order to exploit feedback traders' anticipated/existing participation in those by front-running those trends' reversals (i.e., by selling ahead of their feedback counterparts; De Long et al., 1990a; Brunnermeier, 2008). In this case, prices temporarily depart from fundamentals during the trend's upside, with rational speculators profiting at the upside's peak by simultaneously liquidating their positions and going short (since their sales will lead prices to slump, prompting feedback traders to sell too, thus further depressing prices and rendering short-selling profitable).[13] On the other hand, however, feedback traders can amplify the market's risk, making rational investors reluctant to arbitrage away any mispricing (De Long et al., 1990b; Abreu and Brunnermeier, 2003; Brunnermeier and Pedersen, 2005). This is particularly the case with professional money managers, whose periodic (often quarterly or semi-annual) performance evaluation may motivate them to invest based on short horizons; in this case, if the mispricing grows prolonged, they may end up shouldering heavy losses and be forced to engage in liquidations of their positions (Shleifer and Vishny, 1997; Coval and Stafford, 2007). To the extent that

this can adversely impact their career prospects, they may find it preferable to refrain from tackling the mispricing and simply ride on the trend until arbitrage activity picks up in the market (Matsushima, 2013).[14]

The above showcases that, even though feedback traders can promote mispricing, the latter may well be sustained by their rational counterparts, who, motivated either by speculative intent or risk-aversion, can allow the mispricing to continue for longer than would be theoretically assumed by proponents of neoclassical finance. This denotes that, aside from leading prices to deviate from fundamentals, feedback trading can also prompt rational investors to deviate from their stabilizing conduct in the market and temporarily tolerate (or even adopt) this behavioural trading pattern.[15] As a result, feedback trading need not be confined as a practice to "irrational"/less sophisticated investors but can also inform the strategies of sophisticated investors. This implies that the motives underlying its presence are versatile and we now turn to discuss them in detail in the next sub-section.

3.2 Feedback trading drivers

3.2.1 Cognitive drivers

Neuroscientific research has demonstrated that humans' choices and preferences prompt the activation and interaction of various brain regions, with the combinations and response rates of those regions varying conditional on a decision's complexity and risk/reward potential (Zak, 2004; Loewenstein et al., 2008; Glimcher, 2014). Evidence (Camerer et al., 2005; Miendlarzewska et al., 2019) suggests that the brain enlists the services of regions specialized in both controlled/cognitive (relying on effortful deliberation and analytical reasoning) and automatic (relying on reflexive reactions and heuristics) processing for decisions of varying content. This wealth of processing mechanisms is key in aiding individuals in their strive to

cope with their environment ("sense-making"; see Camerer et al., 2004, Zak, 2004), which is often typified by uncertainty. Although tackling this uncertainty would be expected to invite analytical processing, automatic processes tend to dominate controlled/cognitive ones, primarily because the latter involve a high degree of cognitive effort that can prove costly in terms of both information-acquisition and deliberation (Camerer et al., 2005; Ardalan, 2018). Automatic processes operate below the level of consciousness, develop over time as a result of experiences and habits, and can help reduce a decision-problem to something cognitively tractable (more so given the limitations inherent in human attention; Hirshleifer et al., 2011). With automatic processes often involving pattern-recognition (Zak, 2004), their relevance to feedback trading is obvious. Investors who cannot observe/process all information pertaining to their investments can focus on prices – which offer a statistical summary of market activity - as their main information signal to evaluate stocks without having to resort to time-consuming valuation-assessments (e.g., via fundamental analysis). In this case, prices can be employed for observational learning purposes;[16] learning from historical prices can be mediated by a host of behavioural forces (biases and heuristics) capable of prompting pattern-recognition, each of which can motivate feedback trading in distinct ways.

To begin with, for feedback traders to extrapolate from historical prices, the window of reference has to be defined, whose length (long or short) will determine the historical trend feedback traders will extrapolate on, thus denoting the importance of *anchoring* (Kahneman and Tversky, 1974) in the formation of their expectations. Once the reference window has been defined, feedback traders can extrapolate from it in several ways. It is possible that extrapolation can be influenced by the *representativeness heuristic* (Kahneman and Tversky, 1974; Barberis et al., 1998), which implies the extraction of inferences about a population based on a small, recent sample of observations. An investor employing this heuristic will likely associate a stock's recent positive (negative) performance with the stock being a good

(bad) pick and, hence, may choose to buy (sell) it, thus reinforcing the stock's recent trend and engaging in positive feedback trading[17]; this can further be reinforced by the *availability bias* (Barberis and Thaler, 2003), since a stock's recent performance is likely to be more easily retrievable in an investor's memory. An alternative possibility, however, in this case is that the investor believes in the stock's potential for mean-reversion (*gambler's fallacy*; Tversky and Kahneman, 1971), thereby selling (buying) the stock on its upside (downside) and thus promoting negative feedback trading. What is more, it is possible that her decisions can be affected by *conservatism bias* (Edwards, 1968; Barberis et al., 1998), which posits that individuals update their beliefs slowly in view of new information. In this case, if a new signal is at odds with the existing trend, the investor will downplay it and stick to her belief about the trend persisting; as such, conservatism bias helps support the continuation of trends, thus fostering the evolution of momentum in prices (Jegadeesh and Titman, 1993) and, hence, positive feedback trading. Another widely documented (see the discussion in Frydman et al., 2014) relevant behavioural factor is the *disposition effect*, according to which investors prefer to sell their winners sooner and hold their losers longer. This is largely – though not exclusively[18] - based on prospect theory (Kahneman and Tversky, 1979), which predicts risk-aversion (risk-seeking) in view of gains (losses) and can promote negative feedback trading (for outperforming stocks).[19]

However, feedback trading need not be motivated solely by extrapolative expectations; investors' learning experience with it can also affect its intensity. After all, even if feedback investors are presumed to be irrational, one might argue that any poor performance of such a strategy would lead them to discard it; nevertheless, a series of behavioural factors can challenge this line of argument, both when feedback trading yields profits and when it does not. On the one hand, a negative experience from participating in a trend-chasing speculative episode may be hard to recall (the episode may have taken place a long time ago; see the

availability bias mentioned earlier) and does not guarantee that investors will refrain from participating in another such episode in the future (no two episodes have to be the same).[20] On the other hand, a positive experience from feedback trading renders it more likely that an investor will continue pursuing it as a strategy, either due to the positive outcomes/emotions she has experienced from it (*reinforcement learning*; Choi et al., 2009; Strahilevitz et al., 2011) or because she believes this positive experience to be due to her skills (*overconfidence*; Kahneman, 2012).

3.2.2. Social drivers

The disposition of individuals toward certain topics evolves over time, giving rise to shifts in social mood; far from instantaneous, these shifts unfold over long horizons, during which initially proposed ideas grow in suggestion within a society, as they gradually become part of the social discourse. Once these ideas reach a certain threshold of social penetration, the social pressure and interaction[21] they motivate lead to the evolution of social movements that can set trends in various domains of people's lives (Fenzl and Pelzmann, 2012). From a financial viewpoint, social trends can impact economic decision making and, hence, lead investment trends (Shiller, 1984). The latter tend to rely on the commercialization of a social trend (e.g., adoption/acceptance of a new technology, product line, investment habit etc.) that prompts investors' interest in those firms relevant to the trend.

To the extent that individuals opt for riding onto such a trend via the investment route, the expected outcome is the generation of trend-chasing in the asset (or asset class) associated with the underlying social dynamics, thus rendering the latter a key factor in motivating positive feedback trading in markets. If positive feedback trading grows in popularity, this may also translate into herding (Hirshleifer and Teoh, 2003), since increasing numbers of investors will be chasing the same trend. An example of such a case is the increased postwar

interest in share-ownership by individuals in the US (discussed in detail in Shiller, 1984), which helped sustain the US equities' boom in the first two postwar decades. More recent examples include the dot-com bubble of the 1990s (largely based on the burgeoning social and commercial adoption of the internet; see Taffler, 2018) and the establishment of the cannabis stocks' sector in the past decade in North American exchanges (following the progressive shift in public opinion in favor of cannabis' decriminalization; Andrikopoulos et al., 2021).[22]

Social mood changes, however, need not necessarily be paradigm-shifting or groundbreaking for feedback trading to be affected. It is possible that regular and anticipated events with a specific mood-valence can also affect the propensity of investors toward feedback trading; Andrikopoulos et al. (2020), for example, demonstrated that feedback trading in stock markets of majority Muslim countries is far weaker during Ramadan (a month of positive social mood) compared to outside Ramadan. In addition, evidence from the literature on investor sentiment (a concept relevant, yet not synonymous, to mood)[23] indicates that (positive, in particular) sentiment shifts can motivate feedback trading in various asset classes, including futures (Kurov, 2008), equities (Dai and Yang, 2018) and exchange-traded funds (Chau et al., 2011).

3.2.3 Strategic behaviour drivers

3.2.3.1 Speculation

If noise traders exert a significant impact over securities' valuations, the latter will deviate from fundamentals and this will prompt rational investors to intervene and arbitrage away this mispricing (e.g., Friedman, 1953). An issue with this expectation is that it ignores the possibility of predatory incentives dominating arbitrage intentions in rational investors' decisions. The issue was touched upon in earlier centuries (Vega, 1688; Bagehot, 1873), with

Galbraith (1994) and Kindlberger and Aliber (2005) offering a broad set of examples of such behaviour from financial history. Rational investors can give rise to feedback trading via two different types of speculative conduct: rational and non-fundamental speculation.

Rational speculation involves speculators drawing on their informational superiority (in terms of fundamentals and their processing) to exploit their noise counterparts. The utilization of fundamentals for speculative purposes was delineated by Soros (1987), who argued that prices can bias noise investors' perceptions of fundamentals. According to his "reflexivity theory" (see section 3.1), launching price-trends can entice noise investors to ride on their waves and allow rational speculators to profitably exploit them. Soros' work (alongside earlier literature on historical speculative episodes mentioned above) motivated De Long et al. (1990a), the key – and, perhaps, most widely cited - academic finance treatise modelling analytically how rational speculators exploit noise investors *per se*.[24] The authors show that, if rational speculators receive a private signal indicating that positive news will arrive at some point in the future, they would prefer to trade on that information early on (i.e., buy early) and give rise to an uptrend, in anticipation of noise investors jumping on it. Since this would motivate overreaction in prices, it would allow speculators to profit both by selling at high price-levels and by simultaneously going short (their sales would lead prices to fall, prompting noise traders to follow the downtrend and sell, thus depressing the price even more, rendering short-selling profitable). As a result, rational speculators in De Long et al. (1990a) motivate positive feedback trading by launching a trend in the first place, in anticipation of noise traders' response (i.e., trend-chasing) to it.[25]

However, speculation in capital markets need not be rational, i.e., based on informed investors exploiting their superior knowledge of fundamentals[26] to front-run their uninformed counterparts. Many a time, those engaged in speculation rely on information of a non-fundamental nature (possibly motivated by lack of fundamental-processing skills or high

cost of information). Non-fundamental speculators tend to draw on knowledge of some feature of the trading process (such as the order-flow) in order to either forecast/pre-empt trading activity or trail it. Examples of this kind of conduct include trade-based manipulation (Allen and Gale, 1992)[27], order-flow learning (Madrigal, 1996; Yang and Zhu, 2017)[28] and brokers front-running their own clients (Khwaja and Mian, 2005). If a speculator tries to front-run the order-flow of other investors, she is likely to generate positive feedback trading, by launching a trend and expecting them to follow it; this has been theoretically discussed in De Long et al. (1990b) and empirically verified on the premises of brokerage data by Khwaja and Mian (2005).[29] If, on the other hand, she tracks the order-flow of other investors, then she is likely to be the one positive feedback trading (Allen and Gale, 1992; Madrigal, 1996; Yang and Zhu, 2017).

3.2.3.2 Informational payoffs

Information is neither in equal supply, nor does it diffuse uniformly across assets; small capitalization stocks and stocks of low analyst following, for example, tend to enjoy limited informational coverage and, hence, present themselves with greater informational uncertainty (Hong and Stein, 1999). In addition, investors trading in overseas markets may experience an informational disadvantage *vis-à-vis* their indigenous peers, in terms of either access to local information or ability to process it (Brennan and Cao, 1997; Gelos and Wei, 2005). What is more, acquiring private signals about assets whose pool of information is poor can involve high information costs and this may encourage investors to either abstain from trading those assets or rely on alternative (presumably, non-fundamental) indicators when trading them.

These circumstances imply high information risk and one way to mitigate it is by resorting to price-monitoring; the crux of the argument here is that past prices can allow an individual to learn something about an asset for which they know little.[30] In this case, similar to what we

mentioned in section 3.2.1, prices serve observational learning purposes; however, their employment is not motivated by behavioural reasons but rather by the need to extract informational payoffs from them (e.g., learn something about the past trades of others). Although prices constitute a noisy statistical summary of other investors' trades (Hirshleifer and Teoh, 2003), they can be viewed as informative enough in settings characterized by informational ambiguity (Grossman, 1989).[31] This would suggest the presence of stronger feedback trading in investments with such ambiguity and, as we shall discuss later in this study, there exists ample evidence in support of feedback trading in small capitalization stocks and among investors trading in foreign markets.

3.2.3.3 Risk aversion

A series of trading tools and strategies activated conditional on directional (up/down) price-movements can motivate feedback trading among investors whose risk-preferences are sensitive to changes in their wealth. Market downtrends, for instance, can witness enhanced activation of stop-loss sell orders[32] and portfolio insurance[33] (Sentana and Wadhwani, 1992); this is considered rational if investors are unable/unwilling to accept losses beyond a certain fraction of their wealth (Grossman and Zhou, 1996) - and the adverse effects of these losses over their consumption (Dybvig, 1995). Since the activation of stop-loss sell orders and portfolio insurance leads to liquidations of positions during price slumps, this suggests that they help enhance positive feedback trading (Balduzzi et al., 1995; Osler, 2005). A similar effect is conferred by margin trading (Watanabe, 2002; Hirose et al., 2009); assuming a fall in prices, investors trading on margin would be expected to unload their positions to cover their obligations to their brokers, thus amplifying the downtrend.[34] On the other hand, if the market is on an uptrend, investors may activate stop-loss buy orders[35] as well as increase their margin trading positions in anticipation of the trend's continuation, thus again boosting positive feedback trading.[36]

3.2.3.4 Technical analysis

Technical analysis constitutes an active money management approach whose seminal practice can be traced centuries ago.[37] It comprises a set of rules based on extrapolating from historical data (primarily, prices and volume) to trace past trends and project them into the future and its key precept is that monitoring historical prices is key to identifying investors' sentiment (and their willingness to trade on it). Primarily, it relies on three foundations (Murphy, 1999; Kirkpatrick and Dahlquist, 2006; Lo and Hasanhodzic, 2010): a) prices reflect all available beliefs/information of investors (thus implying that there is little need in studying fundamentals); b) prices generate patterns (trends) over time; and c) these patterns are recurring and can be modelled. In order to identify buy/sell signals to trade on, technical analysts draw on a rather large battery of indicators (see Nazário et al., 2017 for a survey of the relevant literature), including traditional chartist indicators[38], automated trading tools[39] and combined signals (whereby technical trading rules are combined among themselves as well as with non-technical elements)[40]. Contingent on the historical trends identified, different technical rules can prompt their adherents to follow those trends (positive feedback trading) or buck them (negative feedback trading). Despite the negative treatment it has occasionally received by neoclassical finance research[41], technical analysis is widely practiced in various asset classes, including equities (Nazário et al., 2017), foreign exchange (Taylor and Allen, 1992; Menkhoff and Taylor, 2007; Park and Irwin, 2007) and derivatives (Park and Irwin, 2007) with evidence suggesting that – to varying extents – it remains popular among traders.[42]

3.2.3.5 Style investing

Style investing is an umbrella-term encompassing any strategy whereby stock-selection takes place on the premises of specific stock-characteristics (hence, it has also come to be known as

"characteristic trading"; Barberis and Shleifer, 2003) and is commonly observed among institutional investors (e.g., Hong and Stein, 1999). Examples of stock-selection characteristics include value (e.g., value versus growth strategies), industry (strategies targeting a broader industry, such as e.g., pharmaceuticals, or a narrower sector, such as e.g., biotechnology), size (e.g., strategies targeting large, mid or small capitalization stocks) and past performance (e.g., momentum and contrarian strategies). Categorizing stocks by a given characteristic helps simplify the stock-selection problem (Barber et al., 2009); whereas sell-decisions involve choosing stocks to sell from among those already in an investor's portfolio, buy-decisions merit extrapolating from the universe of listed stocks. This is particularly useful for institutional investors, since it allows them to process information more efficiently and provides them with a benchmark (the average performance of their style) against which they can be evaluated (Barberis and Shleifer, 2003).

Style investing can motivate feedback trading of either sign in multiple ways. To begin with, styles can (as mentioned above) involve strategies based on past performance, such as momentum and contrarian; to the extent that many funds follow such strategies, this can amplify feedback trading in the market.[43] Second, styles that outperform (underperform) during a period can motivate funds to switch to (away from) them, thus prompting trending toward (away from) stocks belonging to those styles (style-based feedback trading; see Barberis and Shleifer, 2003 and Frijns et al., 2016). Third, combinations of different styles may also entail predictable patterns, which could be exploited by feedback trading on them at the style-level; for instance, Barberis and Shleifer (2003) showed that strong autocorrelations are not only observed within-style but also across-styles and demonstrated the profit-potential of combining different styles. Fourth, style-feedback need not only be motivated via a "horseracing" among styles but also via switching of fundamentals-driven investors to trend-following strategies (Lux, 1998; Chiarella et al., 2014; He and Zheng, 2016); motivated by

utility-maximization, this decision hinges on investors opting for the strategy with the highest relative profitability during a given period, irrespective of its fundamental or style nature.

3.2.3.6. Agency concerns

Although informed investors can engage in rational speculation at the expense of their noise peers, this is by no means the sole outcome of their interaction. A series of studies (De Long et al., 1990b; Abreu and Brunnermeier, 2003; Brunnermeier and Pedersen, 2005) have showcased that rational investors are far less willing to engage in arbitrage if noise investors enhance the risk-level of the market. Noise investors can exacerbate fundamental risk (e.g., deteriorating fundamentals may prompt noise traders to push prices to levels lower than warranted by fundamentals – see what we mentioned earlier regarding reflexivity theory) and can give rise to noise trader risk (De Long et al., 1990b). In this case, mispricing can become prolonged, rendering arbitrage costly for professional money managers (key candidates for arbitrageurs; Shleifer and Vishny, 1997), whose investment horizons can be rather short, considering that their performance evaluation takes place at regular (usually quarterly) intervals. A prolonged mispricing can lead them to suffer losses and be forced to unload their positions to cover those losses; as this can entail dire career consequences, they may choose to desist from arbitrage, and/or ride on the trend (if they believe they can profit from it). If so, then any trend (be it upward or downward) reflective of mispricing (and, hence, positive feedback trading) can continue, up to the point where noise trader demand will be exhausted or arbitrageurs will choose to become active (Matsushima, 2013).

Another avenue through which agency concerns can incite feedback trading is window dressing (Lakonishok et al., 1991; Agarwal et al., 2014); in view of their aforementioned regular performance evaluation, fund managers often resort to adding (removing) recent winners (losers) to (from) their portfolio in order to emit an image of competence, thus

contributing to positive feedback trading in the market. In addition, if fund managers of high quality pursue an outperforming investment style, their lower quality peers may end up copying it in order to improve their professional image; if so, this will enhance herding among fund managers and amplify style-based feedback trading.

3.3 Summary

The discussion above indicates that feedback trading is a versatile practice, rooted in both behavioural, as well as non-behavioural considerations. From a behavioural perspective, social mood shifts, alongside a series of biases and heuristics associated with extrapolation (anchoring; representativeness; gambler's fallacy; conservatism; availability bias; disposition effect) and self-assessment (overconfidence; reinforcement learning) can give rise to feedback tendencies among investors. However, investors practicing feedback trading are not necessarily behaviourally motivated, as there exists a host of rational reasons that can prompt the emergence of such a practice. Key among those reasons is speculation, whereby some investors try to prey on their peers drawing on their informational superiority (rational speculation) or some non-fundamental feature of their environment (non-fundamental speculation). In addition, feedback trading can be encouraged via institutional investors' agency concerns; it can also be driven by informational reasons (monitoring prices can function as a substitute for missing/opaque information) and risk aversion (conditioning trades on price-movements in order to mitigate losses during price-slumps). What is more, several trading strategies (technical analysis; style investing) can also motivate investors to track historical trends. In the next section we discuss the empirical evidence on feedback trading in order to gauge the popularity of this trading pattern across various asset classes.

4. Empirical evidence

We discuss the extant empirical literature on feedback trading for each asset class (equity indices/equities; fixed-income; derivatives; exchange-traded funds; currencies; depository receipts; property; commodities; cryptocurrencies), as well as styles, separately. As studies on equities command a clear majority of this literature, research on this asset class is presented using a binary classification (micro/macro), contingent on whether it involves data specific to an investor-type (domestic institutional; foreign; retail) or aggregate market prices.[44]

4.1 Equity markets

4.1.1. Micro level

Studies on feedback trading at the micro level in equity markets rely on data of varying frequency (ranging from high frequency to annual) that allow us to decipher the trading behaviour of distinct investor types, such as institutional, retail and foreign. These studies utilize two basic types of data. On the one hand, many use proprietary data, normally trades and/or holdings, which contain identifiers for each investor; on the other hand, others employ data aggregated per investor type (e.g., investment flows for institutional investors), without direct identifiers for individual trading participants. The key types of investors studied in this research line are domestic institutional, foreign (who are, near-exclusively, institutional) and domestic retail (foreign retail traders are normally of residual presence in most cases). As a general observation, domestic institutional and foreign investors tend to exhibit positive feedback trading in a clear majority of cases, with the bulk of evidence on retail investors indicating that they display contrarian tendencies.

4.1.1.1 Domestic institutional investors

Empirical research on domestic institutional investors suggests they are prone to (positive, in most cases) feedback trading internationally, a fact which has been largely attributed to non-

behavioural reasons. Agency concerns feature prominently among the latter; US fund managers have often been found to positive feedback trade, for example, a fact which has been associated with window dressing and reputational reasons (Lakonishok et al., 1992; Grinblatt et al., 1995; Nofsinger and Sias, 1999; Wermers, 1999). Their momentum patterns tend to amplify during crisis-periods, implying the relevance of risk aversion as a driver of those patterns (i.e., unloading their positions during crises to curtail their losses)[45]; this has been confirmed for the dot com crash (Greenwood and Nagel, 2009)[46] and the global financial crisis (Babalos et al., 2021).[47] Fund managers' agency concerns can also be impacted by their regulatory environment – and its evolution over time – and this has been found to affect their feedback trading; regulatory requirements, for example, can affect asset allocation in pension funds and motivate feedback trading of either sign, as evidence from Poland (Voronkova and Bohl, 2005) and the UK (Blake et al., 2017) demonstrates. Changes in a market's regulatory setting can also impact its funds' feedback trading patterns; examples of such changes include financial liberalization (Yang, 2002)[48], deregulation (Kim and Nofsinger, 2005)[49] and cross-border exchange membership (Gavriilidis et al., 2013).[50]

To the extent that fund managers are subject to a relative assessment framework (i.e., their performance is assessed versus that of their peers or specific indices), any feedback trading observed among them would likely be associated with correlations in their trades (to avoid deviating from their performance-benchmark). Indeed, most research on institutional investors' behaviour examines feedback trading alongside herding and denotes that the two patterns co-exist, with some studies demonstrating that feedback trading motivates herding (Grinblatt et al., 1995; Wermers, 1999; Voronkova and Bohl, 2005; Wylie, 2005; Walter and Weber, 2006; Hung et al., 2010; Chiao et al., 2011; Kremer and Nautz 2013; Celiker et al.,

2015) and other studies (Lakonishok et al. 1992; Nofsinger and Sias, 1999; Sias, 2004; Choi and Sias, 2009; Gavriilidis et al., 2013; Blake et al., 2017) reporting no evidence of this.

Style-investing based on size or past performance can motivate feedback trading of either sign internationally (Bennett et al., 2003; Choi and Sias, 2009; Hung et al., 2010; Kremer and Nautz, 2013; Celiker et al., 2015)[51], part of which may be the result of preference-shifts of mutual funds.[52] The role of speculation has also been confirmed, with Liao et al. (2011) reporting evidence of US funds negative feedback trading based on idiosyncratic sentiment, selling stocks with highly optimistic sentiment (presumably, those most overpriced due to noise trading). What is more, fund managers' feedback trading is motivated by the extraction of informational payoffs; as ample evidence (Lakonishok et al., 1992; Nofsinger and Sias, 1999; Wermers, 1999; Voronkova and Bohl, 2005; Ng and Wu, 2007; Sias, 2007; Hung et al., 2010)[53] denotes, they tend to feedback trade the most among smaller stocks (whose informational coverage is relatively limited).[54] On the other hand, correlated information processing (see Chiao et al., 2011 for evidence from Taiwan) and investment preferences (Iihara et al., 2001; Bennett et al., 2003; Voronkova and Bohl, 2005) can prompt fund managers to exhibit strong feedback trading (primarily of positive sign) towards very large capitalization stocks.[55]

Overall, extant empirical findings reveal that domestic institutional investors are prone to feedback trading; with the exception of some evidence of negative feedback trading, fund managers tend to mostly momentum trade in their domestic markets. [56] This appears to be non-behaviourally motivated, with agency concerns, risk aversion, informational payoffs, and style investing appearing relevant to it.

4.1.1.2 Foreign investors

Research on foreign investors' feedback trading is often motivated by financial episodes, in view of foreign funds' treatment as crises-transmitters in emerging markets (e.g., Kim and Wei 2002a, b). Empirical evidence suggests that higher frequencies tend to return more evidence in support of their feedback trading, thus denoting that foreign funds employ such strategies for short-horizon investments. On balance, most studies confirm foreign funds' momentum trading in emerging markets, including Brazil (Gonçalves and Eid, 2017), India (Arora, 2016; Hiremath and Kattuman, 2017; Chauhan and Chaklader, forthcoming), Malaysia (French, 2017; Liew et al., 2018), South Korea (Kim and Wei, 2002b; Choe et al., 2005; Oh et al., 2008; Kim et al., 2009; Jeon and Moffett, 2010; Hong and Lee, 2011; Ikizlerli et al., 2019), Taiwan (Chang, 2010; Chiang et al., 2012; Liao et al., 2013; Hsieh, 2013), Thailand (Phansatan et al., 2012; French, 2017), and Vietnam (Vo, 2017). As per developed markets, similar evidence surfaces in Finland (Grinblatt and Keloharju, 2000, 2001; Do et al., 2008), Germany (Baltzer et al., 2019), Japan (Karolyi, 2002; Kamesaka et al., 2003; Hood et al., 2013), and Sweden (Dahlquist and Robertsson, 2004); this pattern is also confirmed in cross-market studies at the regional (Kaminsky et al., 2004; Hsieh et al., 2011; Chakraborty and Kakani, 2016) and global (Froot et al., 2001; Choi and Skiba, 2015; Kanas and Karkalakos, 2017) levels. Contrarian trading among foreign investors is less frequently encountered, having been documented to date in South Korea (Wang and Lee, 2015), Taiwan (Yang, 2002), Turkey (Adaoglu and Katircioglu, 2013; Ülkü and Ikizlerli, 2012) and European emerging markets (Ülkü, 2015).[57]

Key in motivating feedback trading among foreign portfolio investors is their perceived informational disadvantage *vis-à-vis* their domestic counterparts in their host markets, as has been documented in a series of studies (Brennan and Cao, 1997; Kim and Wei, 2002b; Choe et al., 2005; Kim et al., 2009; Arora, 2016; Gonçalves and Eid, 2017; Hiremath and Kattuman, 2017; Chauhan and Chaklader, forthcoming). To the extent that buy-decisions are

more taxing compared to sell-ones (buy-decisions involve choosing from among the universe of listed stocks; sell-decisions involve focusing on the stocks already present in one's portfolio), one might expect this informational uncertainty to motivate stronger feedback trading on the buy-side. Some research does, indeed, confirm that foreign investors positive feedback trade much more strongly (Vo, 2017), or even exclusively (Dahlquist and Robertsson, 2004), on the buy-side. Other studies (Samarakoon, 2009; Dhingra et al., 2016) showcase that their feedback trading switches signs between the two sides (positive on the buy- and negative on the sell-side), while Chiang et al. (2012) showed that positive feedback trading holds for both sides of the market, yet varies with the magnitude of order-flows' deviation from their equilibrium value.[58] What is more, Liao et al. (2013) showed that foreign funds in Taiwan momentum traded more in those stocks in which they had already built substantial ownership stakes (suggesting a role for familiarity or habit investing).

On the other hand, some research (Froot et al., 2001; Kamesaka et al., 2003; Oh et al., 2008; Hong and Lee, 2011; French, 2017; Liew et al., 2018; Ikizlerli et al., 2019) shows that foreign feedback traders are informed, rationally updating their trading to market conditions (e.g., macroeconomic events – see Adaoglu and Katircioglu, 2013 and Ülkü and Ikizlerli, 2012), often outperforming their domestic peers. Their feedback trading can be motivated either by aggregate market (Ülkü and Ikizlerli, 2012) or individual stock (Choe et al., 1999) returns – or both (Porras and Ülkü, 2015); in addition, Phansatan et al. (2012) showed that foreign investors in Thailand bore an informational advantage over their local peers at the macro (i.e., in terms of timing the market), yet not at the micro (i.e., their security selection was suboptimal) level.

With respect to financial crises – which have triggered much of the research on foreign portfolio investors – evidence is notably mixed. The 1994 Mexican crisis prompted stronger momentum among foreign traders in 13 Latin American markets (Kaminsky et al., 2004);

much more research is available regarding the 1997 Asian crisis, without, however, results appearing consistent. Choe et al. (1999) showed that foreign funds momentum traded before, yet not during the Asian crisis in South Korea; conversely, Kim and Wei (2002a) found that offshore (onshore) funds contrarian (momentum) traded in that market within the Asian crisis, with similar results reported by Kim and Wei (2002b) for non-resident investors. Regarding Taiwan, Lin (2006) reported no difference in foreign funds' positive feedback trading within-versus-outside the Asian crisis, while Chen et al. (2012) showed that foreign funds negative (positive) feedback traded within (before) the outbreak of the global financial crisis.[59]

The above indicates that foreign funds are susceptible to (mainly positive) feedback trading in overseas markets due to informational payoffs. In most cases, they rely on historical prices to bridge the informational gap between them and their domestic peers; occasionally, however, they employ feedback patterns even when informed, potentially for speculative purposes.

4.1.1.3 Retail investors

A large volume of studies has assessed the trading behaviour of retail investors on the premises of either brokerage accounts' data or aggregate trading flows' data. The findings reported suggest that individual investors almost always engage into feedback trading of either sign.[60] In most cases, their behaviour is reflective of negative feedback trading, something which has been confirmed in several markets, including Australia (Colwell, et al., 2008; Henker and Henker 2010), China (Feng and Seasholes, 2005; Ng and Wu, 2007), Finland (Grinblatt and Keloharju, 2000, 2001; Vieru et al., 2006; Linnainmaa, 2010), France (Barrot et al., 2016), Japan (Iihara et al., 2001; Hood et al., 2013), Malaysia and Thailand (French, 2017), Qatar (Ahmed, 2014), South Korea (Oh et al., 2008; Hong and Lee, 2011; Ikizlerli et al., 2019), Sri Lanka (Samarakoon, 2009), Taiwan (Hsieh, 2013), and the US

(Warther, 1995; Odean, 1999; Bange, 2000; Barber and Odean, 2000; Griffin et al., 2003; Kaniel et al., 2008). On the other hand, a smaller number of studies report evidence of retail investors exhibiting positive feedback trading in China (Ng and Wu, 2007), Japan (Kamesaka et al., 2003) and the US (Hvidkjaer, 2006; Bailey et al., 2011; Humphrey et al., 2013).[61]

The propensity of retail investors toward feedback trading has often been ascribed to them being the prime candidates for noise trading, amid the confluence of biases and heuristics affecting their investment decisions (Barber et al., 2009; Barber and Odean, 2013). In that vein, retail investors have been found to feedback trade motivated by an array of such forces, including attention-grabbing (Barber and Odean, 2008; Barber et al., 2009), disposition effect (Odean, 1999; Grinblatt and Keloharju, 2001; Barber et al., 2009; Linnainmaa, 2010; Bailey et al., 2011; Chordia et al., 2016; Baltzer et al., 2019), overconfidence (Odean, 1999; Vieru et al., 2006) and representativeness heuristic (Barber et al., 2009).

A reflection of retail investors' relatively lower financial sophistication that can motivate feedback trading[62] is their extensive use of limit orders in order to time the market, despite evidence (e.g., Linnainmaa, 2010) suggesting they are not particularly successful at doing so. Since rising (falling) markets tend to trigger sell (buy) limit orders, this implies that limit orders can give rise to negative feedback patterns. Evidence from Germany (Dorn et al., 2008) and the US (Kelley and Tetlock, 2013), indeed, indicates that retail investors' momentum (contrarian) trading is associated with market (limit) orders, with Linnainmaa (2010) ascribing Finnish individual investors' negative feedback trading to limit orders as well. Conversely, Lee (2016) found that South Korean retail traders exhibited momentum (contrarian) behaviour when employing limit (market) orders, which was attributed to differences in the investors' base between South Korea (which bears strong retail participation) and the US/European markets (where retail participation is lower).

Style-investing appears to occasionally motivate feedback trading among retail investors, yet evidence on this is rather sparse, compared to that concerning their domestic institutional counterparts. Japanese retail investors, for example, have been found (Kim and Nofsinger, 2007)[63] to negative (positive) feedback trade with a focus on riskier (value) stocks during bear (bull) markets; specifically with regards to (retail, in their majority) margin traders in Japan, Hirose et al. (2009) showed that they positive (negative) feedback traded at the market (stock) level on the buy side and that margin buying was associated with negative (positive) feedback trading for stocks of large (small) capitalization.[64] The association of stock-size with the sign of feedback trading was further documented by Bradrania et al. (2017), who reported contrarian (momentum) tendencies among Australian retail investors when trading stocks of large/mid (small) capitalization.[65] With respect to US retail traders, Jame and Tong (2014) found that they tend to be momentum trading at the industry level; this is confirmed at the firm-level for long horizons, yet not for short ones (for which they are found to contrarian trade).[66]

Overall, research denotes that retail investors are rather prone, in most cases, to negative feedback trading, largely motivated by behavioural reasons and (to a lesser extent) by style investing. Perhaps unsurprisingly (given their less sophisticated background), their feedback trading is not associated with outperformance; indeed, a rather common finding across several studies (Barber and Odean, 2000; Grinblatt and Keloharju, 2000; Kamesaka et al., 2003; Kim and Nofsinger, 2007; Oh et al., 2008; Linnainmaa, 2010; Ahmed, 2014; Kim and Park, 2015; Bradrania et al., 2017) is that retail traders following such strategies tend to underperform their institutional (and, presumably, more informed) counterparts, losing money in the process.[67]

4.1.2. Macro level

Empirical research on feedback trading at the macro level relies on either market index values or stock prices. This line of empirical research employs data whose frequency is, on average, higher (daily, in most cases) than that of the data employed at the micro level and has to date produced evidence illustrating the presence of (primarily, positive) feedback trading in various equity markets internationally.

4.1.2.1 Equity market indices

Research exploring feedback trading with respect to equity market indices is undertaken almost always at the daily frequency and relies predominantly on the empirical design proposed by Sentana and Wadhwani (1992).[68] The findings generated to date confirm the presence of (mainly positive) feedback trading across a broad cross-section of both developed (Sentana and Wadhwani, 1992; Koutmos, 1997; Watanabe, 2002; Westermann, 2004; Venetis and Peel, 2005; Chau and Deesomsak, 2015; Gebka and Serwa, 2015; Chau et al., 2016; Goyal et al., 2018; Kusen and Rudolf, 2019; Chen and McMillan, 2020) and emerging/frontier (Koutmos and Saidi, 2001; Koutmos et al., 2006; Moore, 2007; Bohl and Siklos, 2008; Schuppli and Bohl, 2010; Gebka, 2012; Chau et al., 2013; Chowdhury et al., 2015; Kuttu and Bokpin, 2017; Kyrkilis et al., 2018; Dai and Yang, 2018; Andrikopoulos et al., 2020) equity markets. Although the evidence suggests that emerging/frontier markets are more prone to accommodating feedback trading, its significance is often manifested in developed markets as well, though less frequently so.

A key stylized feature of feedback trading encountered in both developed (Sentana and Wadhwani, 1992; Koutmos, 1997) and emerging/frontier (Koutmos and Saidi, 2001; Schuppli and Bohl, 2010; Kuttu and Bokpin, 2017) markets over different decades is that it tends to grow stronger during market downturns compared to upswings.[69] This directional

asymmetry has been attributed to investors' risk-aversion declining with wealth, prompting them to engage in sales during market slumps (possibly via the activation of portfolio insurance and stop-loss orders, as well as the unloading of margin positions, as these studies suggest). Such behaviour would be expected to be further observed during periods of market stress; however, results on this appear relatively mixed. Some studies find that positive feedback trading across European markets grew more pronounced in the global financial crisis' aftermath, motivated by size-effects (Kyrkilis et al., 2018) and the concomitant liquidity shocks (Chen and McMillan, 2020); evidence from cross-border European exchanges (Euronext; OMX), however, indicates a weaker presence of feedback trading following the crisis' outbreak (Goyal et al., 2018), while Andrikopoulos et al. (2020) report little difference in feedback trading before and after its outbreak across emerging and frontier markets internationally.[70]

A series of studies has also assessed the impact of institutional changes over feedback trading, in order to gauge whether improvements in the quality of the market environment – and their anticipated benefits over informational flow/transparency - can reduce investors' propensity to feedback trade. The latter was, indeed, confirmed in Chinese markets following the opening of A-shares to qualified overseas institutional investors in 2001-2002 (Schuppli and Bohl, 2010), in developed European markets following the adoption of the Euro in 1999 (Westermann, 2004) and in developed stock markets internationally following the introduction of index futures (Antoniou et al., 2005). A similar picture was reported for European transition economies following adoption of International Financial Reporting Standards in 2005 (Chau et al., 2013) and their accession to the European Union in 2004 (Moore, 2007).[71] To the extent that institutional changes involving improvements in a market's informational quality (e.g., via the entry of foreign investors or higher transparency

levels) dampened feedback trading in the above cases, this suggests a role for informational payoffs as a driver behind feedback trading prior to the introduction of those changes.

Some studies have examined the association of feedback trading with sentiment, motivated by the assumption that noise traders are related to sentiment-shifts in the market (De Long et al., 1990b). Chau et al. (2016) found that sentiment-watchers in the US countered the prevailing market sentiment during pessimistic/bear markets (i.e., were contrarian) for the 1978-2011 period, thus demonstrating that trading on sentiment can involve speculative considerations (e.g., to exploit noise investors). On the other hand, Dai and Yang (2018) showed that Chinese investors projected stronger feedback trading between 2007 and 2016 during periods of both very optimistic and very pessimistic (yet not average) sentiment in their domestic markets, more so following the introduction of short-selling in 2010.[72] In addition, Andrikopoulos et al. (2020) demonstrated that investors in eleven majority Muslim markets tended to feedback trade outside, as opposed to within, Ramadan (a period traditionally associated with positive social mood in the Muslim world) during the 2001-2016 window.[73]

A small number of studies have investigated cross-market feedback trading, namely whether feedback trading in a market is motivated by other markets' returns. Along these lines, Gebka and Serwa (2015) showed that the 1990-2010 period witnessed positive feedback trading in G7 markets driven by return-spillovers from the US, with Kusen and Rudolf (2019) reporting evidence of cross-market feedback trading in major international stock markets (i.e., investors were prone to trading on foreign markets' historical returns) between 2007 and 2017.[74],[75]

Overall, equity market indices internationally accommodate (mostly positive) feedback trading, more strongly so in emerging/frontier markets. Although macro level findings are, by

nature, less informative about trading motives (they do not pertain to identifiable investor-types), empirical evidence from the market index level indicates that feedback trading appears to be often motivated by non-behavioural (risk aversion; informational payoffs; speculation) reasons.

4.1.2.2 Individual stocks

A smaller amount of literature has investigated the presence of feedback trading in equity markets at the macro level using the prices of samples/the universe of individual listed stocks. This research line is rather heterogeneous in terms of the sampling procedure, as well as the empirical methods employed; this heterogeneity is primarily due to many of these studies utilizing feedback trading as a control factor when testing some theory (rather than being explicitly focused on feedback trading *per se*).

A theme permeating some of these studies is stock return autocorrelation and whether it is driven by feedback trading (among other factors). In the context of a regression framework, Säfvenblad (2000) documents a significantly positive average daily first-order return autocorrelation across 62 major stocks traded on the Stockholm Stock Exchange between 1980 and 1995, attributing it to negative feedback traders engaging in profit-taking following positive recent equity performance. Miwa and Ueda (2011) found that monthly autocorrelations in US stocks amplify following large volume-rises for the 1987-2006 period and illustrated how this could be motivated by positive feedback trading. Drawing on a set of 423 listed stocks from the UK market for the 2007-2012 window, Gebka and Wohar (2013) demonstrated using a quantile regression framework that daily autocorrelation varied across different performance quantiles, with negative feedback trading being a key candidate in explaining the positive autocorrelations observed among lower-return quantiles. Wan and Yang (2017) use the Sentana and Wadhwani (1992) model and report positive feedback

trading among the constituent stocks of the SZ300P index (which includes the 300 largest stocks listed on the Shenzhen stock exchange) during the 2010-2013 period for various high frequencies (5/10/30 minutes), with its presence found to amplify return-autocorrelation.

Similarly to what we discussed earlier regarding market indices, some studies assess the effect of institutional changes over feedback trading using individual equities. Chau et al. (2008) explored the effect of the introduction of Universal Stock Futures (USFs) over feedback trading in UK-listed stocks with USF contracts linked to them and found that USFs' introduction further dampened (the already limited pre USF introduction) feedback trading among those stocks. Bohl et al. (2013) explored whether short-selling bans helped determine the presence of feedback trading in a set of six developed stock markets during the years of the global financial crisis (2008-2009) and reported results denoting that the short-sales' bans during that period led to heightened levels of positive feedback trading in most cases.[76]

Investigating feedback trading at the stock-level can also yield insights as to whether some stocks are more prone to feedback trading than others and which sign their feedback trading assumes; such information can culminate in a "mapping" of the market based on investors' feedback trading tendencies and potentially help inform trading strategies. In that respect, using daily data from all US listed stocks for the 1980-2009 window, Shi et al. (2012) showed that extreme recent underperformers were more likely to entail positive feedback trading and that there existed a positive relationship between the presence of the latter in a stock and that stock's informational uncertainty. The authors further demonstrated that exploiting the strength of positive feedback trading at the stock-level could help enhance the profitability of momentum strategies. A similar "mapping" at the daily frequency (based on Sentana and Wadhwani, 1992) is provided by Charteris and Rupande (2017), who showed that about a fifth to a third (contingent on the horizon examined) of listed stocks on the South

African stock market exhibited (negative, in the majority of cases) feedback trading between 2004 and 2013.[77]

Overall, evidence from empirical studies on feedback trading using individual equities denotes a strong association between feedback trading and return-autocorrelation, although causality between the two cannot readily be inferred from the studies at hand. To the extent that autocorrelation motivates/is motivated by feedback trading, this can be a reflection of extrapolation from/amplification of price-trends due to behavioural (e.g., noise traders' biases and heuristics) and non-behavioural (e.g., style investing; speculation on noise-motivated price-trends) reasons.

4.2 Fixed-income

Unlike the literature for equity markets, research on feedback trading in fixed-income markets is very limited in size. By and large, the evidence available suggests that positive feedback traders grow more active in bond markets during periods of high volatility, resulting in negative return-autocorrelation (Dean and Faff, 2008, 2011[78]; Cohen and Shin, 2013)[79]; these studies largely ascribe this to the institutional environment of bond markets that impacts bond traders' professional conduct and risk-preferences. The contribution of institutional investors to feedback trading in this asset class is far from clear; though Wei (2018) shows that US funds were rational investors (as opposed to their retail counterparts) during the 2002-2014 period, Cai et al. (2012) find them to be consistent momentum traders chasing inter-quarter returns between 2003 and 2008.[80] Evidence from European markets (Frijns et al., 2020) denotes a tendency on behalf of bond traders to switch between arbitrage and feedback strategies during the 2008-2015 window, contingent on the relative performance of each over time, suggesting that style-feedback (i.e., adopting styles when they outperform) likely motivates their trades.[81]

4.3. Derivatives

The bulk of research on feedback trading in derivatives' markets pertains to index futures contracts[82], with a large number of studies (Wang, 2002, 2003; Ghysels and Seon, 2005; Cheng et al., 2007; Kurov, 2008; Salm and Schuppli 2010; Antoniou et al., 2011; Lai and Wang, 2014, 2015; Smales, 2016; Chen and Yang, 2021) confirming empirically the significance of (predominantly, positive) feedback trading in that segment.[83] At the macro level, positive feedback traders often appear more active in index futures during market slumps (likely due to index futures being utilized for portfolio insurance - Salm and Schuppli, 2010; Antoniou et al., 2011)[84] and extrapolate from horizons of several days ("long memory"; Antoniou et al., 2011).

At the micro level, research offers evidence on feedback trading from three markets (US; South Korea; Taiwan) and allows us to gauge the variations in feedback trading across different trader-types. Studies on US futures' markets indicate that hedgers (speculators) engaged in positive (negative) feedback trading during the 1990s (Wang, 2002, 2003); however, Smales (2016) demonstrated that hedgers (speculators) negative (positive) feedback traded during the 1997-2012 period, yet switched feedback trading signs within the global financial crisis.[85] In addition, US index futures traders have been found to project feedback trading when sentiment (extracted via sentiment surveys) is high (Kurov, 2008) and uncertainty (proxied by the CBOE VIX index) is low (Chen and Yang, 2021).[86] In the case of Taiwan, earlier evidence by Cheng et al. (2007) suggested that positive feedback trading in index futures was confined to retail traders and dealers at the weekly frequency during 2001-2002, with no other trader-type found to feedback trade; later evidence (Lai and Wang, 2014, 2015), however, denotes that foreign investors (investment trusts) negative (positive) feedback traded during the 2008-2013 window at the daily frequency. Finally, with respect to South Korea, Ghysels and Seon (2005) found that foreign and domestic institutional

(domestic institutional and retail) investors positive (negative) feedback traded in the futures market at the daily frequency prior to the outbreak of (during) the Asian crisis in 1997. Overall, the feedback trading of the various trader-types discussed above is largely attributed to market timing, dynamic hedging and hedging pressures.

4.4 Exchange-traded funds

Exchange-traded funds (ETFs, hereafter) are assets tracking a given benchmark[87] and are publicly listed and traded in equity markets; in that sense, they constitute a hybrid instrument (fusing properties of open- and closed-ended funds), that allow their holders to establish long or short positions in an index of their choice via a single ETF.[88] They constitute one of the most rapidly growing asset classes in contemporary financial markets, their popularity being primarily due to the advantages they can confer in terms of risk management, low expense fees, instant exposure and tax-efficiency (for more details on those, see Charteris et al., 2014 and Kallinterakis et al., 2020). ETFs can attract feedback trading due to a series of reasons, both behavioural[89] and rational[90], and the past few years have witnessed a surge in research on this topic for their market segment.

The earliest evidence on feedback trading in ETFs was provided by Madura and Richie (2004), who showed that US-listed ETFs' returns during the 1998-2002 window were prone to overreaction in-session (during after-trading hours), followed by reversals during after-trading hours (in-session), essentially denoting intraday contrarian behaviour. A similar set of findings was reported by Da Dalt et al. (2018) for Finland's largest ETF (OMXH25 ETF) and the underlying constituents of its benchmark index; drawing on transaction data for the 2002-2014 period, the authors found that Finnish households were strong contrarians when trading both the OMXH25 ETF and the constituent stocks of the OMXH25 index, more so for the latter.

Drawing on the empirical design proposed by Sentana and Wadhwani (1992), a number of studies have examined how feedback trading in ETFs interacts with price-relevant factors, including sentiment and premiums/discounts. Chau et al. (2011) demonstrated that the three largest US ETFs accommodated significant positive feedback trading during the 2000-2007 period, more so when sentiment was optimistic and markets were bullish. ETFs with an emerging market focus have been found to exhibit significant feedback trading (Charteris et al., 2014; Da Costa Neto et al., 2019) contingent on lagged premiums/discounts, while Kallinterakis et al. (2020) reported similar results for US-listed country ETFs targeting Asia-Pacific markets conditioning feedback trading on both observed and forecast premiums/discounts.[91] In view of the clientele-variations among ETFs (some may be more dominated by retail investors, others by institutional ones), it is not possible to assert the reasons underlying their documented feedback trading; however, evidence (see footnotes 86 and 87) suggests that it may be motivated by both behavioural and non-behavioural reasons.

4.5 Currencies

The popularity of technical trading in currency markets has been established in a series of studies (Frankel and Froot, 1987; Edwards and Magee, 1997; Vitale, 2000; Osler, 2003). Evidence suggests that an overwhelming majority (around 90%) of currency traders in the London market rely, at least partially, on technical rules (Allen and Taylor, 1990; Taylor and Allen, 1992), while stop-loss orders exhibit predictability in their clustering around specific exchange-rate levels (a fact which motivates trend-chasing; Osler, 2005). In addition, currency traders tend to bear short investment horizons, often motivated by risk-aversion[92], while order-flow has often been found to be of more importance than news' arrival in shaping the volatility of currency rates (see the discussion in Osler, 2005). The above render feedback trading likely to be encountered in currency markets, with several papers having been devoted to this issue.

Drawing on the Sentana and Wadhwani (1992) model, several studies (Aguirre and Saidi, 1999; Laopodis, 2005, 2008; Tayeh and Kallinterakis, forthcoming) have confirmed the presence of feedback trading of either sign in a wide cross-section of currencies internationally at the daily frequency. Much of this feedback trading hails from emerging and frontier markets' currencies (Aguirre and Saidi, 1999; Tayeh and Kallinterakis, forthcoming), with financial crises' episodes conferring no uniform impact over its significance (Laopodis, 2005, 2008; Tayeh and Kallinterakis, forthcoming). All of these studies indicate that feedback traders often exhibit asymmetries in their presence following currencies' appreciations/depreciations; these asymmetries have been associated with reduced credibility of a currency and/or anticipation of central bank intervention (see Aguirre and Saidi, 1999 and Laopodis, 2005, 2008 for a more detailed discussion). In a different methodological context (VAR framework) and for higher frequencies (one- and five-minutes), Daníelsson and Love (2006) reported the presence of significant contemporaneous and lagged positive feedback trading[93] in the order-flows of the USD/EUR rate between December 1999 and July 2000.

A finding common to several papers is that feedback traders in currency markets tend to extrapolate from past horizons of various length. Gradojevic (2012) and Gradojevic and Lento (2015) assessed the presence of feedback trading in the Canadian Dollar – US Dollar rate contingent on trades emanating from commercial clients and financial institutions during the 1994 – 2005 window. Their empirical design involved assessing the causality between order flows of each type and movements of the CAD/USD rate and their findings indicated that commercial clients (financial institutions) were particularly prone to feedback trading across short[94] (long)[95] horizons, with the profitability of their trading rising with the trading horizon. In addition, the evidence presented in Tayeh and Kallinterakis (forthcoming)

suggests that two-thirds of the 66 currencies of their sample reflected (almost exclusively positive) feedback trading extrapolating from return-lags of up to six days.[96]

Overall, extant research suggests that feedback trading is widely encountered in currency markets, exhibits patterns (e.g., asymmetry) and relies on extrapolating from horizons of various length. Aside from technical trading, risk aversion/agency concerns of currency dealers can also prompt the emergence of such trading patterns; as per the stronger presence of feedback trading in emerging/frontier markets, it could potentially reflect a rational response to the informational opacity of those markets.

4.6 Depository receipts

Depository receipts are certificates representing ownership in shares of corporations listed/incorporated in overseas markets and are traded like ordinary stocks internationally. Those traded in US markets are known as American depository receipts (ADRs), while those traded in other markets are known as Global depository receipts (GDRs). This asset class has been rather scantly investigated in terms of its investors' behaviour, in general; the sole evidence on feedback trading pertaining to this market segment is found in Li and Yung (2004), who show that institutional trading in ADRs during the 1985-1998 period was strongly reflective of positive feedback trading.[97] To the extent that ADRs pertain to foreign stocks, these results may be due to US funds responding to the potential informational ambiguity of ADR-stocks' home-markets by tracking their historical price-trends.

4.7 Property

Property and property-related assets (e.g., indices, funds, stocks, etc.) have been found to be prone to feedback trading, aided by investors' extrapolative expectations regarding the property market; for example, Case et al. (2012) reported a strong tendency of US homebuyers toward predicting future appreciations of housing prices, if the latter had

recently appreciated. Evidence in favor of positive feedback trading in real estate stock market indices has been reported for a series of developed markets in Europe, the US and Asia-Pacific (Koulakiotis and Kiohos, 2016; Kyriakou et al., 2020; Balomenou et al., 2021), with Kyriakou et al. (2020) documenting a switch to negative feedback trading in some European countries during the 2007-2009 global financial crisis.[98] Conditioning daily order imbalances on past market returns, Zhou and Lai (2008) further showed that Hong Kong property stocks exhibited significant positive feedback trading in 2004 and 2005, without its presence, however, bearing a destabilizing effect over their prices. With respect to real estate prices, empirical studies have demonstrated that they entail positive feedback effects, which can spill over across regions (e.g., towns, neighborhoods etc.; Clapp and Tirtiroglu, 1994) and give rise to bubbles (Riddel, 1999) in the US real estate market.[99]

4.8 Commodities

Feedback trading has been found to be present across a broad spectrum of commodities, with most evidence of its presence emanating from the energy market. Research has indicated that feedback traders are active in the crude oil spot and futures markets (Cifarelli and Paladino, 2010, 2012; Bu, 2011; Wu et al., 2012; Cifarelli, 2013); their significance is time-varying (Cifarelli and Paladino, 2010; 2012; Wu et al., 2012) and can be identified with specific trader-types, such as non-commercial and managed money traders (Bu, 2011), commercial hedgers (Tokic, 2012) and oil producers/consumers (Cifarelli, 2013). Chau et al. (2015), on the other hand, document no evidence of feedback trading in the crude oil market, with their results supporting the presence of feedback traders in other energy markets (coal[100]; electricity).[101]

Precious metals have also attracted some attention recently with regards to their feedback trading potential.[102] Utilizing a heterogeneous agents' framework with monthly gold

prices for the 1970-2012 period, Baur and Glover (2014) showed that both fundamentals-driven and trend-following traders resorted to feedback strategies of either sign in the gold market, with the sign of these strategies varying over time. Using US traders' weekly futures positions on gold, silver and platinum for the 1993-2009 window, Mutafoglu et al. (2012) find that commercial (non-commercial) traders are susceptible to negative (positive) feedback trading in silver and platinum (gold and platinum), particularly after the 1990s. Drawing on daily prices of the South African Krugerrand (the first-ever gold bullion coin launched) during the 1996-2019 period, Charteris and Kallinterakis (2021) showed that it entailed significant positive feedback trading; the latter interacted significantly with a variety of factors related to the coin's pricing (such as gold prices and South Africa's geopolitical risk, equity market performance and currency rates), yet began waning following the global financial crisis' outbreak.[103]

Taken together, the extant literature clearly indicates the presence of feedback traders in commodities and commodity-linked assets (e.g., futures) internationally. As the studies cited here largely argue in their discussion, much of this feedback trading is motivated by speculative and risk hedging incentives of the various types of participants in commodities' markets.

4.9 Cryptocurrencies

Cryptocurrencies constitute the most recently emerging of all the aforementioned asset classes, documenting explosive growth since the 2010s. Their widely purported zero fundamental value has rendered them prone to noise trading (Cheah and Fry, 2015; Yermack, 2015) and this naturally raises the question of whether feedback traders are active in their market; evidence from the (very) few studies on this issue to date largely affirms their presence. Da Gama Silva et al. (2019) document significant positive (negative) feedback

trading for Bitcoin, Ethereum, Cassino Coin and ECC (Tether), without, however, detecting any feedback trading for the rest of the 45 cryptocurrencies of their sample, while King and Koutmos (2021) report positive (negative) feedback trading for Bitcoin, Ethereum, XRP and Cardano (EOS and Stellar), with little evidence of asymmetry in its manifestation. Karaa et al. (forthcoming) demonstrated that feedback trading in the Bitcoin grows stronger at higher frequencies, for periods of higher sentiment and volume, and during hours corresponding to the trading hours of major Western stock exchanges.[104]

4.10 Styles

Although styles benchmarked against historical returns (e.g., momentum; contrarian) can give rise to feedback trading, it is possible that style-returns *per se* can also be used as benchmarks that can be feedback traded on. As mentioned earlier (section 3.2.3.5), institutional investors may well end up following (abandoning) styles that have outperformed (underperformed) during a period, thus investing in (divesting from) stocks belonging to those styles ("style-based feedback trading"; Barberis and Shleifer, 2003). Empirically, the presence of feedback trading at the style-level has been investigated by several studies, primarily in the context of the US market. Drawing on annual/quarterly US fund-flows for the 1984-1999 window, Teo and Woo (2004) showed that style-selection and -switching were products of momentum on style-performance over time. Froot and Teo (2008) employed aggregate daily US investment funds' flows covering the 1995-2003 period and demonstrated that US funds exhibited persistent momentum trading at the style-level, controlling for a series of style-proxies. In the context of Chinese markets, Koutmos and Song (2014) reported the absence of feedback traders for a series of sector, size and style indices from the Shanghai stock exchange during the 2002-2013 period. Using monthly data of US hedge funds' style indices in a multifactor model-setting, Schauten et al. (2015) showed that most hedge funds in the US positive feedback traded on styles during the 1996-2009 period.[105] In addition,

based on an empirical version of the Barberis and Shleifer (2003) model estimated using monthly funds' holdings, Frijns et al. (2016) reported that over three-quarters of US mutual funds engaged in significant (positive and negative, in roughly equal proportions) feedback trading within and across styles for the 1961-2010 period.

5. Summary and suggestions for future research

We provide the first comprehensive survey of feedback trading, in terms of both its theoretical foundations, as well as its empirical literature. Feedback trading *per se* involves extrapolating from price-history (which market efficiency deems an exercise in futility), sidelines fundamental information (which departs from the rationality-assumption of neoclassical finance) and can lead prices to deviate from their intrinsic values. As a result, its practice has often been associated with noise traders' conduct and, drawing on evidence from behavioural finance, we illustrate the role of biases and heuristics in its evolution; though correct, the behavioural arguments underlying feedback trading do not constitute its sole possible explanation, however. As we outline in detail, there exists a host of non-behavioural drivers (rational/non-fundamental speculation; agency concerns; style investing; technical analysis; risk aversion; informational payoffs) that can also motivate feedback trading among investors not necessarily subscribing to the noise trading paradigm. This raises the possibility that informed, rational investors can also choose to extrapolate from historical prices, thus casting doubt as to whether "irrational" investors are solely to blame for any observed mispricings in the market. Indeed, if noise investors are as unimportant as the efficient market hypothesis portrays them to be, and feedback trading were to be identified exclusively with them, then evidence of its practice would be scant; empirical research, however, suggests otherwise.

Empirical studies on a broad cross-section of asset classes denote that feedback trading is very widely observed over time and across markets internationally and allows us to identify a series of relatively frequently observed regularities. To begin with, fund managers' agency concerns can prompt them to (positive, in most cases) feedback trade *in tandem* (their feedback trading is often accompanied by herding); in addition, their feedback trading is often motivated by style investing, with style-momentum also contributing to this.[106] Informational payoffs are also key in inciting (positive, in most cases) feedback trading in emerging/frontier markets; this is observed at the micro level for foreign institutional investors' equity trades, and at the macro level for equity market indices and currencies; informational payoffs are also found to motivate strong (again, mostly positive) feedback trading in small capitalization stocks among domestic institutional investors. The role of informational payoffs as drivers of feedback trading is further (indirectly) implied through a series of evidence on regulatory changes associated with enhanced transparency/sophistication tending to dampen feedback trading (suggesting that the feedback trading observed pre-changes was likely due to informational reasons). What is more, risk aversion (largely due to hedging reasons) strongly motivates (primarily, positive) feedback trading in equities, bonds, derivatives and commodities. Financial crises motivate significant changes in the sign, magnitude and significance of feedback trading internationally and across asset classes; however, these changes present themselves with no identifiable patterns.

As far as retail traders are concerned, they are mostly contrarians in their equity investments (motivated largely by behavioural factors) and consistently underperform their institutional counterparts. With respect to sentiment, evidence from domestic institutional investors' equity investments, equity market indices, derivatives and ETFs suggests that (optimistic, in almost all cases) sentiment motivates positive feedback trading; however, those trading on the sentiment of the market are contrarians (possibly of speculative intent). In addition, the

presence of feedback trading is associated with inefficiencies (e.g., autocorrelation in equity markets) and mispricing (e.g., premiums/discounts in ETFs).

Taken together, the above suggest that much of the feedback trading in international markets is likely associated with rational motives, thus demonstrating that, although it does not conform to strict rationality, it is often pursued for rational reasons. What do the above imply for future research in this area? To begin with, technological advancements in the investment environment impact the manifestation of feedback trading of both institutional and retail investors. With respect to the former, the proliferation of algorithmic/high frequency trading among their ranks over the past couple of decades raises the possibility of distinct feedback trading dynamics at higher frequencies. With the extant number of studies exploring feedback trading at high frequencies being rather small, there is clearly a need for further insights on this issue. As regards retail investors, recent years have witnessed the advent of retail investors' activism amplified via online trading and social media usage (e.g., Robinhood investors during the COVID pandemic; see Welch, forthcoming) and it would be interesting to gauge whether it accommodates any particular feedback trading patterns.

Future research could further explore a series of implementation aspects of feedback trading. The ongoing indexing trend (Stambaugh, 2014), for example, has led to the popularization of investment instruments benchmarked against indices (e.g., ETFs) and it would be interesting to assess whether feedback trading in these instruments varies conditional on the pricing of their underlying benchmarks and/or the relative instrument-index pricing (e.g., when the instrument trades at a premium/discount versus the benchmark). A small number of studies to date have explored this for equity ETFs (see section 4.4) and future researchers could consider broadening the scope of this literature by focusing on ETFs with non-equity benchmarks, as well as other benchmarked instruments (such as ADRs or exchange-traded notes). Second, it would be interesting to explore the variations in feedback trading between

overnight and trading hours, the determinants of those variations, and whether feedback trading during trading hours is affected by overnight feedback trading (and vice versa). This is a very thinly explored area (Madura and Ritchie, 2004; Kusen and Rudolf, 2019) that clearly merits more attention given the documented (e.g., Gao et al., 2018) profitability of momentum strategies based on overnight returns. Third, future research could consider expanding the thin literature (Shi et al., 2012; Charteris and Rupande, 2017) on feedback trading "mapping" in order to explore whether detection of stocks' feedback trading "identity" (i.e., whether a stock accommodates positive, negative or no feedback trading) can be used to inform trading strategies (feedback and non-feedback alike). Fourth, specifically with regards to the micro level, it would be very interesting to see research on issues pertaining to the "feedback" identity of investors (e.g., does a fund or an individual feedback trade consistently over time and, if not, which factors motivate this shift?) and the stability of feedback motivations over time (do the same funds/investors feedback trade for the same reasons over time?).

The above suggestions for future research on feedback trading are not exhaustive and denote that, voluminous as the feedback trading literature may seem, new research questions will inevitably pose challenges (and existing ones may merit revisiting). Eventually, as financial history has so amply confirmed, the institutional and technological evolution of financial markets can always be relied upon to offer new trends in prices– which investors will likely be tempted to chase, fearful (as per Vega's opening quote in the beginning of this paper) that they may run away from them.

Notes

[1] The first review studies on feedback trading were those by Holmes and Kallinterakis (2014) and Koutmos (2014) and they both assumed a relatively narrow focus on the subject. Holmes and Kallinterakis (2014) produced a very brief overview of feedback trading, in terms of its sources, models and empirical findings; Koutmos (2014), on the other hand, focused on a specific feedback trading model (Sentana and Wadhwani, 1992), whose structure and limitations he discussed in great detail, before presenting empirical evidence from works relying on that model.

[2] RAMESES (Realist And MEta-narrative Evidence Syntheses: Evolving Standards) publication standards originated in medicine and have been developed and formalised by Wong et al (2013) for meta-narrative reviews. This type of reviews is applicable for topics with different conceptualizations and which have been investigated by different researchers, hence display substantial heterogeneity and are especially in need of common standards to ensure their scientific rigour and comparability. RAMESES standards have been developed through identification of commonalities in the relevant survey literature and consultations with an experts panel, resulting in a recommendation of 20 items to be included when reporting a meta-narrative review. These include, e.g., providing a "rationale for review" (item 3), describing the "searching processes" (item 9), providing information on "document characteristics" of reviewed publications (item 14), and including "conclusions and recommendations" (item 19), to name but a few. Of special prominence is item 7 which recommends adherence to guiding principles of meta-narrative reviews: pragmatism, pluralism, historicity, contestation, reflexivity, and peer review.

[3] We also review theoretical approaches to feedback trading; however, their exposition reflects a mix of papers, whose degree of relevance to feedback trading varies in most cases (with several of them pertaining to neoclassical finance). As a result, we decided not to impose any distinct classification of theoretical feedback trading studies; for more on this, please see section 3 below.

[4] These 34 (243-209) papers were excluded here due to their shortcomings in terms of either their quality or direct relevance to feedback trading; some of them, for example, claimed to be examining feedback trading, without their empirical design actually allowing for this, while others utilized feedback trading as a possible explanation only for their empirical results, without feedback trading *per se* being tested at all.

[5] Positive (negative) feedback traders buy (sell) after price-rises and sell (buy) after price-falls.

[6] Momentum (contrarian) strategies aim, by definition, to capitalize on the broadly documented (see Galariotis, 2014 for an overview) underreaction (overreaction) of securities' returns which produces short-run continuation (long-run reversals). This is an extension of feedback trading; the latter, by definition, pertains to extrapolating from historical prices, making no explicit assumptions as per the motives underlying said practice.

[7] Technical analysis *per se* involves a broad array of rules based on historical prices, often coupled with sentiment and volume indicators; these rules are based on theoretical and/or empirical interpretations of historical price-trends (and their recurrence over time across various time periods), interpretations primarily hinging on investor psychology. Similar to momentum/contrarian trading, this is an extension of feedback trading; the latter entails extrapolation from historical prices, making no explicit assumptions as per the rules underlying said practice or the rationale underlying those rules.

[8] As per the definition of market efficiency (Fama, 1991), prices respond to news immediately and reflect all available information at any point in time over time; to the extent that news arrives randomly, the responding prices are expected to be equally random and, hence, impossible to predict. This reflects the concept of random walk, which, again, suggests that extrapolating from historical prices – and, thus, feedback trading – is an exercise in futility; as a result, in an efficient market, prices would not be expected to reflect informative patterns (and any such patterns observed would cease being profitable once transaction costs were taken into account; Jensen, 1978). Of course, the mere presence of feedback traders in a market does not necessarily render it weak-form inefficient, since their trades may well cancel each other out (the case, e.g., of some of them positive and some of them negative feedback trading; Koutmos, 2014); what is more, even if their trades move prices away from their fundamental values, it is still possible that arbitrageurs will correct the mispricing (Friedman, 1953; Fama, 1965).

[9] Since feedback traders rely solely on historical prices, they ignore other information signals relevant to their investments (e.g., a firm, industry or an economy), thus suggesting that their knowledge of their investment's structure of fundamentals is likely limited. If so, this will hinder them from discovering the correct distribution of prices, opting instead for a (subjective) distribution reflective of price-trends and -reversals that confirms their beliefs; in turn, this indicates that their beliefs are unlikely to be consistent (Sargent, 1993).

[10] Empirical evidence (Cutler et al., 1990; 1991) suggests that short (long) horizons tend to manifest positive (negative) first-order return-autocorrelations, indicative of continuation (reversal) of returns. These findings hold for a series of asset classes with higher liquidity (such as equities, fixed income and currencies), yet not for those with lower liquidity (e.g., property or collectibles, for which positive autocorrelations are reported for long horizons as well).

[11] The research cited here (see also Farmer, 2002; Farmer and Joshi, 2002) has demonstrated that high (low) volatility and volume periods are typified by negative (positive) return-autocorrelation. The fact that each sign (positive; negative) of autocorrelation is associated with the same state (high; low) of both volatility and volume may be due to the established (Karpoff, 1987; Gallant et al., 1992; Jones et al., 1994) positive correlation between volatility and volume. See also McKenzie and Faff (2003) for the effect of business cycles over the link between volatility/volume and autocorrelation.

[12] See also Black (1986) for the role of noise trading, in general, in boosting volume. For more on trend-chasing phenomena during several episodes in financial history, see Neal (1982), Galbraith (1994), Kindleberger and Aliber (2005), Dale et al. (2005) and Bassino and Lagoarde-Segot (2015).

[13] A famous proponent of this rational speculative strategy is George Soros, as expounded in his 1987 book "The Alchemy of Finance". In his book, Soros proposes his "theory of reflexivity", according to which the relationship between fundamentals and prices is bidirectional, in the sense that it is not only fundamentals that shape prices (essentially, what market efficiency stipulates) but also prices that shape investors' perception of fundamentals. To illustrate this, assume that a sector's fundamentals reflect a positive picture; if many investors choose to enter long positions in that sector's stocks, their prices will rise, thus both confirming those fundamentals and making them appear more positive than they may be (thus potentially encouraging more trend-chasing). Rational speculators can draw on this two-way relationship between prices and fundamentals (dubbed "market reciprocity" by Soros) and support new/existing trends in the market in order to bias the perceptions of feedback traders as regards stocks' prospects.

[14] By amplifying noise in the market, feedback trader activity culminates in limits to arbitrage, whose practice becomes costly due to the elevated levels of various risk-variants (fundamental, noise trader, etc.); for more on this, see the discussion in Barberis and Thaler (2003). What is more, whether arbitrageurs can monitor each other in the market or not can lead to differential delays in their responses to mispricing; see Abreu and Brunnermeier (2002; 2003) and Brunnermeier and Morgan (2010) for more on this.

[15] As we shall discuss in more detail in the next sub-section, fundamentals-based traders may temporarily switch to trend-based strategies if they perceive the latter to be profitable (Chiarella et al., 2014; He and Zheng, 2016).

[16] Prices can allow investors to indirectly observe the trades of other investors in the aggregate, without direct peer-monitoring being necessary (see the discussion in Hirshleifer and Teoh, 2003) and this can lead them to ignore their private signals and render the public pool of information poorer (Lee, 1998).

[17] For survey evidence on the role of representativeness in motivating extrapolative expectations see Case et al. (2012) for US homebuyers' expectations of housing prices and Greenwood and Shleifer (2014) for stock returns.

[18] For a detailed behavioural/neuroscientific discussion of the disposition effect, see Frydman et al. (2014).

[19] Although the disposition effect promotes contrarian trading (Brown et al., 2006) for stocks on the upside, its impact over feedback trading in underperforming stocks is far less clear. Holding onto a losing stock presumably prevents the stock's price from further declining, so one might argue that this does not help support momentum in losing stocks. Yao and Li (2013) show that, upon separating the loss-aversion and risk-aversion components of prospect theory's value function, the former is found to promote negative and the latter positive feedback trading.

[20] See also the discussion in De Long et al. (1990a), p. 383; Greenwood and Nagel (2009) argued that negative investment experiences following a bubble's crash can render investors less willing to participate in another market rally; this suggests that bubbles rely on new generations of investors with no prior bubble-experiences. This supports Galbraith (1994)'s view on the evolution of speculative episodes being generation-dependent; in his view, every generation wants to try to get rich, thus casting doubt over the learning effect of previous generations' failures in their attempts to do so. Galbraith further argued that the memory of a bubble's crash does not survive for more than 20 years, beyond which any recollection of the crash dissipates. Of course, Galbraith refers to episodes from earlier centuries; the globalized financial architecture and financial technology advances since the 1990s have led markets to witness bubble and crash episodes every few (and certainly not twenty) years.

[21] The case of "social learning" (Shiller, 1984), whereby people learn by interacting with/observing each other, in which case new habits or trends are mutually reinforced via this interaction/observation.

[22] Regulatory/monetary policies tend to be supportive of newly evolving investment trends (Gerding, 2007; Hirshleifer, 2008; Tokic, 2020).

[23] Unlike mood (which is irrelevant to fundamentals and is of a pre-rational nature), sentiment involves cognitive effort (it is the product of the extrapolation of fundamentals-proxies, such as cash flows, into the future) and is related to economic indices (e.g., consumer confidence indices and IPOs' first-day returns). For more on mood and sentiment, see Frijda (1993), Schwarz (2002), Lucey and Dowling (2005) and Baker and Wurgler (2007).

[24] De Long et al. (1990a) also mention (p. 381) a series of earlier studies entailing the notion of destabilizing speculation and discuss how their study differs from theirs.
[25] For an extension of the De Long et al. (1990a) model based on multiple signals and predicting reduced overreaction, see Arnold and Brunner (2015).
[26] Fundamentals refer to any information signal relevant to the value of an investment asset, including (but not limited to) earnings, dividends, cash flows and sales, to mention but a few.
[27] Trade-based manipulation refers to the case whereby an investor manipulates prices through her trades, without necessarily being in possession of fundamental information; in Allen and Gale (1992), the sole knowledge of the trade-based manipulator is who the informed investor is (whom she chooses to follow).
[28] Order-flow monitoring can be used, e.g., to predict noise trader demand (Madrigal, 1996).
[29] This front-running need not always be ethically questionable (as in the case e.g., of brokers front-running their clients in Khwaja and Mian, 2005); a non-fundamental speculator can also employ indicators yielding insight into noise trader demand and trade ahead of it, in anticipation of its predicted direction. As De Long et al. (1990b) argued (p. 727): "An alternative rational investment strategy would be to gather information about future noise trader demand shifts and to trade in anticipation of such shifts. Such information can come from examining trading volume, price patterns, buy/sell ratios, and other "chartist" indicators." De Long et al. (1990b) further argued that this practice is preferable to arbitrage for rational investors maintaining short horizons.
[30] While the above argument relies on information asymmetry among traders, relying on observed prices to inform one's trading decisions could be also justified by attempts at exploiting price patterns induced by factors unrelated to traders' heterogeneity, such as nonsynchronous trading, bid–ask bounce, partial price adjustments caused by sequential information arrivals or transaction costs, or time-varying risk premia (see, e.g., Gebka and Wohar, 2013, for a review of those arguments).
[31] Such behaviour would be similar to that of momentum traders in the model proposed by Hong and Stein (1999); in their setting, information diffuses slowly among fundamentals-driven investors (dubbed "newswatchers"), prompting them to respond to it sequentially. This motivates underreaction in prices, which begin to trend and this trend is later picked up (and tracked) by momentum traders (leading prices to overreact). In a similar vein, investors in informationally uncertain settings can monitor price-trends in order to infer any underlying information not directly accessible by them.
[32] These represent sell orders activated once prices decline to a given threshold.
[33] Portfolio insurance represents a dynamic hedging strategy, whereby an investor (normally, an institutional one) hedges her spot positions using index futures contracts, which she buys (sells) when the market rises (falls). For more on how it can motivate positive feedback trading, see Grossman (1988) and Gennotte and Leland (1990).
[34] Tambakis (2009) demonstrated analytically that part of the effect of positive feedback trading during market downturns is also due to risk-feedback, defined as the propensity to sell more as the market grows more volatile. Essentially, this is the part of feedback trading due to investors choosing to exit a market that has grown too risky for them, and tallies as a concept with the established leverage effect of volatility (i.e., that volatility rises more during down-market periods; Glosten et al., 1993).
[35] These represent buy orders activated once prices rise to a given threshold.
[36] Take-profit orders, an alternative type of orders, can promote negative feedback trading; these orders involve buying (selling) when the price decreases (increases) to a certain level (Osler, 2005).
[37] The earliest documented evidence of technical trading rules in the literature dates from 17th century Japan; Munehisa Homma has been credited with implementing a technical-style system (which later evolved into the well-known "candlesticks") for trading in the rice market (Deng et al., forthcoming). For more on the earliest literature on technical analysis, see also Nazário et al. (2017).
[38] These include price/volume transformations (e.g., moving averages and relative strength indices), supply/demand indicators (e.g., short interest) and sentiment indicators (e.g., put/call ratios), to mention but a few.
[39] Such as neural networks, fuzzy systems and genetic algorithms (Nazário et al., 2017).
[40] Examples include strategies combining technical rules with fundamentals (see, e.g., Chiarella et al., 2014; He and Zheng, 2016).
[41] In the opening paragraph of their study, Lo et al. (2000) mention: "It has been argued that the difference between fundamental analysis and technical analysis is not unlike the difference between astronomy and astrology. Among some circles, technical analysis is known as "voodoo finance." And in his influential book A *Random Walk down Wall* Street, Burton Malkiel (1996) concludes that "[u]nder scientific scrutiny, chart-reading must share a pedestal with alchemy."" – Lo et al. (2000), p. 1705.
[42] Bose et al. (2020) discuss evidence (p. 7) from various survey studies on the percentages of traders who include technical rules in their practice; these percentages range from as low as 27% to as high as 90%.

[43] Interestingly enough, fund managers subscribing to behavioural finance are more likely to engage themselves in momentum and contrarian styles compared to their counterparts that are not (Menkhoff and Nikiforow, 2009).
[44] In the vast majority of cases, foreign investors are of institutional background and retail investors of domestic background, hence these terms are used here without specifying whether foreign (retail) investors are institutional or retail (domestic or foreign); where this specification is needed, it will be mentioned explicitly in the discussion.
[45] This US pattern, however, does not necessarily hold internationally; drawing on Portuguese funds' monthly portfolio holdings during the 1996-2011 period, Gavriilidis et al. (2013) showed that they contrarian traded, more strongly so following the outbreak of the global financial crisis.
[46] Using quarterly portfolio holdings' data for a sample of 1,042 US funds for the 1997 – 2002 window, Greenwood and Nagel (2009) showed that US fund managers strongly momentum traded in technology stocks during the dot-com bubble, more so if they were of younger age; the latter also were those most strongly divesting from those stocks following the bubble's crash in 2000.
[47] Babalos et al. (2021) studied the relationship between monthly aggregate equity fund flows and equity market returns in the US for the 2000-2015 window using a VAR-GARCH model and showcased that rising (falling) market performance led to higher (lower) fund flows during the years following the global financial crisis.
[48] Drawing on daily aggregate trading values and a set of VAR and Granger causality models, Yang (2002) found that the financial liberalization measures enacted in Taiwan in the 1990s led the country's domestic funds to positive feedback trade during the 1996-1999 period in response to the trends launched by foreign investors.
[49] Kim and Nofsinger (2005) used annual institutional ownership data from Japan between 1975 and 2001 and reported limited evidence of (mainly positive) feedback trading; the latter was concentrated among non-keiretsu firms (i.e., firms that did not belong to interfirm business groups - *keiretsu*) and surfaced mainly during the 1990s, a period entailing the burst of the bubble in Japan and the deregulation of its financial markets.
[50] Gavriilidis et al. (2013) showed that Portuguese funds' contrarian trading during the 1996-2011 period grew stronger after 2002 (when Portugal joined the Euronext cross-border exchange).
[51] Hung et al. (2010) and Kremer and Nautz (2013) produce evidence from Taiwan and Germany, respectively; the rest three studies cited here utilize US data.
[52] Falkenstein (1996) and Gompers and Metrick (2001) demonstrated this for US mutual funds, in view of their evolving aversion toward small cap stocks in the 1980s and 1990s.
[53] Voronkova and Bohl (2005), Ng and Wu (2007) and Hung et al. (2010) offer evidence from Poland, China and Taiwan, respectively; the rest four studies mentioned here pertain to the US.
[54] Small cap stocks enjoy limited analyst coverage, thus entailing high information risk; to tackle the latter, funds investing in small stocks may rely on their historical returns (and feedback trade; see also section 3.2.3.2). This is more so during extreme down markets, when some stocks lose much of their value and suffer a decline in their market capitalization – and funds tend to dispose of such stocks (see Sias, 2007), in effect positive feedback trading on stocks that have become "small". Information issues aside, some funds may also feedback trade on small stocks due to style reasons (e.g., funds with a small cap focus, or funds switching to/from the small cap style due to its recent out/underperformance). However, small cap stocks encompass issues (e.g., high bid-ask spreads due to low volume) that may increase the cost of feedback trading on them (see Chan et al., 1996).
[55] The findings of Iihara et al. (2001) pertain to Japan; evidence of positive (negative) feedback trading among large cap stocks was also revealed in the US (UK) by Grinblatt et al. (1995) (Wylie, 2005). In addition, one should bear in mind that many fund managers are assessed versus the performance of main market indices (see e.g., Walter and Weber, 2006) and large cap stocks are disproportionally (over)weighted constituents of those indices. In the event of a market decline, those indices will decline in value and this can prompt funds to decrease those stocks' weights in their portfolio (e.g., via stop-loss orders) in order to curtail their losses and perform window-dressing (see section 3.2.3.6), thus positive feedback trading among large cap stocks.
[56] The sign and significance of domestic funds' feedback trading have often been found to vary between the buy- and the sell-side of the market. US fund managers tend to positive feedback trade on both sides of the market; this appears more pronounced on the buy-side (Badrinath and Wahal, 2002; Cai and Zheng, 2004; Celiker et al., 2015), growing weaker on the sell-side. Specifically with respect to the latter, the sign can even turn negative (Badrinath and Wahal, 2002); similar evidence is presented from Samarakoon (2009) for the Sri Lankan market. In addition, Oh and Parwada (2007) show that, although aggregate daily mutual fund buy-flows and sell-flows are reflective of momentum trading in South Korea, net fund flows reveal contrarian patterns during the 1996-2003 window.
[57] No feedback trading was reported among foreign investors in China (Wang, 2014), with mixed evidence found in a series of multi-market studies (Brennan and Cao, 1997; Bekaert et al., 2002; Swanson and Lin, 2003; Griffin et al., 2004; Richards, 2005; Lin and Swanson, 2008; Tsai, 2009; Jinjarak et al., 2011; Ülkü and Weber; 2014).

[58] Specifically with regards to the short-selling side, Wang and Lee (2015) showed that foreign short-sellers in South Korea negative feedback traded on stocks with a recent history of outperformance.
[59] No evidence of feedback trading was reported for foreign investors in the Indonesian market by Bowe and Domuta (2004) within or outside the Asian crisis.
[60] For exceptions to this, see Feng and Seasholes (2004) and evidence from Warther (1995) for variations of retail flows' contrarian patterns across different types of funds.
[61] For survey evidence in support of retail investors' momentum tendencies, see Patel et al. (1991), who find that US individual investors increase their exposure to mutual funds during bullish markets.
[62] To the extent that less sophisticated investors over-trade to time the market (Barber and Odean, 2000), it is possible that the frequency of their trades can affect their feedback trading. This was confirmed by Goetzmann and Massa (2002), who showcased that various account-types from a sample of 91,000 US retail investors of the Fidelity Spartan Market Index Fund during 1997 and 1998 revealed strong contrarian and momentum trading; however, individual accounts with more than eight transactions were found to consistently contrarian trade.
[63] The authors utilized annual ownership data for Japanese stocks for the 1984-1999 window.
[64] The authors employed aggregate transaction data on all Japanese listed stocks for the 1994-2003 period.
[65] The authors relied on data from the universe of Australian retail investors' holdings for the 2009-2014 window.
[66] The authors drew on US transaction data for the 1983-2000 period.
[67] For experimental evidence on the underperformance of noise traders' negative feedback trading, see Bloomfield et al. (2009). For evidence of retail contrarian trading profitability, see Barrot et al. (2016).
[68] The Sentana and Wadhwani (1992) model hinges on the interaction of two trader-types: a) rational speculators, who rely on a mean-variance model and b) feedback traders, who extrapolate from the lagged period's return. Combining these two trader-types leads positive (negative) feedback trading to give rise to negative (positive) first-order return-autocorrelation. This model has, to date, largely dominated empirical research on feedback trading in market indices, although it has also been used for other asset classes, including derivatives, exchange-traded funds, currencies and gold, as we shall discuss in more detail later on. For a discussion of the Sentana and Wadhwani (1992) model, as well as possible limitations to its structure and applications, see Koutmos (2014).
[69] Feedback trading was found to display no asymmetric properties in European transition markets during the 1990s and prior to the global financial crisis (Chau et al., 2013), while Andrikopoulos et al. (2020) found limited evidence of asymmetric feedback trading among majority Muslim markets during the 2001-2016 period. Of relevance to asymmetric feedback trading are the results produced by Chau and Deesomsak (2015), who demonstrated that expansionary monetary periods during the 1970-2012 window were more likely to accommodate positive feedback trading in G7 economies' markets.
[70] With respect to the 1997-1998 Asian crisis, Gebka (2012) documents significant feedback trading within and outside its window for Asian markets.
[71] All studies mentioned in this paragraph performed their empirical analyses at the daily frequency drawing largely on the Sentana and Wadhwani (1992) framework and conditional volatility modelling.
[72] It is not directly obvious from the paper whether this positive feedback trading is behaviourally motivated (the case of noise investors intensifying their trend-chasing during extreme sentiment periods) or driven by speculation (the case of speculators trailing sentiment shifts to exploit their noise counterparts). Presumably the stronger positive feedback trading post-2010 lends some support to the second possibility (speculators could employ short-sales to better exploit noise traders *à la* De Long et al., 1990a); however, since the 2010-2016 period witnessed abrupt price-swings in Chinese markets (Taffler, 2018), it is possible that they also impacted the post-2010 results.
[73] All studies mentioned in this paragraph performed their empirical analyses at the daily frequency drawing on the Sentana and Wadhwani (1992) framework.
[74] Kusen and Rudolf (2019) also produced seminal evidence on how feedback trading varies within ("intraday") versus outside ("overnight") trading hours. Again here, both their study, as well as Gebka and Serwa (2015)'s investigated feedback trading using daily return observations with the Sentana and Wadhwani (1992) model.
[75] Contrary to the aforementioned studies in this section which investigated feedback trading almost exclusively at the daily frequency (with the exception of the weekly frequency of Kuttu and Bokpin, 2017), Koutmos (2012) drew on the monthly frequency to gauge how the presence of feedback trading is affected when fundamentals-driven traders are added to the Sentana and Wadhwani (1992) model. In the context of the G7 markets, the evidence on feedback trading presented was rather limited and the author attributed this to the role of fundamental traders growing over longer horizons, as prices tend to revert to their fundamental values.
[76] Both Chau et al. (2008) and Bohl et al. (2013) performed their empirical analysis at the daily frequency drawing on the Sentana and Wadhwani (1992) model.

[77] Hu et al. (2015) "mapped" Taiwanese stocks based on their idiosyncratic sentiment; based on transaction data from all Taiwanese listed stocks during the 2010-2013 period and using a VAR-framework, they showed that the higher the intraday frequency, the stronger the positive feedback trading, particularly for bullish sentiment periods.
[78] Dean and Faff (2011) show that the covariance of each of their sample countries' equity markets with their bond market helps determine the magnitude and significance of feedback trading in their bond markets (and vice versa).
[79] Cohen and Shin (2013) use US trade and quote data; the studies by Dean and Faff rely on daily price data. Dean and Faff (2008) focus on Australian bonds, while Dean and Faff (2011) on a set of developed markets' bonds.
[80] Wei (2018) uses transaction data, while Cai et al. (2012) rely on quarterly portfolio holdings.
[81] Frijns et al. (2020) report limited feedback trading in European bond markets during the global financial crisis.
[82] A notable exception is Burghardt (2011), who showed that (primarily retail) investors on the European Warrant Exchange in Stuttgart negative feedback traded on a series of DAX-linked securitized derivatives (including warrants, knock-outs, and investment certificates) utilizing daily order data for the 2004-2008 window.
[83] With respect to studies documenting the absence of feedback trading in index futures, Antoniou et al. (2005) found no evidence of feedback trading in the futures contracts linked to six developed markets' main indices. Kuo et al. (2007) showed that foreign investors did not feedback trade when trading stock index futures contracts in the Taiwanese market during the 2001-2003 period. Along the same lines, Charteris and Musadziruma (2017) reported no feedback trading for the index futures contracts linked to South Africa's top capitalization index (FTSE/JSE Top 40), irrespective of their sample period's partitioning and the market states (up/down) considered.
[84] Both these studies rely on Sentana and Wadhwani (1992)'s model using daily data.
[85] Wang (2002; 2003) and Smales (2016) utilized traders' positions; Wang (2003) relied on monthly data, while the other two studies on weekly data. With the exception of Wang (2003) who used futures' contracts from various asset classes (financial; agricultural; commodities; currencies), the rest two studies focused on index futures.
[86] Kurov (2008) relied on trade and quote data on the S&P500 and Nasdaq 100 E-mini futures contracts between 2002 and 2004; Chen and Yang (2021) utilized weekly traders' positions in VIX index futures contracts.
[87] The benchmark may be an established index (e.g., an equity one), or an *ad hoc* one (e.g., a basket of equities based on size, sector, or another style); ETFs may also be benchmarked against non-equity assets, including bonds, commodities, currencies, and real estate, to mention but a few.
[88] Authorized participants (mainly of institutional background) can in-kind create/redeem units of an ETF in the primary market; for more details, see Charteris et al. (2014).
[89] Charteris et al. (2014) present a detailed discussion (p. 81) on how the design of ETFs can appeal to behavioural factors (e.g., recognition heuristic, familiarity bias, and ambiguity aversion, to mention but a few) that can motivate investors to feedback trade on them.
[90] ETFs can invite feedback trading through two possible "rational" avenues. On the one hand, they can be the subject of feedback-style trading practices (e.g., portfolio insurance and stop-loss orders), similar to ordinary shares (Charteris et al., 2014). On the other hand, since their net asset value (which reflects their fundamental value) is public knowledge and regularly disseminated, some investors may wish to exploit an ETF's price-deviations from its net asset value (i.e., premiums/discounts) by extrapolating from historical premiums/discounts. Such a strategy has been found to be profitable and can give rise to feedback trading *per se* (see the references and discussion in Kallinterakis et al., 2020).
[91] Comparing actual with predicted premiums/discounts, Kallinterakis et al. (2020) also showed that successful premiums/discounts predictions were associated with significant feedback trading. All research mentioned in this paragraph is based on the daily frequency.
[92] Research using order-flow data (Bjonnes and Rime, 2005; Osler, 2005) suggests that currency dealers are reluctant to maintain long exposure to risky currencies; studies focusing on currency traders' agency incentives (Dominguez and Frankel, 1993; Carlson, 1998; Bensaid and DeBandt, 2000) find that they tend to maintain limited risk-exposure to any individual currency, motivated by their professional practice's prudential rules (which prompt them to reduce the probability of a huge loss per currency to an absolute minimum).
[93] Contemporaneous feedback trading is defined in their study as the situation whereby "when aggregated over time, order flow and prices can be expected to impact on each other simultaneously" – (Daníelsson and Love, 2006, p. 35). The notion of contemporaneous feedback trading is encountered in other asset classes as well – see e.g., Li and Wang (2010) for evidence from equity markets.
[94] Daily and weekly.

[95] Four days and above.
[96] In one of the earliest studies on feedback trading in futures' markets, Irwin and Yoshimaru (1999) reported the presence of momentum trading in several currency futures' contracts for the December 1988-March 1989 period.
[97] The study relied on the annual frequency and its empirical design entailed portfolio analyses and regressions. The strong momentum trading among US funds was found to be associated with significant herding among them.
[98] All three studies estimated feedback trading with daily data using the Sentana and Wadhwani (1992) model.
[99] Clapp and Tirtiroglu (1994) utilized real estate (residential sales) transactions data on 19 neighbouring towns from the Office of Policy and Management (OPM), State of Connecticut; Riddel (1999) relied on monthly data on median prices of existing single family homes from the South Coast of Santa Barbara county, California.
[100] Evidence in support of feedback trading in the coal market is also reported by Fan and Todorova (2019) for Chinese futures' contracts between 2013 and 2018; using a quantile autoregression framework, the authors found positive feedback traders to be active in the thermal coal futures market, while also reporting similar results for 23 futures contracts of agricultural, industrial and metal commodities. On the other hand, Wu et al. (2015) reported significant negative (positive) feedback trading on behalf of commercial (non-commercial) traders in seven agricultural commodities' futures contracts in the US for the 1999-2013 period. Some of the earliest evidence from commodity futures' markets is documented in Irwin and Yoshimaru (1999), who reported significant (insignificant) feedback trading in food and fiber, grain, livestock and metals (energy) futures contracts for the December 1988-March 1989 period.
[101] Research on feedback trading in the energy market relies on a variety of empirical designs, including the Sentana and Wadhwani (1992) framework (Cifarelli and Paladino, 2010; Chau et al., 2015), VAR (Bu, 2011), GARCH-modelling (Cifarelli and Paladino, 2012; Wu et al., 2012; Cifarelli, 2013) and trader-positions (Tokic, 2012). With the exception of Chau et al. (2015), who utilize daily spot/futures data from European markets, the rest of the works on crude oil rely on weekly US data.
[102] Gold (both as a precious metal and an underlying asset – e.g., gold stocks, futures, etc.) has traditionally been associated with speculative activity relying on short-term price trends (see the discussion in Charteris and Kallinterakis, 2021), yet without feedback trading *per se* having been examined prior to the studies outlined here.
[103] The study employed the Sentana and Wadhwani (1992) model to test for feedback trading.
[104] All three studies used the Sentana and Wadhwani (1992) model for daily (as well as hourly and weekly, for Karaa et al.) cryptocurrency prices.
[105] This majority positive feedback trading was also confirmed when testing for it for individual US hedge funds.
[106] The findings from this review suggest that the literature on feedback trading is clearly related to the research on herding, momentum/contrarian strategies and technical analysis. If, for example, momentum or contrarian trading is practiced widely in a market, this suggests that many investors pursue similar strategies; this can motivate herding in that market and be translated into feedback trading at the market level. Conversely, if some investors pursue momentum and others contrarian strategies, it is likely that feedback trading will not surface at the market level (the two feedback strategies will cancel each other out) and this will also be reflected into lack of herding. As per momentum strategies and technical analysis, the evidence on feedback trading at the market level can perhaps help explain their profitability (or lack thereof); the presence (absence) of feedback trading, for example, implies the presence (absence) of strong price-trends, which can render momentum/technical rules (not) profitable (since such rules rely on price-trends, *per se*).

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Appendix

Figure 1. The number of empirical papers published per year