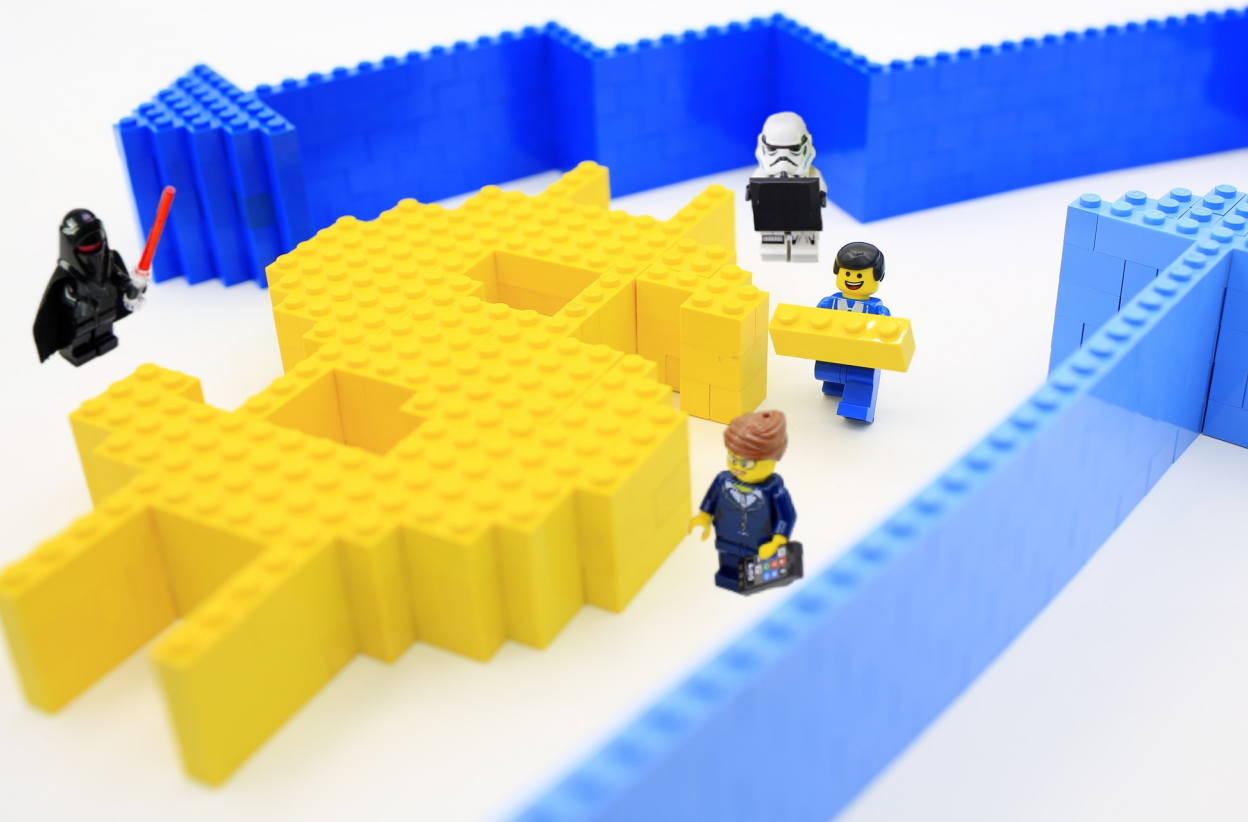


Essays on Investor Behavior and Trading Strategies in International Financial Markets

Anton Hasselgren



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Anton Hasselgren

Academic dissertation for the Degree of Doctor of Philosophy in Business Administration at Stockholm University to be publicly defended on Tuesday 10 September 2019 at 13.00 in Gröjersalen, hus 3, Kräftriket, Roslagsvägen 101.

Abstract

This dissertation contains four articles that in different ways inform on investor behavior in international financial markets, their impact on the underlying market, and the trading strategies that they pursue.

Article I studies how hedge funds herd in currency future contracts and how it is affecting the underlying market. The results indicate that hedge funds herd, and that they herd in a pattern that is consistent with them following the carry trade strategy. Hedge fund herding has an impact on the underlying market, in the direction of the herd, and the results give no indication that their herding in destabilizing.

Article II examines if limits to arbitrage can help explain the returns to technical analysis strategies in the foreign exchange market. The findings show that returns to technical analysis strategies are higher when limits to arbitrage are more severe, supporting the argument that profit opportunities can persist as arbitrage activity is costly and risky. However, investor sentiment seem to be unrelated to technical analysis returns. The main takeaway is that limits to arbitrage are an important determinant of technical analysis profitability.

Article III investigates whether the trading activity of speculators is beneficial for the speed of information diffusion in the foreign exchange market. The findings show that predictive ability of the equity market on foreign exchange strategies dissipates when speculator activity is high. However, the same results are not found for the commodity markets ability to predict foreign exchange strategies. Overall, the results indicate that speculators play a vital role for informational efficiency in the foreign exchange market.

Article IV examines the impact of investor attention on stock and foreign exchange market volatility in emerging economies using a newly constructed innovative attention proxies that capture the full spectrum of the dynamics of the information processing stages. The results show that investor attention significantly effects emerging stock market volatility, but not FX market volatility.

Keywords: *foreign exchange, speculators, hedge funds, investor behavior, trading strategies, information, market efficiency.*

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IN INTERNATIONAL FINANCIAL MARKETS

Anton Hasselgren



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University

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To my loved ones.

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Sitting at my local café, writing this text, I struggle to not be overtaken by emotions when I reflect on how lucky I am to love and be loved by so many amazing people.

Anton Hasselgren

Stockholm, June 2019.

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Introduction

One of the most influential ideas in finance is the efficient market hypothesis (EMH) formalized by Fama (1970). The simple yet powerful idea that ‘prices fully reflect all available information’ forms the core of the EMH and has wide-reaching implications. The EMH in its strongest form suggests that it is impossible to beat the market and that price changes are random and unpredictable. However, one of the key foundations of the EMH – market participants’ rational expectations – has become increasingly criticized by a growing body of behavioural finance research. As Lo (2004, p. 5) puts it, ‘These critics of the EMH argue that investors are often – if not always – irrational, exhibiting predictable and financially ruinous behavior’. Lo’s (2004) adaptive market hypothesis argues that financial market efficiency is closely tied to the behaviour of its participants.

It may seem intuitive that the more sophisticated an investor, the more rational the investor’s decisions would be, and, consequently, the more efficient the market would be. However, Stein’s (2009) American Finance Association presidential address argues that, even if we ignore the critique of the behavioural finance literature and assume that sophisticated professional investors are rational, an increasing number of rational sophisticated investors does not necessarily lead to more efficient markets.

Stein (2009) proposes two mechanisms that could lead to the destabilization of financial markets following the increased activity of sophisticated traders. The first is a crowded trade, or herding, effect, where prices can divert from fundamental values if a large number of sophisticated investors pursue the same trading strategies. Investors can have the same positions, or herd, due to reputational concerns, investor flows, or informational cascades, or simply because they have the same information. Although such herding can be detrimental to market stability, as Stein (2009) points out, this need not be the case if investors contribute to the price discovery process (Lakonishok, Shleifer, and Vishny, 1992).

The second potentially destabilizing mechanism is a leverage, or fire sale, effect. Given multiple highly leveraged investors with some common positions, if a negative shock hits one of the investors in any part of her portfolio, this could cause her to liquidate positions in the common positions, forcing the second investor to do the same, creating further downward pressure on prices, in a vicious spiral. This effect is perhaps best explained with some illustrative examples. The collapse of Long-Term Capital Management (LTCM) and several other hedge funds in 1998 is largely attributed to this mechanism (Lo, 2004; Stein, 2009). Another example is the quant crisis of August 2007 that saw massive losses for quantitative strategies, mainly due to overcrowding and overleveraging (Stein, 2009).

A final example that is commonly attributed to both mechanisms pertains to a strategy of notable importance for this thesis, namely, the foreign exchange (FX) carry trade strategy. The strategy involves borrowing FX with low interest rates and investing in FX with high interest rates. According to the uncovered interest rate parity, a cornerstone of international financial theory, the money an investor makes on the interest rate differential between the two FXs should be offset by the change in their spot rates, so that no profit will be made. However, in reality, the exchange rates tend to move in favour of the trade, leading to profits from both the interest rate differential and changes in the spot rates. Consequently, this strategy has been aggressively pursued by institutional investors (e.g. Jylhä and Suominen, 2011). Over some years, FX traders have been earning high profits by pursuing the carry trade strategy with substantial leverage. Due to the seeming attractiveness of the strategy, it was even vigorously pursued by retail investors, particularly – and this received considerable media attention – by Japanese housewives (*The Economist*, 2007a).

However, since many investors were following the strategy, employing substantial leverage to do so, the strategy was sensitive to both mechanisms described by Stein (2009). In 2007 and 2008, large reversions of the carry trade caused disastrous losses for highly leveraged investors, proving correct the prediction of Goldman Sachs' chief global economist that 'there are going to be dead bodies around when this is over' (*The Daily Telegraph*, 2007, para. 3). Money managers saw their funds blow up and one Japanese housewife was reported to have lost her family's entire life savings within a week (*The New York Times*, 2007).

Retail investors were not single-handedly responsible for the crash of the carry trade, however. The highly liquid FX market consists almost exclusively of professional and sophisticated investors (Bank for International Settlements, 2016), which begs the question, are sophisticated investors really good or bad for market efficiency? This matter is not settled, and evidence points in both directions. Some examples follow. Abreu and Brunnermeier (2003) show that it can be optimal for rational arbitrageurs to invest in already overpriced assets, as long as other rational arbitrageurs do the same. The authors describe that the dynamics can fuel both bubbles and busts. Along these lines, Brunnermeier and Nagel (2004) and Griffin et al. (2011) show how institutional investors both participated in the creation and worsened the rupture of the tech bubble in the 1990s. Their findings are in line with the concerns expressed by Stein (2009), that rational speculators do not always stabilize prices. On the other hand, Kokkonen and Suominen (2015) show that hedge funds' trading (typically thought of as sophisticated investors) reduces mispricing in the stock market, and Akbas et al. (2015) show that, while dumb money (mutual funds) aggravates mispricing, smart money (hedge funds) mitigates it, supporting a story where rational investors are beneficial for market efficiency.

Moreover, rational, sophisticated investors are not always able, or willing, to fully correct mispricing in financial markets. Ample evidence documents a predictable component of financial securities' returns, and that prices can divert from fundamental values, giving rise to arbitrage opportunities and 'anomalies' in international financial markets. In the FX market, technical analysis strategies that only use past price or volume data to make predictions have been described as 'the obstinate passion of foreign exchange professionals' (Menkhoff and Taylor, 2007, p. 936), despite violating even the weakest notion of Fama's (1970) EMH.

Technical analysis seems to have been profitable over longer periods of time (Menkhoff and Taylor, 2007) and is massively popular among FX professionals. In survey studies, Oberlechner (2001) and Gehrig and Menkhoff (2004) find, respectively, that more than 98% and 90% of the respondents used technical analysis to some degree. The carry trade strategy, discussed above, is another example that – despite the strategy’s risk of sudden large losses, often described as picking up nickels in front of steamrollers (e.g. *The Economist*, 2007b) – has generated significant returns over longer periods. Another famous example is the momentum strategy, which bets on trend continuation as a consequence of initial underreaction and subsequent overreaction to fundamental news. The long-term profitability of the momentum strategy has been documented internationally in more than eight different asset classes (Asness, Moskowitz, and Pedersen, 2013). The list goes on, and Harvey, Liu, and Zhu (2016) report that at least 314 factors have been published in top academic journals.¹

Explanations of the persistent predictability put forth by the proponents of the behavioural literature are based on different limits of the rationality of investors. In the gradual diffusion of information theory, proposed by Hong and Stein (1999), predictability is a consequence of attention constraints imposed on investors, so that they cannot fully process or respond to all information instantaneously, resulting in a gradual diffusion of information that, in turn, leads to predictability. Attention is a scarce cognitive resource, and the model of Peng and Xiong (2006) illustrates how investors’ limited attention leads to the processing of market- and sector-wide information, referred to as category learning. Their model demonstrates how the category learning behaviour of investors affects asset prices. Da, Engelberg, and Gao (2011), using Google searches as a proxy for paid attention, show how investor attention predicts higher returns followed by reversals. Barber and Odean (2008) find that individual investors tend to buy stocks that have already caught their attention, such as stocks in the news, stocks with high abnormal trading volumes, and stocks with extreme one-day returns. While institutional investors do not suffer from limited attention to the same degree, attention constraints can still be binding. For example Lu, Ray, and Teo (2016) find that hedge funds whose managers are distracted by marital events (marriages and divorces) perform worse and are more susceptible to behavioural bias.

However, other dynamics can be at play that do not require the market participants to be irrational. The risk-based explanation posits that the returns to the strategies discussed above are not, in fact, anomalous, but compensation for the additional risk inherent in the strategy. In the case of the momentum and carry trade strategies, for example, it has been suggested that the returns are compensation for liquidity and/or crash risk. Moreover, there can be limits to arbitrage (LTA), frictions and risks that are associated with the exploitation of anomalies or mispricing, making arbitrageurs unable or unwilling to correct the mispricing (Shleifer and Vishny, 1997). Implementation costs, such as transaction fees, and capital constraints faced by the arbitrageurs are clear-cut examples. However, idiosyncratic volatility, that is, volatility that is specific to a particular asset, is also an important consideration, since it cannot be hedged.

¹ However, many of these factors are highly correlated and are likely a product of data mining. See, for example, the discussions of Harvey et al. (2016) and McLean and Pontiff (2016).

An example provided by Barberis and Thaler (2003, p. 1056), using the hypothetically undervalued stock of Ford Motor Company, is helpful:

The most obvious risk an arbitrageur faces if he buys Ford's stock at [the undervalued price of] \$15 is that a piece of bad news about Ford's fundamental value causes the stock to fall further, leading to losses... Shorting General Motors protects the arbitrageur somewhat from adverse news about the car industry as a whole, but still leaves him vulnerable to news that is specific to Ford – news about defective tires, say.

The model of DeLong et al. (1990) illustrates how noise traders can pose a risk for rational investors. Noise traders are investors who believe they are acting on information but, in reality, are acting on noise. This is a real concern for arbitrageurs, however, since noise trader sentiment can substantially affect prices. As Barberis and Thaler (2003, p. 1056) explain, 'noise trader risk... is the risk that the mispricing being exploited by the arbitrageur worsens in the short run'. The book *The Big Short* by Michael Lewis, now adapted into a movie, provides a good example. One of the main characters, hedge fund manager Michael Burry, took a large, long-term bet that the US subprime loan market would collapse in 2007. This strategy entailed substantial costs, however, enraging his investors and ultimately forcing him to restrict withdrawals from the fund. While he was eventually proven right, increasing his fund's value by 489%, it was a race of who could last longer, his fund or the market, echoing Shilling's (1993, p. 236) quote that 'the market can remain irrational longer than you can remain solvent'.²

Analysis of the behaviour of investors and the strategies that they pursue is crucial for a broader understanding of the workings of international financial markets. As a concluding remark, I quote from Stein (2009, p. 1543): 'It is undeniable that sophisticated professional investors play a more dominant role in financial markets than they used to. A more difficult question is whether this form of progress will ultimately help to make markets more efficient'.

Summary of the thesis

This dissertation consists of four articles that are related to the research agenda set forth by Stein (2009), and engages in and contributes to the active debate of how investor behaviour is affecting the financial markets that they comprise.

The first article is connected to the first mechanism described by Stein (2009), and it touches upon several of the earlier examples. It analyzes how hedge funds trade as a herd in currency futures contracts and pays especial attention to how this is impacting the underlying market and the famous carry trade strategy in which hedge funds engage. Thus, this article is related to the crowded trade effect, described by Stein (2009), since it evaluates the price impact of crowded trades, that is, herds.

² The quote is often attributed to John Maynard Keynes, but the actual source is more likely A. Gary Shilling (see <https://quoteinvestigator.com/2011/08/09/remain-solvent>).

The second article focuses on the LTA and their potential to explain the returns of technical analysis strategies. Technical analysis consists of trading strategies that are based only on past prices, and it is especially interesting because significant returns to such a strategy challenge even the weakest notion of market efficiency. The persistence of the returns to technical analysis and its popularity among practitioners has been documented in previous research (e.g. Oberlechner, 2001; Gehrig and Menkhoff, 2004; Menkhoff and Taylor, 2007). This article examines if the persistent returns to technical analysis can be partly explained by LTA.

The third article takes a direct approach at evaluating the relation between speculator activity in the FX market and the predictability documented between economically linked financial markets, thus responding to Stein's (2009) call for research to understand whether more sophisticated investors are beneficial for market efficiency. The article tests the gradual diffusion of information hypothesis of Hong and Stein (1999) by hypothesizing that greater speculator activity increases the speed of information diffusion and, therefore, efficiency.

Finally, the last article is related to the behavioural constraints of investors, particularly to attention. It examines how investors' attention to emerging stock and FX markets affects the underlying volatility of the market, and it suggests a new approach for measuring a more complete spectrum of investor attention. Below are presented more detailed summaries of the articles in the dissertation.

Article I

Herding is the tendency of investors to exhibit correlative behaviour, gravitating toward similar trades. This can occur for a number of reasons. For example reputational concerns can cause investors to refrain from diverging from peers' behaviour, or they can ignore their own private information, mimicking instead the behaviour of others, who are perceived to have superior information. It could also be the case that investors trade in herds as a consequence of acting on the same information or signals.

Herding behaviour among different participants of different financial markets has been widely documented (e.g. Wermers, 1999; Choi and Sias, 2009; Brown, Wei, and Wermers, 2014; Cai et al., 2019). It is an important phenomenon to understand and research, because the herding behaviour of investors can have great consequences for the stability of financial markets. Despite strong academic interest, surprisingly little is known about the herding behaviour of a particularly interesting group of sophisticated investors, namely, hedge funds. In Article I, 'Hedge fund herding in the foreign exchange market', I investigate hedge fund herding in currency futures contracts and its potential impact on the underlying market.

My main findings are the following: i) hedge funds herd, ii) they herd in carry trade-consistent patterns, iii) their herding impacts the underlying market, and iv) their herding does not appear to destabilize the market. I measure herding following Lakonishok et al. (1992), using data on hedge fund positions in currency futures contracts from 2006 to 2016, made available by the U.S. Commodity Futures Trading Commission. The levels of herding that I

document are many times higher than typically found for institutional herding in the stock market (e.g. Wermers, 1999), and on par with hedge fund herding in the commodity market (Boyd, et al., 2016). Hedge funds cluster on the buy side of currencies with high interest rates and on the sell side of currencies with low interest rates, consistent with hedge funds trading in accordance with the carry trade strategy, as has been documented previously by, for example, Jylhä and Suominen (2011). I find that hedge fund herding has an instantaneous impact on the market, in the direction of the herd, and that herding in the carry trade strategy predicts higher returns over the coming period. The price impact of hedge fund herding appears to be permanent, suggesting that such herding is not destabilizing for the underlying market but, rather, is driven by fundamentals, facilitating price discovery.

My article contributes to the literature in the following ways. I add to the literature on institutional herding by examining hedge fund herding in the currency market. Only Boyd et al. (2019) and, to some extent, Jiao and Ye (2014) have studied hedge fund herding, as far as I am aware. I also contribute to the literature on hedge fund behaviour by exploring the patterns of hedge fund herding in the currency market (e.g. Griffin et al., 2011; Jylhä and Suominen, 2011; Brunnermeier and Nagel, 2004). By studying the impact of hedge fund herding and carry trade herding on the underlying market, I also provide insights for the debate on whether sophisticated speculators are beneficial for market efficiency (e.g. Stein, 2009; Griffin et al., 2011) and whether herding is destabilizing (e.g. Wermers, 1999).

Article II

Technical analysis, the method of predicting future asset prices based on past price or volume data, is very popular among FX professionals. Survey studies reveal that an overwhelming majority of FX professionals use at least some sort of technical analysis to aid decision making in short-term exchange rate investments (e.g. Allen and Taylor, 1990; Gehrig and Menkhoff, 2004). However, the preference for technical analysis-based investments is not obviously warranted, since it is unclear whether the long-term significant returns of technical analysis strategies that have been documented are actually attainable by investors. Moreover, the reasons for the academically documented profitability of technical analysis strategies are still debated (e.g. Menkhoff and Taylor, 2007; Zarrabi, Snaith, and Coakley, 2017). Contending explanations include, for example, that technical analysis is a tool for analyzing fundamental information or currency interventions by central banks. FX professionals themselves seem to believe that technical analysis is informative of nonfundamentals (e.g. investor sentiment, psychological effects, and noise trader behaviour) or that it is largely self-fulfilling. However, Menkhoff and Taylor's (2007) overview of the literature seems to favour arbitrage risk as an explanation for technical analysis returns.

Despite the vast literature on the profitability of technical analysis, not much effort has been put towards understanding the underlying reasons for why technical analysis might be profitable. In Article II, 'Limits to arbitrage and technical analysis returns in the foreign exchange market', I explore the merits of arbitrage risk and LTA measures in explaining returns to technical analysis strategies in the foreign exchange market.

My two main takeaways are the following: i) higher LTA are associated with higher returns to technical analysis strategies in the foreign exchange market, and ii) investor sentiment does not seem to be related to technical analysis returns. I use a large set of data snooping–corrected technical analysis rules over six major currencies, seven measures of LTA, and two measures of investor sentiment. The results suggest that LTA are important determinants of technical analysis returns in the FX market. This is consistent with the LTA argument in which costly and risky arbitrage deters rational investors from arbitraging away potential profits. On the other hand, despite the common belief among practitioners, I find no evidence to support the notion that technical analysis is a method of analyzing investor sentiment.

My article contributes to the literature in several ways. To the best of my knowledge, this study is the first to empirically consider LTA as an explanation for technical analysis returns in the FX market. This analysis is an important contribution to the literature on the merits of technical analysis (e.g. Menkhoff and Taylor, 2007; Bajgrowicz and Scaillet, 2012). I further contribute to the understanding of technical analysis by examining explicitly its relation with investor sentiment. This study provides insights on this matter for both the academic literature and practitioners. A large stream of research focusing on the stock market shows that investor sentiment is positively related to the returns of mispricing-induced anomalies (e.g. Baker and Wurgler, 2006; Stambaugh et al., 2012), and Smith et al. (2016) document that hedge funds that use technical analysis in the stock market outperform non-users only during high-sentiment periods. Moreover, in the FX market, there is a widespread belief among practitioners that technical analysis is a tool for gauging investor sentiment. My results do not support this view.

Article III

The gradual information diffusion hypothesis (Hong and Stein, 1999) posits that, due to their limited attentional capacity, investors cannot process all information instantaneously. This leads to a gradual flow of information among investors, which, in turn, leads to return predictability. Several extensions have been proposed to generalize the implications of this model. For example, Hong, Torous, and Valkanov (2007) introduce investor specialization, limited investor participation, and market segmentation to generate return predictability across asset markets. Menzly and Ozbas (2010) then introduce the dichotomization of informed versus uninformed investors, where informed investors receive informative signals and uninformed investors are unable to infer signals from the information. A prediction of their model is that the speed of information diffusion is positively related to the informativeness of investors.

In Article III, ‘Speculator activity and the cross-asset predictability of FX returns’, I work jointly with Associate Professor Jarkko Peltomäki and Professor Michael Graham to study how speculator activity impacts the cross-asset predictability of FX strategies’ returns. Bakshi and Panayotov (2013) show how commodities predict the long leg of the carry trade strategy, and Lu and Jacobsen (2016) attribute this predictability, as well as the equity market’s ability to predict the short leg of the carry trade, to a gradual diffusion of information across

markets. We focus on how speculator activity in the FX market affects the predictive ability of equity and commodity returns on FX strategies.

Our main finding is that the ability of the equity market to predict FX strategies vanishes completely when speculators are actively trading in the FX market. However, we do not find the same strong effect for the commodity market's ability to predict FX strategies. We find that, in line with the gradual diffusion of information hypothesis, the explanatory power of the equity and commodity predictors peaks after several lags, but only in periods characterized by low speculator activity. Despite the weaker effect for the commodity market as a predictor, the main takeaway is that speculators play a vital role in enhancing informational efficiency in the FX market. These findings are in line with the theories of Hong and Stein (1999) and Menzly and Ozbas (2010). In additional analysis, we reveal that that only the activity of speculators, as opposed to hedgers, is responsible for the increase in efficiency.

The key contribution of the paper is that we recognize FX market participants as an important aspect of FX market predictability. In contrast to most previous research that relates the informational environment to return predictability (e.g. Chordia and Swaminathan, 2000; Menzly and Ozbas, 2010), we directly measure the activity of a specific trader group, namely, speculators. We also broaden the set of FX strategies to be predicted to include the momentum and value strategy, as well as the carry trade strategy that has been the focus of the literature (e.g. Bakshi and Panayotov, 2013; Lu and Jacobsen, 2016). We also contribute to the debate on whether speculators are beneficial for market efficiency (e.g. Stein, 2009).

Article IV

Investor attention has become a key instrument for behavioural models, which, in contrast to traditional asset pricing models, do not assume unlimited attention capacity. A key assumption in the gradual diffusion of information hypothesis proposed by Hong and Stein (1999), for example, is that investors have limited attention, and the model of Peng and Xiong (2006) illustrates how limited attention leads to category learning, which, in turn, affects asset prices.

However, investor attention is not observable, and previous studies have suggested a myriad of indirect proxies. One stream of the literature has focused on attention-grabbing qualities, such as abnormal trading volumes and extreme one-day returns (Barber and Odean, 2008). Other studies focus on the important role of mass media outlets, using headline news (Chan, 2003), media coverage (Fang and Peress, 2009), and advertising expenses (Grullon, Kanatas, and Weston, 2004) as proxies. Recognizing the growing importance of the Internet as a platform for information dissemination, Internet-based attention proxies have received substantial academic interest. Lately, the literature has converged around Google search queries, which were introduced as a proxy for investor attention by Da et al. (2011). Although Google search queries are correlated with other measures of attention, they are distinctly different. The studies mentioned above all find a strong link between investor attention and asset returns, and the literature has recently been extended to focus on the relation between investor attention and volatility (e.g. Andrei and Hasler, 2015; Goddard et al., 2015).

Article IV, entitled ‘Investor attention to market categories and market volatility: The case of emerging markets’, co-authored with Associate Professor Jarkko Peltomäki and Professor Michael Graham, is based on multiple resource theory (Wickens, 1992), which stipulates that attention can be broken down into three stages: i) perception, ii) processing, and iii) action. Previous papers tend to analyze these stages individually. Attention-grabbing proxies, such as media coverage, are related only to the perception stage, while Google search queries are related to the processing stage. Finally, abnormal trading volumes, for example, are related to both the perception and action stages.

In this article, we combine previous measures of attention – specifically, abnormal trading volumes and Google search queries – using principal component analysis (PCA) to capture a more complete spectrum of investor attention. We apply this innovation to a context in which the category learning of Peng and Xiong (2008) should be particularly prominent: emerging markets. Specifically, we focus on the relation between investor attention and volatility in the categories of emerging stocks and the FX market. We find that investor attention predicts higher volatility in the emerging stock market category, but not the emerging FX market category. Our PCA-based attention measure has greater explanatory power than the individual measures. The main takeaway is that greater investor attention leads to higher emerging stock market volatility and that the literature can benefit from considering several stages of the investor attention process jointly.

This article contributes by recognizing the complex nature of investor attention and by suggesting that its measurement take into account the different stages of investor attention, according to the multiple resource theory of Wickens (1992). This study also contributes to the empirical literature on the relation between investor attention and financial market volatility, by paying particular attention to the proclivity of investors to exhibit category learning behaviour and to the emerging market category of stocks and FX.

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