ANCHORING: SINK OR SOAR

HOW MACROECONOMIC CONDITIONS INFLUENCE STOCK VALUATION

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Abstract

This paper investigates whether stock valuation is influenced by psychological anchoring on macroeconomic news.

Investors are faced with a daunting task; creating a diversified portfolio that consistently delivers value. Monitoring financial markets and determining the influence of idiosyncratic as well as macroeconomic news is a costly exercise. The high variation of realized returns by different managed funds is a clear indication that an effective method has not yet been developed, and tasks are still prone to human decision making processes. This paper takes the stance that investors use heuristics in order to process these vast amounts of information, and be able to form portfolios. Salience has been shown to prove a pivotal role in the processing of information. With the market wide effect that macroeconomic news has, it is bound to play a salient role in news coverages. This paper takes the stance that investors anchor on the more salient macroeconomic news, thereby not correctly processing idiosyncratic news.

Using cross-listed firms, with the secondary listing taking the form of an American depository receipt, macroeconomic anchoring is examined. Macroeconomic events are identified using the top 10 and bottom 10 extreme exchange rate changes (per country) over a period of 800 days. This event identification methodology is used as a proxy for events that only influence one of the two listings. The Carhart 4-factor model is used to determine the expected results, and using the realized returns abnormal returns can be calculated. The difference between the 11-day cumulative abnormal returns of the two listings is then explained using an OLS regressions, with the exchange rate, size, value, whether the firm sponsored the listing, and the origination of the firm.

The findings robustly show that exchange rate shocks are not correctly integrated in prices, leading to a divergence of valuation between the two listings, and thus an arbitrage opportunity. Stock returns mimic each other, revealing investors focus on equalizing returns rather than valuations.

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1. Introduction

Variables that influence stock prices are an integral part of academic financial literature. In addition to fundamental variables, the macroeconomic conditions that stocks are subject to have increasingly come into the limelight – in part due to extreme macroeconomic policies such as Quantitative Easing (henceforth QE). The revelations these findings have brought have been preceded by financial and economic theories that still form the basis of our financial frameworks and understanding of financial markets today.

The seminal theory concerning stock prices – The Efficient Market Hypothesis theory – was introduced by Roberts in 1967. This theory was incorporated into the financial framework since the first published discussion on the subject by Fama in 1970. The hypothesis puts forward three possible efficiency levels for markets:

i. Weak: only historical data is integrated
ii. Semi-strong: historical and public information is integrated
iii. Strong: all information (historical, public and private) has been processed

Initially, a strong efficient market was supported by many academics, in part due to the joint hypothesis problem (Fama, 1991).[1] However, the subsequent robust finding of several sustained anomalies clearly invalidate the strong efficient market hypothesis. The four now widely accepted variables (henceforth factors) deemed to influence stock prices are summarized in the Carhart 4 factor model (1997).[2] Carhart's model includes market risk, size, value, and momentum as factors to explain the return on stocks. The first three factors can be seen as consistent with the efficient market hypothesis, as market risk, size, and value can be interpreted as manifestations of risk. However, momentum does not have a clear relationship with risk.[3] This factor, though by far the most important in terms of magnitude (10% vs the 4 – 6% of size and value), has many potential behavioral drivers (Carhart, 1997), of which anchoring may be one.

The anchoring bias refers to the process through which an individual makes insufficient adjustment from a (potentially irrelevant) starting point to the final valuation. This paper will focus on anchoring to give more depth to the momentum factor. The momentum factor largely remains unexplained, in contrast to size and value, which both have rational fundamental characteristics that drive their influences. A well-documented behavioral effect that relates to anchoring is the salience of news. Klibanoff et al. have shown that salience does strongly influence the reaction by investors, showing that news appearing on the front page of the New York Times has a larger influence than if it appears further on (1998). This shows evidence that

[1] Due to dependency on asset pricing models when testing markets it is impossible to know whether abnormal returns are due to model misspecification or market inefficiency.
[2] The Fama-French 5-factor model published in 2015 ignores momentum. Due to the recent publication of the Fama-French paper and the divided opinions on its validity, I prefer to take the well-established Carhart 4 factor model as a foundation.
[3] In some cases, momentum can be a reflection of risk, e.g. a company approaching bankruptcy. Nonetheless this is one of few examples.

investors choose to filter the unlimited amount of news at their disposal in part by assessing how readily available certain information is, and that '*salience provides a useful heuristic for processing information*' (Klibanoff et al., 1998). By examining this evidence that investors attempt to seek out the most relevant information and reduce the cost of information (specifically search costs), more aspects concerning how information is processed by investors could be revealed .This paper will focus on the following research question:

To what extent does anchoring by macroeconomic news influence the valuation of stocks?

This paper hypothesizes that investors attempt to minimize search costs by examining the viability of stocks starting at the broadest scale (macroeconomic), rather than focusing on idiosyncratic characteristics of firms. As such, positive macroeconomic news would indicate a buy signal, and vice versa, potentially without the investor processing any idiosyncratic news. Take for example the Dutch oil & gas company *Royal Dutch Shell*, whose bonds fall under the corporate sector purchase programme (CSPP) from the ECB. Upon the announcement of the start of CSPP, Shell's (and all other Eurozone corporates) funding capabilities significantly decreased in price, allowing it to economically expand its business or refinance outstanding bonds. Though Shell is cross-listed (on the LSE, Euronext, and NYSE), the investors located in the Eurozone would potentially be more influenced due to the immersion in the macroeconomic environment, and all the behavioral effects (e.g. general market euphoria, coverage) associated to that.

Ample research has been conducted on the topic of anchoring in financial markets, however the focus of previous research is on anchoring on idiosyncratic news, specifically concerning earnings forecasts (e.g. Cen, Hilary, and Wei, 2013). This paper will focus on anchoring on the macroeconomic environment on digesting idiosyncratic news, a topic that has not yet been explored. Furthermore, a novel approach is used to evaluate the irrational deviations from fundamental values due to macroeconomic environments – with the use of cross-listed firms. This methodology has as a benefit that idiosyncratic news does not have to be explicitly examined, since both (or all) listings are subject to identical idiosyncratic company news.

Practical implications encompass the viability of actively managed funds[4], and managing mispricing in the market (and effects such as bubbles). Moreover, the findings could convey the fragility of financial markets. The paper could convey in more depth how markets can only be as efficient as the wisdom of the crowd allows it to be, and how behavioral factors drive markets. Regulation is starting to play a larger role in financial markets, especially with the introduction of MIFID II in January 2018. MIFID II aims to protect investors, and in order to accomplish that, a deep understanding of the workings of the market, the phenomena that occur, and its drivers is needed.

[4] In addition to the literature stating actively managed funds do not beat the market in terms of returns, if idiosyncratic news is not (fully) processed stock picking becomes less useful.

2. Literature Review

2.1 Explaining stock returns

From early on in financial literature, rationality of the market was assumed, and a profitable investment could only stem from incorporating new information into stock prices. The efficient market hypothesis gained traction, specifically the strong efficient market was initially seen as the consensus. This form indicates that all information, historic, public and private, have been absorbed in stock prices, indicating that no arbitrage opportunities are present and higher returns are only possible through taking higher risk (Roberts, 1967).[5] The asset pricing model that is associated with the strong market hypothesis is the Capital Asset Pricing Model (CAPM), which states that the sensitivity of a stock to market returns (risk) can successfully explain returns. The introduction of anomalies by Fama and French that were statistically and economically significant clearly contradicts the CAPM and thus the strong efficient market hypothesis. Instead current asset pricing models show more support for a semi-strong (historic and public information) or even weak (only historic information) hypothesis. Shefrin suggests traditional finance does not hold due to behavioral costs, and behavioral errors (2001). The combination of these errors and costs result in a divergence of the market value of the firm from the fundamental value.

In Fama and French's seminal paper "Common risk factors in the returns on stocks and bonds" the authors illustrate that in addition to the market risk factor (higher risk, higher return), both smaller sized companies and firms with a higher book to market value systematically gain higher returns (1993). These size and value anomalies subsist, perhaps due to limits of arbitrage, yet both the size and value factor can be seen as manifestations of risk. Several potential explanations for the riskiness of smaller firms has been put forward; the financial distress costs play a large role (in contrast to too big to fail small companies garner less government support, have a smaller investor base etc.), and illiquidity costs are another potential explanation (Brennan, Chordia and Subrahmanyam, 1998).[6] A well supported theory concerning the value anomaly is put forward by Zhang; evidence is found that value stocks are more risky (than growth stocks) due to the rigidity of their capital (2005). Especially when the price of risk increases, value firms are not able to adjust their portfolio accordingly, in effect transferring this risk to investors (Zhang, 2005).

Contrastingly, Carhart's 4 factor model includes an anomaly that is not closely related to risk; momentum (Carhart, 1997). The influence of momentum was initially shown by Jegadeesh and Titman, noting that the gained returns had no relation to risk or to the fundamentals of the stock, and a reversion was visible in

[5] The 'higher risk higher return' precept stems from the ideology that purchasing a stock can be seen as a perpetual loan to the firm. If the chance of bankruptcy increases due to the firm having more risk associated, mechanically investors will demand a higher return. This mechanism is amplified by stockholders being the lowest ranked in the pecking order, resulting in a higher potential loss given default.
[6] A plethora of literature concerns the potential miscalculation of real betas, since this literature refers to the methodological aspect and questions the existence rather than the fundamental interpretation I do not reference these here.

the following period (1993). Whereas Jegadeesh and Titman used the findings on momentum to disprove the efficient market hypothesis and show overreactions to news, Carhart saw an opportunity to incorporate the variable to explain the returns of stocks. Momentum is generally not accepted as a factor by Fama and French as can be seen by the exclusion in the 5-factor model introduced in 2015, however, momentum largely influences stock performance. The discovery of momentum's influence has also led to the introduction of momentum strategies by investors and mutual funds (source).

In addition to testing the CAPM and the 3-factor model, the following model (including momentum) was used to test the accuracy of model specification (Carhart, 1997):

$$r_{it} = \alpha_{iT} + b_{iT}RMRF + s_{iT}SMB + h_{iT}HML + P_{iT}PR1YR_t + e_{it}$$

α : Jensen's alpha	HML: High minus Low - value factor
RMRF: Market returns adjusted for the risk-free rate	PR1YR: Prior 1 year return – momentum factor
SMB: Small minus Big - size factor	

Jensen's alpha captures the abnormal return compared to the expected return of the theoretical (factor) model, in other words a risk-adjusted measure of performance (Jensen, 2002). With each addition of a factor, the model can more accurately explain the returns. Whereas size and value each account for 4 -6 % annual returns, momentum can account for a 10% annual return (Carhart 1997). However, most astonishing of the findings is that the momentum factor's influence is nearly eliminated after 5 years, such that the stock experiencing positive or negative initial momentum have a similar monthly return (Carhart, 1997).[7] Thus, momentum is a temporary factor, that is potentially related to market conditions or timely events.

2.2 Effect of news on stocks

When examining the effect of news on stocks, two broad collections of literature can be distinguished: literature concerning idiosyncratic news, and literature concerning macroeconomic news. The method in which these two forms of news influence the firm differ vastly. Macroeconomic news influence stock market reactions by adjusting the expectations with regards to future economic conditions (Veronesi, 1999). Stocks react to idiosyncratic news since it conveys information to investors about the current situation of the firm. Based on the nature of the news, positive or negative, the stock will increase or decrease in value respectively.

Flannery and Protopapadakis examine macroeconomic factors that influence stock returns (2002). Their findings show that six macroeconomic factors are priced (influence the stock price); CPI PPI, monetary aggregate, balance of trade, employment report, and housing starts (Flannery and Protopapadakis, 2002).

[7] This finding is especially interesting since the dataset used is free of survivorship bias.

They, again, postulate that this is due to the effect these factors exert on the future investment opportunity of the firm. Furthermore, findings have shown that stock returns are negatively related to inflation and money growth (Flannery and Protopapadakis, 2002). In order to examine their hypotheses, they use a GARCH-model to examine 17 macro announcements using a value weighted NYSE-AMEX-NASDAQ index (US index).

Klibanoff et al. have shown that salience strongly influences the reaction of investors, showing that news appearing on the front page of the New York times has a larger influence than if it appears further on (1998). An important assumption within this paper is that all investors behave with bounded rationality, such that their portfolios are well diversified (investors will not take on any risk for which they will not be compensated). What this means in practical terms is that an investor is assumed to hold a minimum of 32 stocks in order to benefit from 95% of the possible diversification benefits (Fisher and Lorie, 1970). In order for the price to accurately depict the fundamental value, an investor would thus need to update their expectations on each of the 32 stocks as soon as each news item for the stock is announced. With the vast number of firms in general, and within each investor's portfolio, this is a difficult task. Macroeconomic news, since it influences all financial instruments, has more media coverage and so is more salient. Therefore, it is expected that, even if each stock does not accurately reflect the fundamental value of the firm, on aggregate the market does due to the salience of macroeconomic news. Thus, there may be slight deviations for specific firms, but not for the market as a whole.

2.3 Anchoring

The behavioral phenomenon that this paper examines is anchoring. Anchoring affects the decision making process of an individual through insufficient adjustment from the initial starting point (Tversky and Kahneman, 1974). For stock prices in particular, this can take on several forms; the closing price, opening price or price of peer's shares can all influence the stock reaction of a firm. Campbell and Sharpe examine whether the anchoring hypothesis plays a role in financial markets, and find that the consensus forecasts are biased towards the previous month's data (2009). Such that the forecast is biased from the perhaps more extreme true value towards the realized values the previous month. However, their findings also suggest that this anchoring phenomenon is anticipated by market participants, thus resulting in no market reactions relating to the anchoring phenomenon (Campbell and Sharpe, 2009). When discussing the notion of anchoring, it is important to distinguish between social interaction effects (such as contagion or herding effects) and cognitive limitations. Anchoring does not relate to social interaction effects, but relates to cognitive limits in making objective valuations and decisions when faced with an anchor.

2.4 Cross-listing

A cross-listing refers to a company that in addition to their primary listing on an exchange, has a secondary listing on a different exchange often in a different geographical location and/or time-zone (Ahearne et al., 2004). An extensive amount of literature concerns the benefits enjoyed by firms that have successfully cross-listed. For the purposes of this paper, a brief summary will follow to acquaint the reader with these benefits, since the cross-listing phenomenon is solely used for methodological purposes in this paper, we will not go into depth on the findings. Note that some of the cross-listings by firms are unsponsored, meaning that the firm does not take action to cross-list, but a third party may re-sell the stock on a different exchange. Furthermore, relating to the methodology used in this paper, this section will solely cover evidence from firms that cross-list in a different market, even though listing in the same market on a different exchange could be possible (e.g. NASDAQ and NYSE).

Figure 1 shows the possible different levels of cross-listings, as mentioned before the firms examined by this paper all have their secondary listing in the US. Thus, the listings fall under the American depository receipt (henceforth ADR) category. The four levels detailed in the table below are described in terms of differing characteristics. Most important to note is the difference in commitment by the firm, and the benefits the firm gathers from their secondary listing. For example, a level I listing is unsponsored; the firm has not undertaken the action to be cross-listed but a third party has. This level requires no commitment from the firm, and has as sole benefit the additional exposure in the secondary market. Contrastingly, a level III listing, though requiring substantial effort from the firm due to the issuing of new shares, allows for the raising of capital in the secondary market. Rule 144A refers to a private placement in the secondary market; issuers sell blocks (large amount of stocks sold as a bundle) to previously agreed institutional investors.[8]

[8] Due to the differing nature of these 144A stocks, and the limited liquidity after the placement since the expectations are that institutional investors holding these stocks will not quickly sell, this category is not included in the analysis.

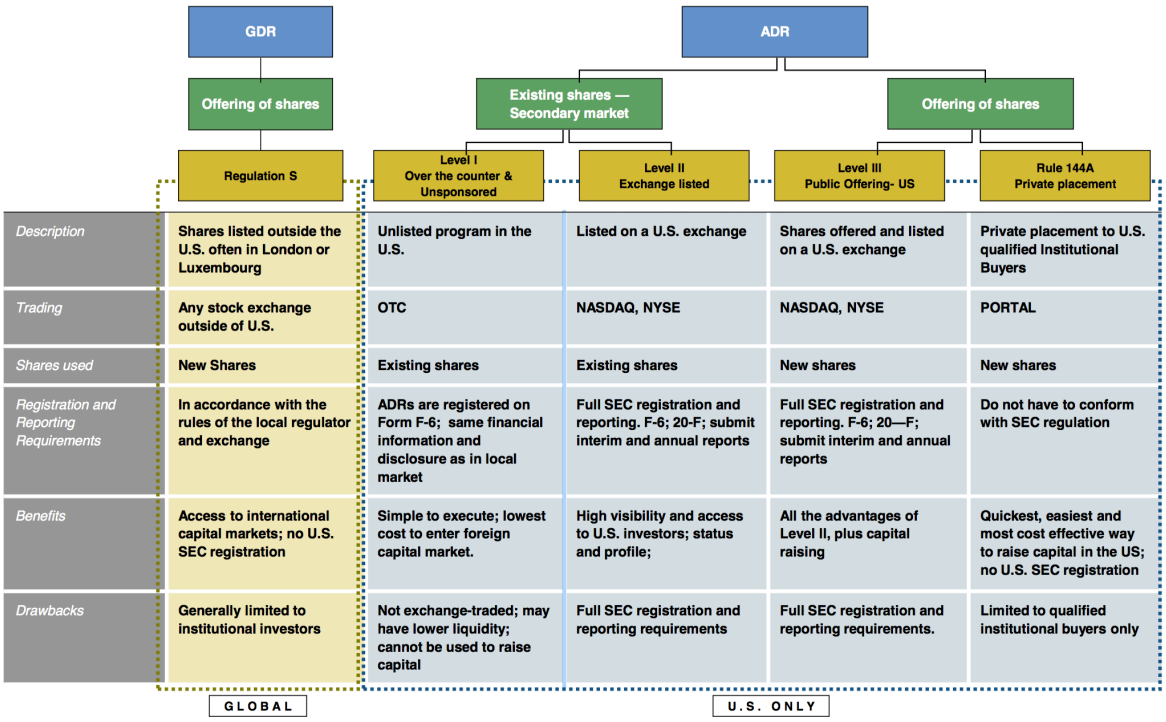

Figure 1: Depository Receipts (J.P. Morgan, 2016)

The benefits of cross-listing can be summarized in four broad concepts: i) Bonding hypothesis, ii) Segmentation, iii) Market liquidity, and iv) Information disclosure. Each of these concepts will be detailed below:

2.4.1 Bonding hypothesis

The bonding hypothesis relates to the firms 'bonding' to stricter investor protection through a secondary listing in the US (King and Segal, 2008). The US is known for having the highest level of investor protection due to more regulation and enforcement. The greater monitoring and transparency reduces information asymmetry, thereby protecting investors (King and Segal, 2008). Thus, firms that cross-list show that they are willing to offer greater investor protection at a cost to the firm[9], making investors more willing to invest. This often leads to an increase in the valuation of the company (King and Segal, 2008).

Furthermore, cross-listing has been found to be especially beneficial for minority shareholders (Reese and Weisbach, 2002; Doidge, 2004). Firms attempt to increase the protection for minority shareholders, since it increases the valuation of the firm and makes raising capital easier. Cross-listing to the US helps in this aspect since the legal system is amongst the top in the world concerning the protection of minority shareholders (Reese and Weisbach, 2002). The bonding takes on several forms, firms have to conform to the US GAAP rules and to some extent the US securities law, file reports with the SEC, and comply to the exchange requirements (which can differ per exchange) (Reese and Weisbach, 2002). Previous research

[9] Depending on the type of secondary listing the firm will have to pay registration fees, in addition disclosing more information is costly.

has documented a small positive reaction to the listing announcement, thereby showing evidence for the bonding hypothesis (Reese and Weisbach, 2002).

2.4.2 Segmentation (avoiding investment barriers)

A well-documented benefit of cross-listing relates to segmentation. By cross-listing, the firm gains access to the funds of foreign investors, that otherwise would not have invested due to barriers. These barriers can take on several forms such as regulatory restrictions (or more specifically fund restrictions[10]), direct costs or opaque environments relating to information (King and Segal, 2008; Sarkissian and Schill, 2009).

2.4.3 Liquidity

Cross-listing can greatly increase the liquidity in a stock due to the additional coverage, and larger investor base. Amihud and Medelson define illiquidity as the cost of immediate execution (1986). An illiquid stock will have a larger cost associated to it, this cost is proxied by the bid-ask spread. This since the ask price includes a premium for purchasing, whilst the bid price has a discount for immediate sale (Amihud and Medelson, 1986). Previous research has documented that the bid-ask spread is negatively correlated with trading volume and the number of shareholders (Amihud and Medelson, 1986). Korczak and Bohl find that cross-listing increase investments from international investors leading to increased liquidity, as well as increasing pricing efficiency (2005). However, results are not conclusive since Berkman and Nguyen don't find evidence that cross-listing improves domestic liquidity, conveying that asset price increases are not due to increased liquidity (2010).

2.4.4 Information disclosure (quality)

Due to the tighter regulations in the US markets, the firm is forced to disclose more information. The accounting standards, US GAAP, also add to the improved sharing of information relating to the accounting of the firm. Ahearne et al. postulate that investors benefit from cross-listing since it leads to more information disclosure thus mitigating the home-bias effect (2004). The home-bias effect relates to investors having the tendency to invest in local stocks due to the additional (subconscious) information they hold on those particular stocks (Ahearne et al., 2004). Furthermore, Lui finds evidence for the hypothesis that cross-listing increase home-pricing efficiency (2007).

2.4.5 Cross-listing price divergence

Rational finance models dictate that, since the stock at both listings has a claim on the exact same assets, the prices should be at unity. However, for the purposes of this paper, to uncover a potential effect prices should be able to diverge. There have been several instances documented of diverging prices of cross-listed

[10] Some funds, and institutional investors, have restrictions concerning what stocks they are allowed to invest in. Cross-listing might make firms eligible for investments if they then satisfy requirements.

and dual listed firms. The majority of the research about pricing divergences concern dual listings in mainland China and Hong Kong. Lui and Seasholes find that, due to a short sale ban in China, the Chinese listing has prices that are 1.8 times the Hong Kong prices (2011). This effectively reflects the limits to arbitrage argument often made when prices diverge from fundamental prices. Most notably, after the ban is lifted, the shares return to trading at unity (Lui and Seasholes, 2011)[11]. Peng et al. show that price convergence does occur, but to an incomplete level, and that large divergences occur more for firms with a small market capitalization (2007).

[11] This paper examines dual listed firms, not cross-listed. But in essence, and especially for the purposes of this paper, they are similar.

3. Theoretical Framework

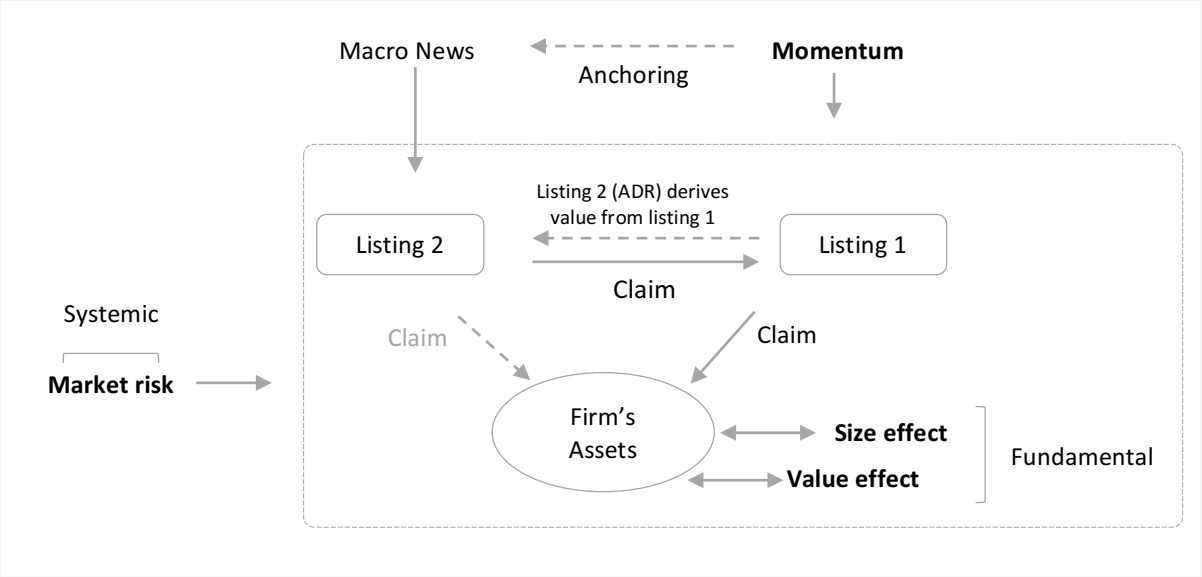

Figure 2: Summary of factors that influence stock returns

Figure 2 summarizes the framework used in this paper, and illustrates the factors through which stock returns can be influenced according to the Carhart 4-factor model, in a multi-listed company setting. Market risk is systemic, in that it influences the entire scope of stocks. The market risk factor is the purest form of risk measuring – the sensitivity of stock returns to the market return. The size and value anomalies relate to the fundamental characteristics of the firm, and are endogenously determined for each firm. The last aspect of the Carhart model is momentum, which is neither related to the fundamentals of the firm, and does not influence all stocks collectively. The focus of this paper is to identify the nature of this factor. A potential driver of the momentum factor is macro-economic news, which can be instrumental in not only rationally influencing the value of the firm, but also the market sentiment. This paper has as core viewpoint that **macroeconomic news is a core driver of the momentum factor**.

Macroeconomic news has rational effects on the valuation of a firm; a positive macroeconomic environment (low interest rates, low unemployment etc.) fosters the growth of a company thereby increasing its value. Since this is related to the fundamentals of the firm, no behavioral (irrational) aspects play a role here. However, behavioral factors start to play a role when the access to information is taken into consideration. Due to the adoption of the internet, and general globalization trends, all information is accessible to all investors. Dependent on location the amount of emphasis put on news items can vastly differ, with news items being more salient in the home economy. This salience, in combination with the cognitive limits of investors, can then translate into the news item becoming a pivotal variable in the decision making process, resulting in investors anchoring on the macroeconomic environment. This anchoring can result in investment decisions that differ from the optimal decision.

Using cross-listed firms, the potential irrational anchoring effect can be examined. As shown in figure 1 the ADR gives the holder claim on stocks of listing 1, effectively equating the stocks and ADRs (for unsponsored listings). More importantly, both an ADR (unsponsored and sponsored) and a stock give the investor a claim on the firm's assets, which should be valued the same for both sets of investors.[12] However, previous research has shown divergences in the price of a stock and value of an ADR are possible, despite the often quoted arbitrage argument. A divergence in this paper would, ceteris paribus, signal that due to the macroeconomic setting of investors the value associated to the firm changes. Please note that the macroeconomic environment of the firm remains the same in both cases, such that the macroeconomic environment the investor experiences can potentially be irrelevant for the valuation of the company. This leads to the first hypothesis:

I. A localized macroeconomic shock does not induce diverging valuations

To examine the hypothesis, localized macroeconomic shocks have to be identified. Global macroeconomic shocks are excluded since they can influence both listings in the same manner, allowing the same behavioral processes to take place for both listings.[13] To identify events, extreme exchange rate fluctuations are used. This identification would signify one of the two economies experiences an event that influences expectations for investors versus the status quo, ceteris paribus. Since the two listings are identical in their claim on company assets, and it is assumed valuation is initially the same for both listings, a perfect counterfactual is present. Please note it is assumed that the rational reaction from investors is the same for both listings, since a macroeconomic shock can alter the potential of a company. However, this framework allows to examine whether there is an irrational aspect in addition to the expected reaction. Treatment group Investors may have an over- or under-reaction to the change in macroeconomic environment compared to the control group investors.[14]

The mechanics of how exchange rates play a role when examining behavioral influences and cognitive limitations. Take the example of a Dutch firm (unsponsored listing); the Dutch listing is the first listing, whilst the US listing is the secondary (ADR) listing. In order for the prices to be at unity the following statement has to hold true: $€\ listing = \frac{\$listing}{\$/€}$. Since the second listing derives its value from the first listing (as shown in figure 2), whilst the first listing derives its value from the fundamental value of the firm, the second listing should adjust in order for the prices to remain at unity. Figure 3 shows the development of the EUR/USD exchange rate from 2013 onwards. Certain periods see quite large volatility, in part due to extreme macroeconomic policy and political instability. Though incorporating exchange rates is a

[12] The aforementioned literature concerning macroeconomic events influencing valuation refers only macroeconomic news affecting the home country of the stock (e.g. if Japan sees lower unemployment this is irrelevant for a Dutch stock).
[13] Global shocks that asymmetrically influence listings are included.
[14] In this paper the treatment is experiencing the localized macroeconomic shock first hand.

mechanical effect, potentially these fluctuations are not fully integrated into stock prices by investors. This leads to the second hypothesis:

II. Stock prices adjust for exchange rates

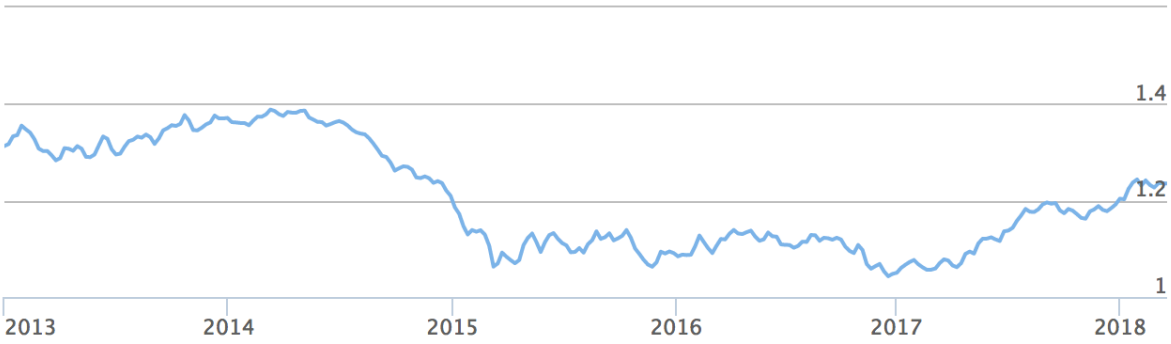

Figure 3: EUR/USD exchange rate development

Investors (irrespective of their location) have as aim to maximize their returns. Therefore, instead of price returns may be their main concern. It is possible that rather than ensuring the value of stocks is the same for each of the listings, the return gained can be a more prominent factor; This leads to the third hypothesis:

III. Returns of both listings move in unison

By moving in unison, it proves that it is not simply irrationality that is introduced in the market, through the prices not being equivalent. Instead the secondary listing is incorrectly linked to the first listing, simply mimicking the primary listing as if it was part of the same environment. Thereby anchored to this economy through the relationship with the primary listing.

Though previous research has examined how macroeconomic conditions influence stock pricing (through future expectations), rational and irrational reactions are seen as one. This research will allow the two effects to be disentangled. The use of a true counterfactual (the alternate listing) allows us to examine what the rational reaction is, and how the irrational factor, perhaps introduced to an over or under-reaction. Due to the structure of this research, and the identification of events, it is only possible to examine this divergence in terms of absolute values, since it is not possible to examine which of the two listings has the rational response based on currency rates. The visual below illustrates the methodology of this framework. The difference between the realized stock price pattern, and the second listing is the divergence from rationality – the main topic of this paper. Comparing the second listing with the expected

returns calculated with the four factor model gives the rational reaction to the macroeconomic shift. Please note that parity is assumed until the commencing of the event.

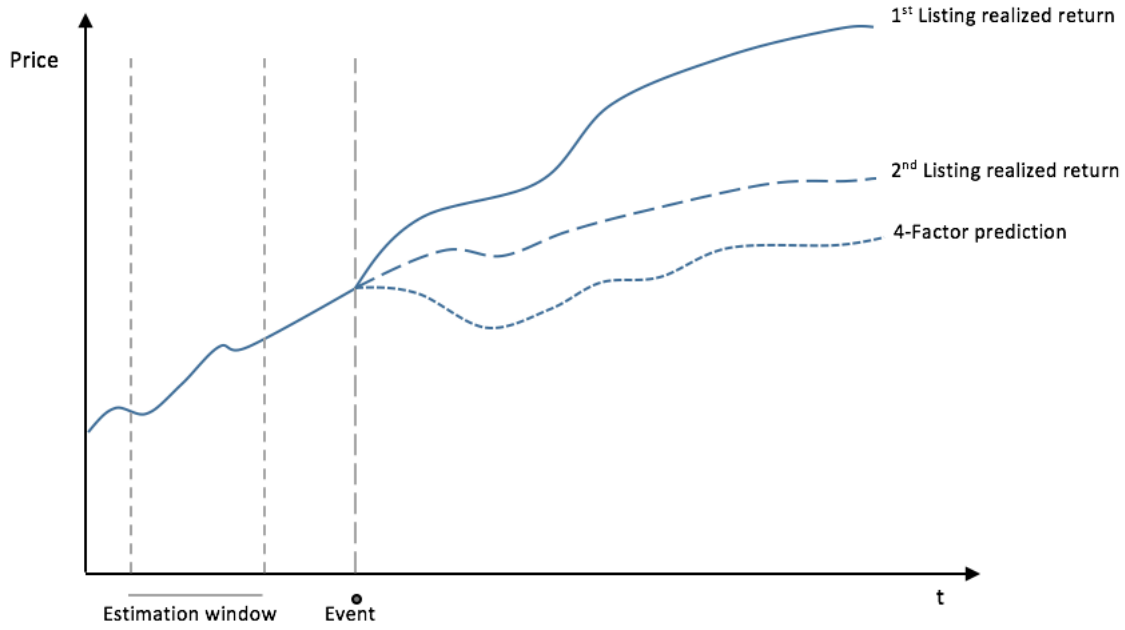

Figure 4: Visual depiction of the hypothesis development

Figure 4 is a depiction of the hypothesis development. The four factor prediction is based on current market conditions. A macroeconomic event, however, will change the valuation of the future conditions for the firm. Thus, the divergence between the prediction and the realized return for the second listing is due to the change in future prospects, which in this paper is proxied by the change in exchange rate. Please note the paper does not examine whether the 4-factor model correctly predicts returns, but rather whether a macroeconomic shock leads to a differential between the two listings. The next section will discuss how the hypotheses will be examined and elaborate more on the dataset used.

4. Data and Methodology

4.1 Data

An overview of cross-listed firms can be found in the Bank of NY Mellon DR database. This database includes firms that have their secondary listing through an ADR. Using DataStream daily prices for both the underlying (primary) listing and the US (ADR) listing can be downloaded. A total of 2173 firms has data available for both listings. It is sometimes the case that a firm only has one listing – the ADR, or due to bankruptcy/a dead listing no data is available for the required time period. The downloaded data spans from 10/01/2014 – 03/02/2017. This period encompasses several macroeconomic environment changes that are of interest to examine. For example, QE and the Brexit. Multi-listed (more than two exchanges) firms are excluded, since the third or more listing will introduce noise.

In order to control for firm characteristics, the market value and book to market are retrieved from DataStream. Furthermore, exchange rates are retrieved from DataStream. The exchange rates all take the form local currency to USD (base currency is USD). Data regarding the four factors is downloaded from the Kenneth French website.

4.2 Methodology

Using the Carhart 4-factor model a 11-day event study will be employed to examine the hypotheses and research question. Please note the two listings will be referred to as the local listing (the initial listing) and the US listing (ADR).

4.2.1. Event Identification

Extreme exchange rates changes will be used as a proxy for localized macroeconomic shocks. Some economies are more stable than others, namely a well-developed market (MECD) can have less variance in daily exchange rate returns than a developing country (LECD). Thus, the events are determined on an intra-country relative basis. For each country, the top 10 and bottom 10 daily exchange rate returns are considered an event. As mentioned previously, these events are determined on an intra-country level, meaning that for some countries the most extreme cumulative exchange rate returns may be close to zero (see appendix 9.5 for the distribution). As a robustness check, events that lead to more than a 4 percent change (in absolute terms) are examined separately.

For each country 20 events will be uncovered, for each firm that has the home listing in that country, the events will be examined – so events are discovered on a country-wide level, but the effects are analyzed on a firm-level basis.

4.2.2. Confounding events

Since events are identified using a ranking of exchange rate returns, it can be the case that two events occur in the same event window (for CAR (-5, +5)). If this is the case, the two event windows will be merged, creating a larger event window. This method is preferred over considering two overlapping event windows, since the influence on exchange returns might be linked. Thus, these two extreme exchange rate moves relate to the same event.

4.2.3 Firm deletions

Since the macroeconomic conditions concerning the local listing can vastly differ, the regressions will take this into account. In order to make the coefficient estimations as robust as possible, per country a minimum number of firms is needed, as is liquidity in the stock. Liquidity is important since this will allow the stock price to move swiftly according to external forces. If there is not sufficient liquidity, stock prices are more likely to diverge. In order to account for need of liquidity, if a firm has more than 150 zero return days (out of 800 days) it is excluded from the dataset. Furthermore, to account for the proper estimations of coefficients, each country will need a minimum of five companies that are cross-listed. Unfortunately, this has resulted in deletion of several countries, please consult appendix 9.1 to see which countries are excluded.

Figure 5 shows the timeline of the methodology. It is important to note each cross-listing potentially becomes active at a different point. The term 'active' refers to the time the second listing - in the US - can be purchased, the date that the secondary listing becomes effective. From this point onwards, a divergence could occur. However, for the purposes of this research, it is assumed that up to the starting point of the dataset the prices of both listings are at unity. This could potentially be relaxed, since if the event causes the prices to converge (instead of diverging), it reveals a previous divergence.[15] The timing of divergence or convergence is beyond the scope of this paper, due to the complexity of the calculations regarding unity of prices, and determining if a divergence is present which listing reflects the fundamental value. The estimation period covers 126 days, which is synonymous to 6 financial months since the data solely covers trading days. Using the market return, size, value and momentum factors found on the Kenneth French website, the coefficients to these factors are calculated for the US listing and local listing. For each firm, the US listing uses the US Fama French & Momentum factor to generate the coefficients. All of the listings are grouped together to perform this regression. For the local listings, various Fama French & Momentum factors are used depending on the where region the firm's home listing is. The four factor groups are: Global excluding US, Europe, Japan, and Asia Pacific excluding Japan.[16] These coefficients in turn are used to calculate expected returns in the event window. The expected returns are subtracted from realized

[15] The explanation for such a divergence could be different than the hypothesis of this paper.

[16] See appendix 9.3 for the inclusion of country per region in the calculation. The calculations of factors are leading in determining in what group a country is place. If a country is not included in the calculations of factors, it is placed in the global excluding US group.

returns in the event window, resulting in the Abnormal Returns (ARs). Subsequently, over the event window the ARs are accumulated to create Cumulative Abnormal Return (CAR). In order to examine the research question, a two-step process will be run. The first step relates to the estimation period, and setting a baseline per company, whereas the second step relates to the event window and direct testing of the hypotheses.

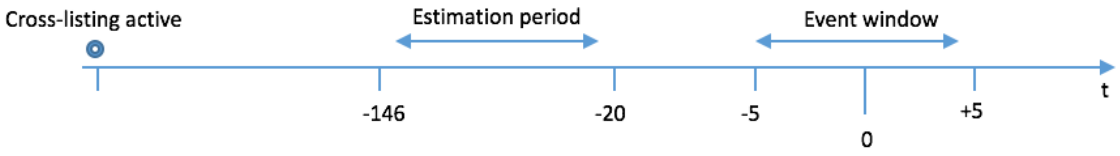

Figure 5: Timeline

4.2.4 Step one – Estimation period

Firstly, Carhart 4-factor regressions will be run during the estimation period. These regressions do not include any control variables and are run as done in Carhart's paper. So in this case there will be an alpha, and four betas calculated. To estimate betas, firms should have at least 60 financial days of data (three months) and preferably more than 120.[17]

Factors are downloaded from Kenneth French website and are dependent on geographical region. For the purposes of this paper daily factors are used. Appendix 9.3 details the four regions that are used in this research. The factors used are the daily market, size, value and momentum factor. Using these factors, idiosyncratic (and per individual listing) regressions are run.[18] This yields a beta for each factor per listing, and an alpha. These betas are calculated as follows:

$$r - r_f = \alpha + \beta_{CAPM}(r_m - r_f) + \beta_s SMB + \beta_v HML + \beta_M WML + \varepsilon$$

α: Jensen's alpha

β_{CAPM}: CAPM beta, relates to the co-movement of the stock with the market

β_s: Beta relating to the size (SMB – small minus big) factor

β_v: Beta relating to the value (HML – high minus low) factor

β_M: Beta relating to the momentum (WML – winners minus losers) factor

Using these findings, the expected return during the event window is calculated using the following formula:

$$Expected\ return = \alpha + \beta_{CAPM}(r_m - r_f) + \beta_s SMB + \beta_v HML + \beta_M WML$$

[17] During preliminary research, the US factors have shown to hold less explanatory power than local factors. This is also theoretically more justified since the intrinsic characteristics of the firm do not change with the US listing.

[18] Idiosyncratic and per listing regressions are run since the different investor base has to be accounted for. A significant amount of research within the behavioural economics/finance field concerns investor sentiment, and how this may potentially different based on geographic location.

4.2.5 Step two – Explaining the variance

Once the expected returns have been calculated, the divergences can be examined. To get to the rational reaction (marked as second listing in figure 2) the mechanical effect of the exchange rate change has to be included. Next explanatory variables can be introduced to explain the drivers behind the irrational response – the divergence.

Firstly, using the expected returns from step one, and the realized returns, ARs can be calculated: $Abnormal\ return = Realized\ return - Expected\ return$. These ARs are then accumulated over the event window to generate eleven-day CARs. Now there are two CARs per firm. Subsequently, the following explanatory regression will be run:

$$CAR_H - CAR_F = \alpha + \beta_1 FX + \beta_2 logSize + \beta_3 logValue + i.FF + i.country + \varepsilon$$

and:

$$|CAR_H - CAR_F| = \alpha + \beta_1 |FX| + \beta_2 logSize + \beta_3 logValue + i.FF + i.country + \varepsilon$$ [19]

i.FF stands for the indicator variable for the group of French variables used (based on region). i.country is an indicator variable that controls for the country. Country dummies are included, since the difference between the efficiency of markets can vastly differ, as can the nature of the event.

[19] Terms in between vertical bars signify absolute terms

5. Results

Figure 6 showcases the eleven-day event window, and the four most important variables; the local listing CAR, US listing CAR, the difference between these two variables, and the cumulative exchange rate. What is imperative from this figure, is that the local listing and US listing CARs mimic each other. This is reiterated by the difference of CARs, which in the eleven-day window does not deviate significantly from zero. When examining the exchange rate, as expected, there is a peak at day zero (the event day). This peak is mirrored in the CARs of both listings. Standard theory, however, would dictate that this exchange rate spike would cause a deviation in returns, in order to keep price levels at unity. To the contrary, both listings seem to experience this spike in their returns, and both listings experience an upward trend. This figure, however, is simply a preliminary view of what the pattern is and will now further be examined with the use of regressions.

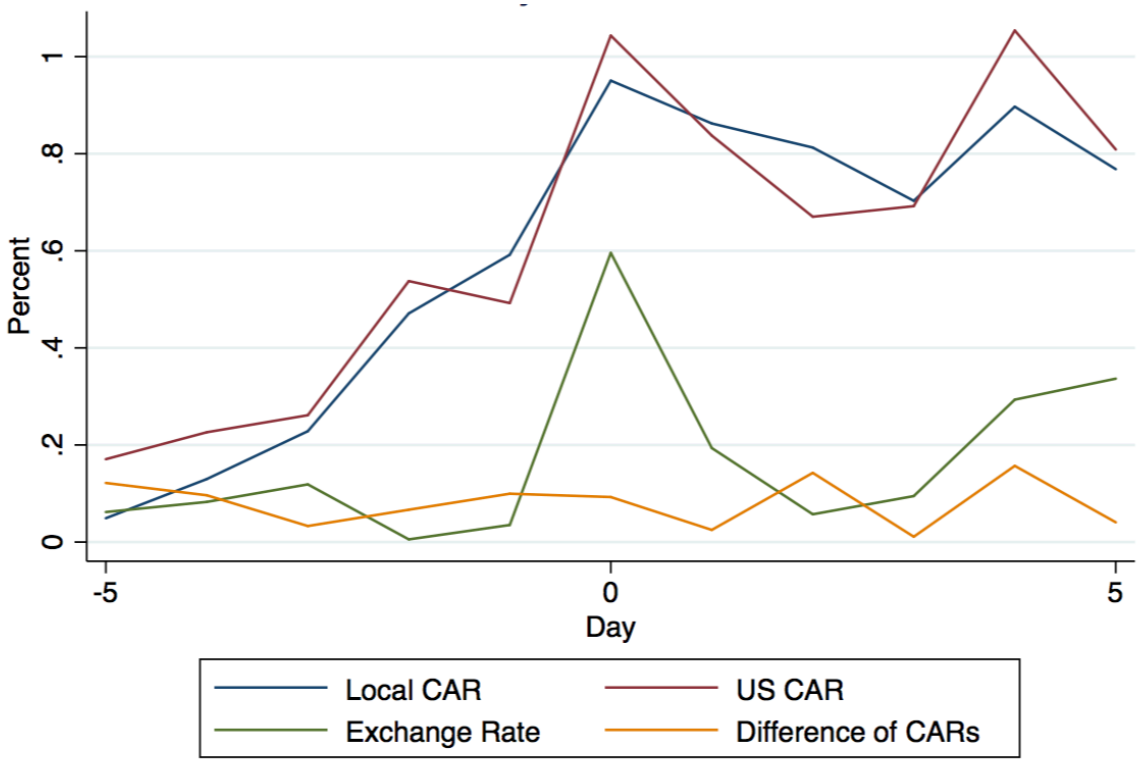

Figure 1 Stock return pattern during the eleven-day event window

Table 1 shows the descriptive statistics for the four pivotal variables. The independent variable, the divergence of CARs, has a mean of 0.03%. Though this is economically seen not significant, the distribution of the variable has fat tails with the difference increasing up to 128.37% (in absolute terms). The same statement holds true for the other variables; an economically insignificant mean however a distribution with fat tails. Please resort to appendix 9.5 for a visual depiction of the distributions.

Table 1 Descriptive statistics[20]

VARIABLE	MEAN	STD. DEV.	MIN	MAX
DIVERGENCE OF CARS	0.03	5.59	-128.37	123.45
CUMULATIVE EXCHANGE RATE	0.47	4.13	-8.60	40.03
LOCAL CAR	0.56	8.34	-123.45	71.06
US CAR	0.58	8.39	-120.90	77.70

Table 2 shows the regression results for an eleven-day window. It is important to note that two different regressions are run, with fundamentally differing reasons. The first regression has the difference of CARs as its dependent variable. This regression examines what the influence is of the exchange rate, size, value and the Fama-French factor region, as well as country. Fundamentally, this regression would be able to differentiate between positive and negative events, since there is a directional factor associated. In reality, however, the method in which this research is put together does not allow for directional factors. Due to the inability to identify whether the events result in a positive or negative divergence, since it is also uncertain in which of the two economies the event occurs, the second regression is introduced. The second regression has as dependent variable the absolute difference of CARs. Important to note is that the absolute value of the cumulative exchange rate is used instead of the cumulative exchange rate. Using absolute values solves the issue of which economy experiences a macroeconomic event. Fundamentally and statistically, the absolute difference of CARs has a stronger basis. In addition, the r-squared associated is higher (0.322 vs. 0.216), meaning the model is a better fit. The third regression examines only the events that lead to an exchange rate change of more than 4% since some 'extreme events' in countries may be an outlier compared to the other data points in the 800 days, but not in terms of absolute values. The following section will solely focus on discussing the second and third regression.

[20] These statistics include only tested event and data points (day +5 from the eleven-day window).

*Table 2: OLS regressions for difference of CARs and absolute difference of CARs. The base regression is on the Japanese region (Fama-French Factors). Regressions are clustered on firm-level – there are 657 clusters in each case. To run the regressions 8184 events are used. [21] P-values are reported in parentheses. Base regression includes Argentina. Japan, Singapore and the United Kingdom have been omitted due to collinearity. Statistical significance at the 10%, 5% and 1% are denoted by *, **, and *** respectively.*

Independent Variables	Difference of CARs (-5, +5)	Absolute Difference of CARs (-5, +5)	Absolute difference of CARs Exchange rate >|4+| (-5, +5)
Cumulative Exchange Rate	0.644*** (0.000)	-	-
Absolute cumulative exchange rate	-	0.663 *** (0.000)	0.612*** (0.000)
Log Size	0.193 (0.142)	-0.820 *** (0.000)	-0.824*** (0.000)
Log Market-to-book	-0.245 (0.129)	0.549 *** (0.000)	0.402** (0.017)
Sponsored	0.346 (0.254)	-0.241 (0.412)	-0.420 (0.221)
Factors			
Global Factors (2)	-10.180*** (0.000)	-4.952 *** (0.000)	-1.771 (0.250)
European Factors (3)	-0.516 (0.526)	-3.750 *** (0.000)	-3.282 *** (0.008)
Asia Pacific Factors (4)	-1.016 (0.127)	-3.164 *** (0.000)	-0.439 (0.733)
Countries			
Australia	-0.016 (0.974)	-0.158 (0.693)	-
Belgium	-1.370 ** (0.032)	1.893 (0.163)	2.443 (0.198)
Brazil	9.647 *** (0.000)	3.047*** (0.000)	2.348 ** (0.016)
Chile	7.167 *** (0.000)	5.812*** (0.000)	2.640* (0.082)
China	10.031*** (0.000)	3.704*** (0.00)	-
Denmark	-1.052 (0.137)	1.686* (0.078)	4.336** (0.014)
Finland	-1.080*** (0.000)	-0.368 (0.358)	0.238 (0.705)
France	-1.802** (0.021)	0.737 (0.303)	0.955 (0.146)
Germany	-0.837 ** (0.019)	0.471 (0.190)	1.503** (0.022)
Greece	-1.552 (0.390)	4.660*** (0.000)	4.296* (0.090)
India	8.424 *** (0.000)	3.396*** (0.000)	-
Indonesia	7.913 *** (0.000)	9.522*** (0.000)	12.308*** (0.000)
Ireland	-0.443	0.117	-0.267

[21] Per firm 20 events are identified, however due to the merging of overlapping event windows, the total amount of event windows – and thus final event count – is lower.

	(0.359)	(0.865)	(0.771)
Israel	11.261***	3.436**	-
	(0.000)	(0.034)	
Italy	-0.805 *	0.138	0.823
	(0.080)	(0.691)	(0.188)
Korea	7.963 ***	8.130***	7.607***
	(0.000)	(0.000)	(0.000)
Mexico	9.602***	2.345***	-3.191***
	(0.000)	(0.002)	(0.002)
Netherlands	-0.793***	-0.440**	0.923*
	(0.001)	(0.041)	(0.084)
Norway	-1.044**	1.229***	1.407**
	(0.003)	(0.007)	(0.018)
Russia	8.362 ***	7.414***	9.421***
	(0.000)	(0.000)	(0.000)
South Africa	7.423	3.778***	0.177
	(0.000)	(0.000)	(0.866)
Spain	-0.956***	0.061	0.830
	(0.006)	(0.860)	(0.132)
Sweden	-0.909	2.627***	7.987***
	(0.270)	(0.000)	(0.000)
Switzerland	-1.844 ***	0.195	2.500***
	(0.000)	(0.616)	(0.000)
Taiwan	9.282 ***	2.798***	-
	(0.000)	(0.000)	
Constant	-1.168	12.506***	10.472***
	(0.590)	(0.000)	(0.002)
R-squared	0.2158	0.3218	0.5246

According to the second regression, for every percent that the exchange rate increases, the divergence increases by 0.663%. The complement, 0.337% per percent increase, is integrated in the prices. Thus, the larger the event, the more noticeable the arbitrage opportunity. Both the size and value of a firm are highly significant. For each percentage point increase in size, the divergence between returns decreases by 0.820%. This means that larger firms have less divergence in prices. Furthermore, firms that have a percentage point higher market-to-book value have on average 0.549% higher stock return divergences. Interestingly, whether a firm is sponsored has no statistical significance – the difference is driven by investors and not the firm.

The inclusion of countries dummies allows for the examination of the market efficiency of each country. Interestingly, many of the countries that are statistically insignificant are European countries (MEDCs). Furthermore, the countries that have seen extreme fluctuations in have coefficients that are significant at the 1% level.

Lastly, the robustness check that includes only events identified by an exchange rate return of more than 4% (in absolute value), confirms the sign and magnitude of the four most important variables (the first four variables in table two).

Using the findings of these regressions, the hypotheses can be examined.

I. A localized macroeconomic shock does not induce diverging valuations

This hypothesis is rejected Through mechanical effects the difference of CARs should show a mean average of 0.47% over the event window, the difference between the CARs amounts to 0.03%.

II. Stock prices adjust for exchange rates

This hypothesis is rejected. Table one shows an adjustment of 0.03%, however the exchange rate is highly significant in explaining this difference.

III. Returns of both listings move in unison

This hypothesis is not rejected, as figure 4 shows the CARs seem linked to each other. Rather than focusing on stock prices, investors seem more interested in equating returns.

6. Discussion & Conclusion

The findings have shown that the exchange rate is highly significant in the ability to explain the divergence between the stock return patterns, however the listings do not sufficiently adjust for the shift in exchange rates. Furthermore, the stock return patterns of the cross-listing mimic each other. Combining these two findings provides evidence for anchoring on macroeconomic events. The mimicking of returns reveals another interesting facet; investors appear more interested in equalizing returns than equalizing valuations.

In order to examine whether selection bias might be present, due to the fact that firms opt to cross-list and thus may intrinsically differ from firms listed on one exchange, sponsored firms are examined. The results show that this variable is statistically not significant. Thus, firms that are cross-listed due to the actions of a third party have the same stock return pattern as firms that independently decide to cross-list.

Whether the event is sponsored (backed by the company) is not statistically significant. Tying this together with figure 6 sheds a different light however. Figure 6 reveals that the two stock return patterns behave similarly. For secondary listings that are not officially backed by the firm, this is what would be expected, since the second listing is simply a derivative of the first, and the firm derives no direct benefits from this cross-listing. However, since these findings are similar for sponsored and non-sponsored listings, the involvement of the firm, and thus the information sharing of the firm (level of idiosyncratic news) has no influence of the size or presence of the divergence.

Lower value firms have a larger price divergence, and smaller firms have a larger price divergence – interestingly these factors are part of the Fama French 3-factor model (a predecessor to the Carhart 4-factor model based solely on rational factors). These stocks are, according to the three and four factor models, better stocks to invest in since they will yield a higher return. This paper shows that for these stocks, the divergence is higher. Several theories concerning the Fama-French factors include the presence of mispricing in the market. These findings would contribute to the literature concerning factors as group identifiers of stocks consistently prone to mispricing. This would then be revealed by a macroeconomic shock or event, as is the case in this paper.

It would be expected that, if a divergence would occur, the US listing adjusts to close the gap, since this is the secondary listing – in a sense a derivative of the actual stock. Table one, however, has revealed that the mean of the CAR for the US listing is in fact higher than for the local listing. This might be more related to differing investor bases, and lack of knowledge concerning idiosyncratic aspects of the firm. Take for

example a Dutch firm; the Dutch market consists of 75 index-listed firms. Thus, it would be reasonable to assume that a local investor has some knowledge concerning each stock (e.g. ABN AMRO is a household name due to its commercial banking endeavors in the Netherlands), the so called home bias effect. Contrastingly, foreign (US) investors, do not have access to this knowledge, since it is acquired through direct contact with the firm, and the setting in which the investor finds themselves. This paper, however, has shown that in light of macroeconomic events investors do not behave rationally and discard idiosyncratic considerations (based on fundamental valuation). US investors, with no grasp of what the fundamental valuation should be, can therefore experience these effects even stronger.

Even though idiosyncratic considerations are not directly included in this research, implicitly they are present. The use of cross-listed firms as a sample has allowed for the omission of idiosyncratic news, since both listings are subjected to identical news. Idiosyncratic news plays an important role in the financial world since it is the basis of fundamental valuation. Using all of the available news, a discounted cash flow, multiple analysis or any other type of analysis can be done, and this will yield one value. The fact that the exchange rate return is not correctly adjusted for in the returns of the listings shows that the two listings will have differing valuation of the firm, thereby revealing that idiosyncratic news is not properly processed. It is also possible that the listings initially had a differing valuation for the firm, and that the event has led the listings to converge. To examine which of the two cases is prevalent, further research has to be done. In either case, at one point in the process, the listings were not at unity.

Relating these findings to the Carhart 4-factor model, certain aspects of the phenomenon uncovered in this paper have similarities to the momentum factor. Whether momentum plays a role in the anchoring of valuations on macroeconomic events remains uncertain. Though both findings, momentum and anchoring, have strong roots in irrational behavior, they are indisputably different. Moreover, for anchoring to occur, firms do not have to have a track record in the previous period, thereby making this occurrence more unexpected and in practical terms, for traders, an even better opportunity.

7. Limitations

Due to the complex and intricate nature of this topic, limitations in the methodological approach are inevitable. Though the choices perhaps result in sub-optimal identification, from a theoretical perspective, the alternatives have proven either similar or poorer. The limitations are split into two sets; 1) theoretical methodology, 2) statistical methodology. These limitations will be detailed further below.

7.1 Theoretical Methodology

The use of a true counterfactual has proven invaluable to this research. However, one of the limitations that impacts the extent to which results can be interpreted is the inability to identify in which of the two countries the macroeconomic 'shock' occurs. The exchange rate, used to identify events, solely gives one value per day, which is a ratio of the purchasing power of that currency in comparison to the secondary currency. Thus, if one of the two currencies appreciates or depreciates, the ratio will be influenced. This gives rise to four scenarios in the case where one of the two remains constant, if both are assumed to be affected by a macroeconomic event simultaneously the topic exponentially increases in difficulty of examining using (conventional) statistical methodologies that are at my disposal.
Take the example of euros to dollar (€/$). Each scenario, appreciation or depreciation, has two possible explanations. The lack of ability to explain which one causes the divergence potentially causes only a part of the phenomenon to be uncovered.

Furthermore, since exchange rates have a mechanical influence on stock prices (relating to the well-known arbitrage argument), instead of prices, returns are used. However, this solves one problem (exchange rates are accounted for), though highlighting another issue. It is assumed that prices are at unity before the macroeconomic event, causing the prices to diverge if there is a difference in stock market reactions. This, however, does not have to be the case. Potentially stock prices were not at unity, and the macroeconomic event has drawn more attention to this firm causing prices to in fact converge. This may overall be a moot point since it does reveal a divergence was previously present, however it would show that macroeconomic shocks can be a trigger for prices to revert to unity, versus leading to differing views and thus prices. This converging of prices may seem more of a realistic option if illiquid markets are taken into account. Macroeconomic events may drastically increase liquidity in certain markets, thereby mitigating the constraints of arbitrage – costliness etc.

7.2 Statistical Methodology

Though this paper has attempted to avoid the use of 'filler' variables, that are not closely linked to the topic at hand (e.g. as in datamining), undeniably there might be spurious variables that are not accounted for in regressions. As mentioned previously, illiquidity may cause convergences. The methodology used in this paper deleted firms that have a stock return pattern that suggest illiquidity. The extent of liquidity/illiquidity, however, may influence market reactions as well. There are many more potential variables that might, even to a small extent, influence stock prices.

Furthermore, selection bias may influence the results for this paper. In an attempt to create the most comprehensive methodology and to find a true counterfactual, cross-listed firms are taken as the sample. The literature review details the benefits enjoyed by firms that are cross-listed, these firms thus may be intrinsically different from other single-listed firms. One method to adjust for this is a difference-in-difference methodology that matches cross-listed firms with single-listed firms based on firm characteristics and the 'probability to cross-list'. For example, a large corporation may have 75% probability to cross-list, based on the benefits that will be enjoyed, this firm can be matched with a firm that is cross-listed but hypothetically would receive the same score on probability to cross-list. Again, accounting for this would increase the complexity of this paper manifold, resulting in a methodology similar to a triple difference-in-difference whilst simultaneously inducing noise from potential bad matches. Perhaps the examination of supported and unsupported DR's can shed some light on this manner, since in the first option firms willingly cross-list, and the second option a third party undertakes steps.

The use of factor models, though abundant in finance literature, could also be disputed. The factor models use historical data to estimate the betas used in the expected return calculation. This means that there is an assumption that during the estimation window no events occur. Lastly, with event identification, an implicit assumption is made that all events in fact influence the exchange rate. If, however, mispricing occurs in stock pricing, this will undoubtedly also be the case for exchange rates. Over- and under-reactions can also play a significant role here, since if an under-reaction occurs an event may not be identified (the reaction will be more spread out), whilst an overreaction may result in a false event identification (the statistical type I and type II errors play a role here). Perhaps alternate methods of identifying results are possible: the increase in market wide liquidity can be an effect of a macroeconomic event. Though this methodology is questionable, it does potentially solve the directional issue.

7.3 Future Research

The biggest obstacle to this paper potentially uncovering an important phenomenon is the absence of a directional factor – it cannot be concluded which stock listing caused a potentially divergence. In order to

gain more conclusive results, this variable has to be introduced, in particular since asymmetrical effects may be present. A potential method for the introduction of this variable is to take another, independent, currency and examine the two currencies using the third currency as the base. This allows for the examination of which currency shits, assuming the other remains at a similar level or the status quo. Naturally this can induce noise into the regressions, and thus the exclusion of this factor in this paper. Perhaps other methodologies that are more fit can be attempted.

Furthermore, this paper uses cross-listed firms that all have one of the two listings in the US. Though this makes the sample very unanimous, in terms of methodology creating more ease, it disregards firms that have multiple listings of which none on a US exchange. Cross-listings in Asia might be of interest to examine. A significant amount of literature concerning cross-listings has a sample focused on Chinese firms, that have an H-class and A-class listing. The geographic spread is significantly smaller (mainland China vs. Hong Kong). It is interesting to examine whether the results hold true in such close proximity.

Lastly, solidifying the findings from this paper to create a concrete practical result would be valuable. More research on how to create a trading strategy from these findings, identifying which type of firms are more prone to divergences can be an interesting practical outcome from this paper.

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9. Appendix

9.1 Data distribution by country

Countries in italic have been deleted from the data set. The countries have been deleted since they hold too few data points. Countries with less than 8000 observations (5 firms – 2 listings), have been deleted. Please note, a country with 8,000 observations consists of 4,000 observations from the home listing (currency), and 4,000 observations from the US listing (currency). Hong Kong is also deleted since the currency is pegged to the US currency. This does not allow for the examination of events through exchange rate fluctuations.

Country	Frequency	Percent	Cumulative	Currency (Country Code)
Japan	184,000	15.71	15.71	12
United Kingdom	123,200	10.52	26.23	22
France	75,200	6.42	32.64	3
Brazil	65,600	5.60	38.25	4
Germany	62,400	5.33	43.58	3
Australia	51,200	4.37	47.95	2
China	49,600	4.23	52.19	6
India	48,000	4.10	56.28	9
Taiwan	43,200	3.69	59.97	21
Switzerland	40,000	3.42	63.39	20
Russia	36,800	3.14	66.53	16
South Africa	36,800	3.14	69.67	18
Hong Kong	*35,200*	*3.01*	*72.68*	*8*
Sweden	32,000	2.73	74.41	19
Mexico	22,400	1.91	77.31	14
Netherlands	22,400	1.91	79.23	3
Chile	19,200	1.64	80.87	5
Israel	19,200	1.64	82.51	11
Italy	19,200	1.64	84.15	3
Spain	19,200	1.64	85.79	3
Argentina	17,600	1.50	87.30	1
Korea	17,600	1.50	88.80	13

Norway	14,400	1.23	90.03	15
Denmark	12,800	1.09	91.12	7
Belgium	11,200	0.96	92.07	3
Indonesia	9,600	0.82	92.90	10
Finland	8,000	0.68	93.58	3
Greece	8,000	0.68	94.26	3
Ireland	8,000	0.68	94,95	3
Singapore	8,000	0.68	95.63	17
Colombia	*6,400*	*0.55*	*96.17*	-
Philippines	*6,400*	*0.55*	*96.72*	-
Turkey	*6,400*	*0.55*	*97.27*	-
Austria	*4,800*	*0.41*	*97.68*	-
Hungary	*4,800*	*0.41*	*98.09*	-
Jersey	*3,200*	*0.29*	*98.36*	-
Luxembourg	*3,200*	*0.27*	*98.63*	-
Portugal	*3,200*	*0.27*	*98.91*	-
Romania	*3,200*	*0.27*	*99.18*	-
Egypt	*1,600*	*0.14*	*99.32*	-
Macau	*1,600*	*0.14*	*99.45*	-
Malaysia	*1,600*	*0.14*	*99.59*	-
New Zealand	*1,600*	*0.14*	*99.73*	-
Poland	*1,600*	*0.14*	*99.86*	-
Thailand	*1,600*	*0.14*	*100.00*	-
Total	1,171,200		100.00	

9.2 Frequency of firms by country

For each currency the same number of events are examined – the bottom and top 10 returns of the exchange rate. This results in the 2.5% extreme results being labeled as events. However, since each country may have varying amounts of companies that are cross-listed, the number of recorded events can vary. Please see below for the number of recorded events per country (please note each country has a minimum of 5 firms in order to make estimations effective):

Table 3: Events per country

Currency (Country Code)	Country	Frequency (event date is x20 because the first and last ranked 10 days are marked as events)
1	Argentina	11
2	Australia	32
3	Eurozone	151
4	Brazil	41
5	Chile	12
6	China	31
7	Denmark	8
9	India	30
10	Indonesia	6
11	Israel	12
12	Japan	115
13	Korea	11
14	Mexico	14
15	Norway	9
16	Russia	23
17	Singapore	5
18	South Africa	23
19	Sweden	20
20	Switzerland	25
21	Taiwan	27
22	United Kingdom	77

The country code 3 refers to Eurozone countries: Belgium, France, Germany, Greece, Ireland, Italy, Netherlands, Spain.

9.3 Description of Fama-French factors

In order to complete this research, four Fama-French factor groups are used. The table below indicates what each factor set consists of.

Table 4 Classification of factor groups

Europe	**Japan**	**Asia Pacific excluding Japan**	**Global excluding US**
Austria	Japan	Australia	All other countries mentioned in this table
Belgium		New Zealand	
Switzerland		Singapore	
Germany		Hong Kong	
Denmark			
Spain			
Finland			
France			
Great Britain			
Greece			
Ireland			
Italy			
Netherlands			
Norway			
Portugal			
Sweden			

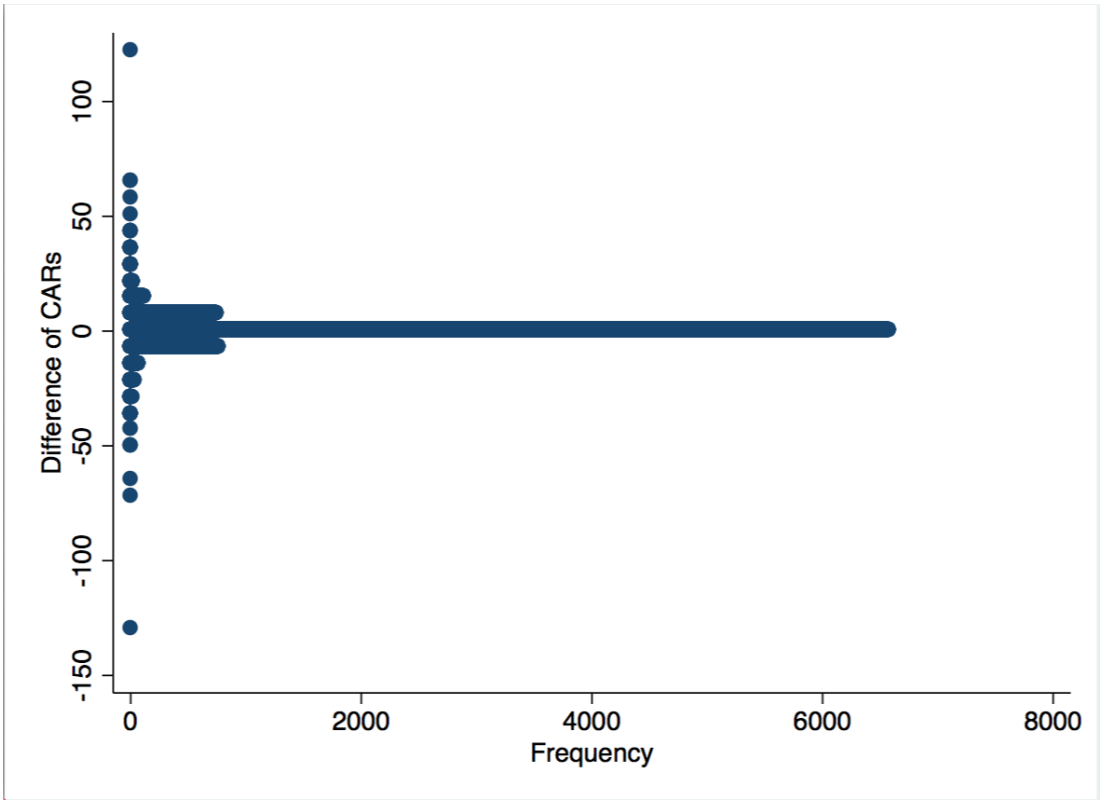
If a country is not listed in a portfolio mentioned on the Kenneth French website, it is classified as a global ex US stock. North America is not used, since Canada is not part of the data set.

The sample is unbalanced from the perspective of the factors; the following table shows the data distribution by factors:

Table 5 Factor distribution by region

Factor Region	**Percent of sample**
Europe	45.7
Japan	13.7
Asia	6.7
Global	33.9

9.4 Distribution of the difference of CARs



9.5 Distribution of the cumulative exchange rate returns