Can Momentum Be Explained by Fund Flows or Disposition Effect? The Impact of Behavioral Biases and Capital Flows in Brazilian Market Movements

Francisco Pitthan

***Abstract*—Momentum is one of the most robust anomalies in financial markets, there are two main recent explanations for this phenomenon, a behavioral-based explanation through disposition-effect (i.e., the willingness to sell "winners" too quickly and to hold "losers" for a long time) and a fund-flow based explanation. The disposition-effect explanation is centered in the convergence of the spread between the fundamental value and the observed market price (disposition-effect causes an underreaction to news that generates this spread), and the fund flows-based explanation is due to the persistence of the performance of mutual-funds (which usually keep buying winning positions and selling the losses). This paper compares those theories using Brazilian data (which is suitable for the strong presence of momentum). The empirical analysis was done using Fama-MacBeth regressions with results pointing the disposition-effect explanation as the most significant, with the robustness analysis contributing positively to the main findings.**

***Index Terms*—Behavioral finance, disposition-effect, fund flows, momentum.**

I. Introduction

Momentum is arguably the strongest anomaly in financial markets. [1] were the first to document this phenomenon and show that a strategy – of buying winning stocks (stocks that have performed well in the past) and selling losing stocks (stocks that have performed poorly in the past) – generate significant returns. Even after [1] documented the existence of momentum, the anomaly still persists to this day with no closed explanation, being also documented in international markets and other asset classes. Momentum is also particularly strong in many developing countries such as Brazil. Given its empirical relevance, many theoretical explanations for the existence of momentum have been proposed. The two main competing explanations are: (i) through disposition-effect and (ii) through mutual fund flows. In this paper, I evaluate empirically both explanations of momentum in the Brazilian financial market.

A more behavioral explanation of momentum is based on the disposition-effect. The disposition-effect refers to the investors' willingness to sell "winners" too quickly and to hold "losers" stocks for too long. According to this explanation, investors who suffer from disposition-effect will tend to underreact to news. [2] argue that investors who are subject to the disposition-effect are eager to make profits, selling their assets too soon (in case of good news), thus pushing the market price below its fundamental value and generating a spread. In following periods this movement will continue (with investors subject to the disposition-effect that are less eager to make quick profits than those of the first period continuing to sell), keeping the spread until the fundamental value is reached. The convergence of this spread is interpreted as momentum and would happen in the opposite direction face to bad news.

In turn, the explanations based on the fund-flow hypothesis provide a learning interpretation for the momentum anomaly. According to [3], mutual funds that outperform others are expected to attract growing flows of investments. As a result of the increased inflow, these outperforming mutual funds frequently reinvest in their past winning positions. In turn, funds with bad performance are likely to suffer capital outflows; losing investments the managers of those funds usually close past losing positions. Combing the effects of both inflow and outflows, this simple reasoning was found to produce momentum in stock prices.

The main objective of this paper is to compare both momentum explanation theories using the same empirical framework. I focus on the Brazilian financial market, which is suitable for the strong presence of momentum. I find that the behavioral-based explanation of disposition-effect was sufficient to explain momentum significantly. The same was not true for the fund-flows based explanation, that did not manage to show significant results.

The results contribute to the empirical literature on momentum. [2] used aggregated data from the US financial market to show the significance of the spread between the fundamental value and the market price, in both a theoretical and empirical analysis. Other studies include [4], which found a significant spread that generates momentum for a large Chinese brokerage firm, and [5], that pointed out that in assets with a larger presence of individual investors the momentum generated by disposition-effect is stronger. In the fund-flow based explanation literature, the two main studies come from [3], that had a more empirical approach to the persistent performance of mutual-funds, showing a significant explanation for momentum, and the work from [6], with a theoretical approach that besides momentum also pointed out the presence of reversal in the occurrence of extreme outflows or inflows. The main results are closely related with previous outcomes from the behavioral literature,

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Francisco Pitthan is with Catholic University of Leuven (KU Leuven), Belgium (e-mail: francisco.donascimentopitthan@kuleuven.be).

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contributing with more significant results for the disposition-effect explanation, which was not in accordance with the literature of fund-flow based explanations.

This is the first empirical paper to my knowledge that compares both explanations of momentum. Despite the strong presence of momentum in Brazil, no other studies searched for the link of the behavioral-based explanation for momentum in Brazil, however, there are other works that study the existence of the disposition-effect itself, such as by [7] and [8].

The main analysis uses [9] regressions with consistent Newey West HAC estimators [10] for heteroscedasticity and autocorrelation. The dependent variable was monthly returns of assets presented in the Brazilian financial market. To test for momentum, I included among the covariates the intermediate horizon past returns, in which the momentum is stronger and usually significant (in markets with momentum), accordingly to [1]. An explanation for momentum is found when an independent variable is both significant and able to get rid of the intermediate portfolio's significance. The main independent variables were unrealized gains, related to the disposition-effect explanation (considers the average reference price which investors that suffer this anomaly use to make decisions), and the flux-induced-trading variable, related to the fund-flow explanation for momentum (measures the part of the capital variation from funds which is due to investments inflow and outflow). The performed analysis verifies if the inclusion of one (or both) of these variables is enough to explain momentum. The main results indicate that only the disposition-effect variable was both significant and enough to explain momentum. Other covariates from the analysis are past returns (of short and long-term horizons, besides the intermediate one), the logarithm of market capitalization and the average yearly turnover of shares of each company. The database was composed of Brazilian market data coming from Economatica.

The robustness analysis focused on possible additional explanations, exploring the volume effect that may explain momentum, since the main disposition-effect variable depends partially on the volume and time-series variation of the turnover. It was tested by isolating the volume-effect from the variable (not considering its time-series variation) for the tests. The results from the robustness tests contribute positively to the main findings, which kept the significance of momentum for the disposition-effect.

This paper is subdivided into six chapters. Chapter II focus on the literature review of both competing theories, also showing additional behavioral motivations for agents. Chapter III shows in-depth the dataset and the methodology used, including summary statistics, graphs, and the empirical analysis methodology. The main results are presented in Chapter IV, with the robustness analysis in Chapter V. Finally, Chapter VI points the concluding remarks.

II. Main Explanations for Momentum

Momentum is one of the most robust anomalies in financial markets with recurrent examples in the literature. An overview is presented by [5]. As an example, [11] documented the recurrence of momentum in several international markets; [12], that reported the profitability of strategies that exploit this phenomenon as the recent central anomaly in financial markets; in addition, [13] provided more robust evidences for the findings of [1].

Since it is been one of the most important anomalies in Financial Economics, an expressive movement in the literature with the objective to explain momentum has been formed. Among the most important ones, the explanations through behavioral biases can be highlighted, specially the explanation using the disposition-effect, and explanations by capital-fund flow investment movements.

A. Behavioral Explanations

The existence of the phenomenon of momentum contradicts one of the central paradigms of financial theory: the market efficiency hypothesis (MEH), as seen in [14]. The paper of [15] summarizes the thought: by MEH, new information would be incorporated into prices instantly (i.e. prices would be "right", there would be no investment strategy that could systematically exceed the average risk-adjusted returns in the market).

However, a strong prior hypothesis within this framework of market efficiency is that individuals are rational. From [16], rationality means two things in this scope: (i) under the arrival of new information, individuals update their beliefs correctly (i.e., in the manner described by Bayes' law); (ii) their choices are accepted in a normative way, that is, they are consistent with subjective expected utilities (SEU), according to [17]. Thus, from MEH, prices would be "right", there being a nonexistence of investment strategies that could intermittently surpass the average risk-adjusted returns of the market.

As persistent profits above the market average are found via momentum strategies, breaking some MEH precepts (e.g. rationality), an attempt is made to find an explanation for such anomaly. Again, as [5] have found, literature is divided into two groups for this explanation: (i) via a risk-compensation approach (macroeconomic or business cycles) as in [18] and [19], that is, momentum would be broadly related to the welfare of the companies and the economy itself, being subject to their depressions, the momentum profits would be a compensation for this risk; and (ii) from the existence of an investment behavior bias, affecting the rationality of part of the market (being one of the branches of behavioral finance), this group is subdivided as to the updating of beliefs (overreaction and underreaction, face to recent news). Among the subgroup of overreaction are: [20] and [21], in which overconfidence, self-attribution and betting on trends behavior causes investors to exaggerate their reaction face to new information (thus causing an upward/downward trend as more and more investor keep repeating this behavior); from the underreaction group, [22] and [23], in which investors would make decisions based on past returns, causing a convergence of the price until past returns are weak enough to stop attracting new investments.

Thus, I note that there was no consensus, whereas the explanations by risk appear to be insufficient, see [19], and that the previous behavioral-based literature did not manage to directly explain momentum (citing several types of behavioral bias, with no single or closed explanation). The recent literature on the subject suggests a new approach to the group of explanations by investment behavior bias, the

explanation through the disposition-effect (DE), from contributions by [2]; [4]; [5]; [24]; and [25], which also break the preceipts of rationality. The DE, was first presented in [26], which is defined as the willingness to sell winning stocks too early and hold losing ones for a long time (as is suggested by the title of the mentioned paper), legitimizing a possible explanation for the underreaction to news. The disposition-effect itself is also a well-documented behavior bias, as seen in [27], being relevant to highlight its elements before going into this literature that seeks to explain the momentum'.

The positive theory of DE has four main elements: (i) Prospect Theory (PT) by [28] finds that bets are not evaluated (from the value function) in terms of final wealth, but rather of gains and losses (such as the reference value, e.g. returns on purchase value), assigning greater weights to small probabilities (argument for lotteries and insurance); although in PT utility functions are concave everywhere depending on the final wealth, the value function, in the face of moderate probabilities, has an "S" shape – concave (risk aversion) for gains and convex (risk seeking) for losses[1], with preferences that violate the axioms of the expected utility theory of [30], which is central to subject expected utilities; (ii) Mental Accounting (MA) by [31] states that investors tend to separate bets on different "mental accounts" and, from them, apply PT's decision rules to each account, ignoring interaction effects (e.g. "mental accounts" that are opened from the purchase of an asset j, are only closed under the total settlement of the same asset), being a good argument for the aversion of some investors in carrying out tax- swap operations, even in the case of shares that follow similar distributions[2]; (iii) " Seeking Pride and Avoiding Regret", with regret as the feeling associated with ex-post knowledge that previous decisions would produce better results and with pride as its positive counterpart, noting that pride can turn in regret (e.g. an asset j sold with gains generates pride, but if the price of j continue to rise the pride will turn into regret) ; (iv) "Self Control" has the most straightforward example in the reluctance to perform losses, the most central issue here is to control these losses, as set in [33], holding down losing stocks postpones the feeling of regret, and quickly selling winning stocks anticipates the feeling of pride[3]. Having defined the phenomenon, I can conclude that a disturbance face to the rational behavior of the traditional theory is observed in investors subject to the disposition-effect.

In a seminal paper, [2] demonstrated, using US data, that the main elements of DE, prospect theory (PT) and mental accounting (MA), create a spread between the fundamental price of a stock, F_t, and its equilibrium market price, P_t, from the underreaction to news, and that the convergence of this spread would generate predictable equilibrium prices (momentum). This spread occurs since new information of an asset i would have a mitigated effect, because investors who suffer from the disposition-effect would lower the impact of both good news (they would sell their shares quickly to make small profits, increasing the price at a lower level) and bad news (they would not sell their losses, making the price fall at a lower rate), in comparison to their average buying price, R_t, the reference price. Since rational investors would still follow the fundamental price, this spread would keep reducing until the equilibrium price equates the fundamental price.

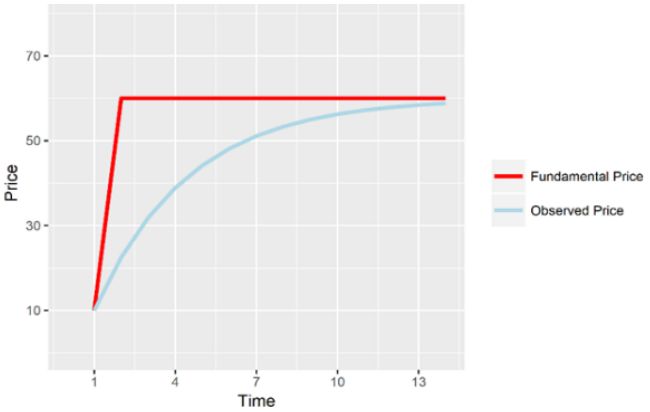

Fig. 1. Prices in the presence of disposition-effect.

In Fig. 1, I can see an example of the intuition behind the disposition effect explanation of momentum. At $t = 1$ take $F_t = P_t = R_t = \$\,10$ for all investors: under good news, F_t goes to $\$\,60$ in $t = 2$. In the absence of DE, P_t would also be equal to $\$\,60$, but as DIs are risk averse in the part of gains, part of them carries out a sale operation, which causes the price to not increase as much; without further information the process continues until the price reaches equilibrium (rational investors would keep buying asset i until $F_t = P_t$).

With data from a large brokerage firm in Shanghai in China, [4] ordered stocks with higher gains / losses not realized by investors under the DE, they found a spread creation, which generates momentum. [24], on the other hand, deals specifically with the effect of investors subject to DE in underreaction to news with data from an American mutual fund holding. [5] attest that the momentum generated by DE tends to be stronger in stocks with a large presence of individual investors. In the work of [25], the occurrence of DE before stock splits is pointed out, but this incidence does not occur after the split takes place, even when momentum still happens (apparent failure of explanation in the case of splits). Although there is documentation of DE in the Brazilian market, such as in [7], [8], [34] and [35], literature has not yet looked at the relationship of DE with momentum in the Brazilian market.

From the aggregate data, [2] use in the application of their model the reference value of the entire market, being only the reference value of the investors subject to the DE that directly affects the momentum. In [4], although DE is estimated individually, the sample is too small to be able to infer momentum in the entire market. [24] contributes to the relationship between DE and underreaction to news, but does not directly address the explanation of momentum. In

[1]One example for this risk aversion occurs in bets with an expected value greater than zero and with equal chances for gains and losses, e.g. in experiments people do not usually accept bets with equal chances to win R$ 110.00 and to lose R$ 100.00, see [28] and [29].

[2]PT alone does not explain this reluctance. [32] points out that in order to "treat" this "*get-evenitis disease*" one way would be to shift the thinking from closing "mental accounts" to asset-relocation thinking.

[3]If the myopic agent does not have its own self-control, it is necessary to have devices to limit the losses (e.g. rational planner realizes a sale when reaching a given percentage of losses).

addition to using aggregate data, [5] neglect the presence of type 1 and type 2 errors, i.e., including some individual investors that are not subject to the DE and excluding institutional investors who are subject to the effect. [25] uses similar methodology to [2], but concentrates mostly in the specific case of stock splits. All things considered, even though the literature has fundamental inputs, it still needs important contributions with more robust results that would also consider different markets and financial scenarios.

B. Capital-Fund Flow Explanations

Going in the opposite direction of behavioral motivations, there has recently been a movement in the literature of explaining momentum through investment capital-flows of mutual funds. The empirical documentation that motivates this literature begins with [36], which demonstrates that winning stocks have high turnover which leads to the conclusion of a greater prevalence of momentum strategies, especially in funds. In addition, [37] document that the "herd effect" provides momentum of intermediate terms, such as in [1], and long-term reversal.

The first exponent of this literature was [3], in which he initially notes that: (i) the performance of mutual funds is persistent in horizons of one year; (ii) capital flows predict the performance of the fund in the next quarter ("smart-money" effect); and (iii) individual stocks exhibit medium-term momentum. He argues that these three empirical patterns are explained (at least partially) by predictable price pressure caused by mutual funds capital flow. The author's motivation is that institutional capital flows can affect contemporary stock returns and that mutual fund flows are predictable from past performance and flows.

Ref. [3] argues that there is a persistence of fund performance, as winning funds attract more capital flows, generally reinvesting in past positions, maintaining or even increasing expected returns. The explanation for the smart-money effect comes from the very persistence of fund performance, attracting more and more new capital. The generation of momentum from the capital flows of funds comes from the reinvestment in past winning positions in funds that have achieved good past performance (and thus receive larger capital flows of new investments), the opposite occurring for funds with poor performance (when capital outflows occur, mutual funds are forced to liquidate their losing positions).

In their results, [3] verifies that funds liquidate 100% of their positions after a poor performance (with capital outflows) and reinvest 62% of capital inflows in existing positions. From its measure of Flux-Induced-Trading, it attests that explanations based on capital-fund flows can explain greater fraction of momentum profits in shorter and intermediate formation period (funds are constantly transferring their positions). This explanation is stronger in recent years (increasing the share of funds) and for stocks with higher market value.

Ref. [6] come with a theoretical model on the explanation of momentum from capital flows of funds, having as empirical motivation the work of [3], showing that the explanation can work even in markets where investors and managers of funds are rational. As an explanation, the authors suppose a negative shock on an asset *i*, funds that control this asset report lower returns, triggering investor outflows that update negatively on the efficiency of the managers directing those funds. As a consequence, managers sell asset *i*, further pressing down the price. Momentum is generated if outflows are gradual and generate gradual price declines and diminish expected returns, in the other hand, reversal is generated by outflows that push prices below the fundamental value, thus expected returns eventually increase (going back to its fundamental value).

The explanation of momentum in both cases (by the disposition-effect and the investment capital-flow of mutual funds) was not verified in Brazil and in most developing markets. Given the need for contributions in this literature, since: (i) momentum is a significantly documented anomaly in the literature, both in Brazil and in the world, but that it still lacks a closed explanation that is globally accepted; and since (ii) in the Brazilian market that was not yet explored, this project is justified.

III. Data and Methodology

I have collected data of average and closing daily price (with and without adjustment), volumes and quantities traded, market value of each paper, turnover of each paper, daily value and market size indexes of stocks presented in Bovespa, regarding funds, I have also collected total value invested in shares, total equity and monthly positions in each share.

The analysis is monthly with data from January 1994 to November 2017, contemplating 286 months. Three years were used to estimate the reference value for investors subject to the disposition-effect. Assets with no volume or with less than three years of observation were not considered. Outliers' quartile with an extreme variance of turnover was excluded from the analysis. Considering greater liquidity, only the most traded papers and funds were considered (237 assets and 1000 funds by market value and liquidity). I observe that the fund data consists of all different kinds of mutual funds that have positions in shares from companies listed in Bovespa.

Considering the momentum phenomenon, I obtained financial factor measures from Brazil (from NEFIN's website) and United States (from French's website) to make a profitability comparison of momentum-based investment strategies. For both markets, I made a comparison with multiple strategies from the financial economics literature, which can be seen below in Fig. 2 (Brazil) and Fig. 3 (USA). In January 2010, $ 100.00 was theoretically invested in four portfolios following four long-short strategies: momentum (long in winners and short in losers), Size (long in high market value and short in low market value), Market (long in the market portfolio and short in the risk-free asset) and Value (long in high book-to-market ratio and short in low book-to-market ratio).

Fig. 2 shows that momentum strategies (blue in the figure) have average yields much higher than the other strategies in Brazil: an investment of $ 100.00 in January 2010 for a portfolio following this strategy would have a value of $ 690.00 in January 2016. Considering the period between January 2010 and February 2016, there was an appreciation of 589.00% of the amount invested in 2010 through this strategy, being 373% from January 2010 to April 2018.

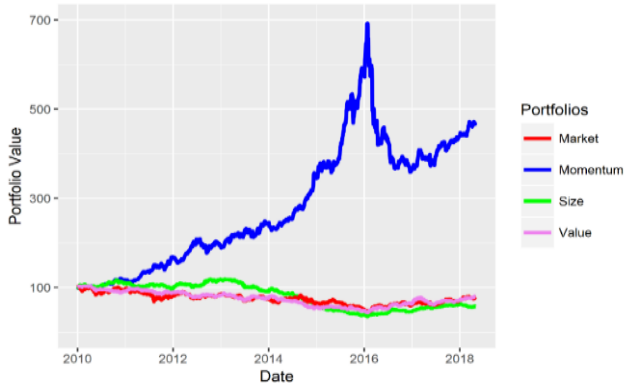

Fig. 2. Momentum strategy in the Brazilian market.

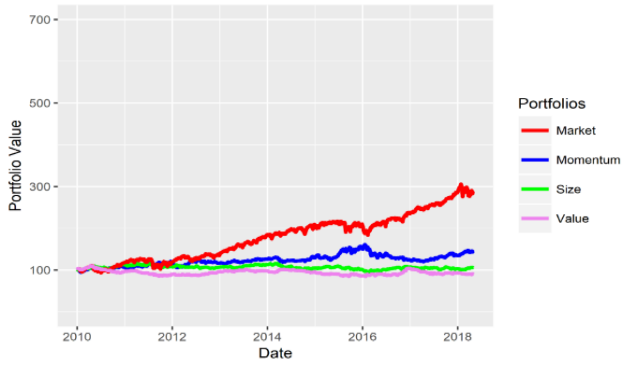

Fig. 3. Momentum strategy in the American market.

The present paper follows a similar framework as [2], which build their empirical analysis upon a theoretical model based on a partial equilibrium scope of the supply and demand for a risky asset i. They propose a calculation of the reference value R_t in function of past prices and turnovers. In the authors' estimation, R_t was estimated over a five-year horizon. In the present work, a reference value with a horizon of three years (weighting for each one of the 156 weeks) was used, since I am using a smaller data sample:

$$R_{t-1} = \frac{1}{k}\sum_{n=1}^{156}\left(V_{t-1-n}\prod_{\tau=1}^{n-1}[1 - V_{t-1-n+\tau}]\right)P_{t-1-n}$$

given that P_t is the market price of asset i observed in t; R_t is the reference price (used by the disposition investors to measure gains and losses, it can be thought as the average price which they bought the asset) V_t is the share of the reference price update that is due to the past market prices.

With that, the proxy measure for unrealized gain can be defined, following the methodology of [2], that is going to be later used as the main independent variable to test momentum in the disposition-effect case[4]:

$$g_t = \frac{P_{t-1} - R_t}{P_{t-1}}$$

In order to evaluate the effect of behavioral biases in Brazil, it was estimated the disposition-effect following the methodology of [27], using the share of gains (losses) realized as a share of total holdings, i.e., share of realized and unrealized gains (losses) to obtain the measures of Proportion of Gains Realized (PGR) and Proportion of Losses Realized (PLR). The [27] calculation was made with disaggregated data from a large brokerage house, therefore the estimation for the aggregate case was modified, the definition of a gain or a loss was made using the reference value (i.e. if asset i had an unrealized gain greater than zero at t, all volume traded was interpreted as a gain). Since all volume traded of a given asset i was interpreted as either a gain or a loss (depending if unrealized gains was greater or smaller than zero), the total number of outstanding shares of assets with positive (negative) unrealized gain was considered as the total number of assets with a gain (loss). Thus, it was estimated the PGR:

$$PGR_t = \frac{\text{quantity of shares of assets with } g_t > 0}{\text{total of outstanding shares of assets with } g_t > 0}$$

With PLR estimated in an analogous manner. In order to estimate the disposition-effect itself, here noted as disposition-effect index (DEI), one measure is subtracted from the other:

$$DEI = PGR - PLR$$

To follow the capital-fund flow-based explanation, first I estimate the capital flow for each fund i, according to [38] methodology, discounting the Total Net Assets (TNA) of each fund the return in the period:

$$flow_{i,t} = \frac{TNA_{i,t} - TNA_{i,t-1} \times (1 + r_{i,t})}{TNA_{i,t-1}}$$

To take the expected value of $flow_{i,t+1}$, I take:

$$E_t[flow_{i,t+1}] = \beta_0 + \beta_1 alpha_{i,t} + \beta_2 flow_{i,t} + \beta_3 flow_{i,t-1} + \beta_4 flow_{i,t-2}$$

where $alpha_{i,t}$ is the constant in [39] four-factor asset pricing model:

$$E[r_{i,t} - rf_t] = alpha_{i,t} + \beta_{1,i}(rm_t - rf_t) + \beta_{2,i}(SMB_t) + \beta_{3,i}(HML_t) + \beta_{4,i}(UMD_t)$$

From this, it is estimated the Flux-Induced-Trading (FIT) for each asset j (adding up for the position of each fund i), which is going to be the main variable to test momentum for the capital-fund flow-based explanation, according to [3]'s methodology:

$$E_t[FIT_{j,t+1}] = \frac{\sum_i shares_{i,j,t} \times E_t[flow_{i,t+1}] \times PSF_{i,t}}{\sum_i shares_{i,j,t}}$$

where $PSF_{i,t}$ stands for a partial scaling factor used as a weight for each fund i based on its total net assets.

As it is standard in the literature, like [2] and [25], the estimation of the impact of the disposition-effect in momentum uses monthly cross-sectional regressions, according to [9]. The same regression (with the proper testing variables), will be used for the capital-fund flow-based explanation. Consistent Newey-West HAC estimators [10] were used for heteroscedasticity and autocorrelation. The optimal number of lags was obtained according to [40]'s methodology. As dependent variable, the monthly returns of the assets j in each cross-section:

$$r_t = a_0 + a_1 r_{-4:-1} + a_2 r_{-52:-5} + a_3 r_{-156:-53} + a_4 V_{avrg} + a_5 s_{t-1} + a_6 g_{t-1} + a_7 FIT_{t-1}$$

[4][2] lagged P_t for P_{t-1} to to avoid confounding market microstructure effects, such as bid-ask bounce.

As covariates: $r_{-4:-1}$, the previous month return with respect to the last week; $r_{-52,-5}$, the return of the past year with respect to the past month; $r_{-156:-53}$ the 3-year long run return with respect to the previous year; V_{avrg}, the average yearly turnover of the share of each company; and s, the logarithm of the market capitalization of each company in $t-1$. As explanatory variables, I propose the unrealized gains g and the measure of Flux-Induced-Trading, FIT. Additional variables may be tested in further interactions of this work.

IV. Results

After calculating the reference values for each asset and each time period, the Proportion of Gains Realized (PGR) and the Proportion of Losses Realized (PLR) were estimated to then test the disposition-effect index. From [27], t- statistics test the null that the difference in proportions is equal to zero, assuming that all realized gains and losses are independent decisions:

TABLE I: Disposition-Effect Index Test

Variable	Mean	$P>t$	Standard Deviation
DEI_t	0.004	0.000	0.000

From the results presented in Table I, it is verified that the disposition-effect index is significantly different from zero to 5% of significance. Taking the medians of both proportions, PGR was 50% higher than PLR, which agrees with the rest of the literature.

In view of the indications of the disposition-effect in the Brazilian market, the main results are presented, omitting some regressors when noted. The Fame-Macbeth equation [9] was estimated using Newey-West estimators [10]. Using the methodology of [40] it was found that the optimal number of lags was twenty-five. Table II-Table VI present the average coefficients and time-series t-statistics for the Fama-Macbeth regressions.

TABLE II: Fama-Macbeth Regression Estimates

Table II: $r_t = a_0 + a_1 r_{-4:-1} + a_2 r_{-52:-5} + a_3 r_{-156:-53} + a_4 V_{avrg}$

Variable	Coef.	Std. Err.	t	$P>t$	[95% Conf.	Interval]
$r_{-4,-1}$	-0.007	0.009	-0.870	0.383	-0.024	0.009
$r_{-52,-5}$	0.003	0.002	1.860	0.064	0.000	0.007
$r_{-156,-53}$	0.001	0.001	0.690	0.494	-0.001	0.002
V_{avrg}	-0.001	0.019	-0.040	0.971	-0.037	0.036
a_0	0.002	0.001	1.440	0.151	-0.001	0.004

TABLE III: Fama-Macbeth Regression Estimates

Table III: $r_t = a_0 + a_1 r_{-4:-1} + a_2 r_{-52:-5} + a_3 r_{-156:-53} + a_4 V_{avrg} + a_5 s_t$

Variable	Coef.	Std. Err.	t	$P>t$	[95% Conf.	Interval]
$r_{-4,-1}$	-0.007	0.008	-0.780	0.437	-0.023	0.010
$r_{-52,-5}$	0.004	0.002	2.060	0.041	0.000	0.008
$r_{-156,-53}$	0.001	0.001	1.420	0.156	0.000	0.002
V_{avrg}	-0.004	0.019	-0.220	0.824	-0.042	0.033
s_{t-1}	-0.001	0.000	-1.160	0.249	-0.001	0.000
a_0	0.008	0.006	1.320	0.187	-0.004	0.021

Table II was estimated excluding the unrealized gain, Flux-Induced-Trading (FIT) and market capitalization variables. In the case of Table III, the unrealized gain and the FIT variables were excluded. From the results in both Tables, only with the covariates, it is observed a reversal of the short-term returns, but a persistence in the case of intermediate and long-term returns. We can also see that momentum is very strong, since the return of the intermediate portfolios ($r_{-52,-5}$) is quite significant. The volume effect (related to market capitalization) is not very significant.

TABLE IV: Fama-Macbeth Regression Estimates

Table IV: $r_t = a_0 + a_1 r_{-4:-1} + a_2 r_{-52:-5} + a_3 r_{-156:-53} + a_4 V_{avrg} + a_5 s + a_6 g$

Variable	Coef.	Std. Err.	t	P>t	[95% Conf.	Interval]
$r_{-4,-1}$	-0.010	0.008	-1.260	0.208	-0.027	0.006
$r_{-52,-5}$	0.001	0.001	0.400	0.686	-0.002	0.003
$r_{-156,-53}$	0.000	0.001	0.380	0.703	-0.001	0.002
V_{avrg}	-0.002	0.020	-0.110	0.912	-0.041	0.037
s_{t-1}	-0.001	0.000	-1.420	0.156	-0.001	0.000
g_{t-1}	0.005	0.002	2.690	0.008	0.001	0.009
a_0	0.010	0.006	1.540	0.125	-0.003	0.022

Table IV was estimated excluding the variable FIT. With the inclusion of the main independent variable for the explanation of the disposition-effect, the unrealized gain, it was verified that g_t was significant at 1% degree of significance. Besides, g_t also presented a positive coefficient, which is in accordance with the literature and the presented partial equilibrium model. The inclusion of the unrealized gains variable lead to the loss of significance of the intermediate portfolios return, in which the momentum is the strongest, as noted in [1]. This loss of significance is interpreted as an explanation for momentum. By taking its coefficient and considering the summary statistics (given that the 90th percentile is on average 80% greater than the 10th percentile) we can verify that winners outperform losers by 0.4% a month (4.8% a year).

TABLE V: Fama-Macbeth Regression Estimates

Table V: $r_t = a_0 + a_1 r_{-4:-1} + a_2 r_{-52:-5} + a_3 r_{-156:-53} + a_4 V_{avrg} + a_5 s + a_7 FIT$

Variable	Coef.	Std. Err.	t	$P>t$	[95% Conf.	Interval]
$r_{-4,-1}$	0.000	0.008	-0.030	0.979	-0.016	0.016
$r_{-52,-5}$	0.007	0.003	2.420	0.017	0.001	0.013
$r_{-156,-53}$	0.002	0.001	2.230	0.028	0.000	0.004
V_{avrg}	-0.053	0.045	-1.160	0.247	-0.143	0.037
s_{t-1}	-0.001	0.001	-0.980	0.328	-0.002	0.001
FIT_{t-1}	0.001	0.001	0.100	0.922	-0.001	0.001
a_0	0.008	0.008	1.030	0.307	-0.008	0.024

TABLE VI: Fama-Macbeth Regression Estimates

Table VI: $r_t = a_0 + a_1 r_{-4:-1} + a_2 r_{-52:-5} + a_3 r_{-156:-53} + a_4 V_{avrg} + a_5 s + a_6 g + a_7 FIT$

Variable	Coef.	Std. Err.	t	$P>t$	[95% Conf.	Interval]
$r_{-4,-1}$	-0.010	0.008	-1.260	0.210	-0.024	0.005
$r_{-52,-5}$	-0.001	0.001	-0.390	0.699	-0.003	0.002
$r_{-156,-53}$	0.002	0.001	1.460	0.147	-0.001	0.004
V_{avrg}	-0.060	0.038	-1.610	0.112	-0.135	0.014
s_{t-1}	-0.001	0.001	-1.180	0.243	-0.002	0.000
g_{t-1}	0.007	0.003	2.080	0.040	0.000	0.014
FIT_{t-1}	0.002	0.001	0.160	0.875	-0.001	0.001
a_0	0.011	0.009	1.270	0.205	-0.006	0.028

Table V was estimated excluding the unrealized gain variable, but including the Flux-Induced-Trading (FIT) in its place. The main variable from the capital-fund flow-based explanation of momentum, FIT, was not significant in the estimation. Its inclusion was not enough to make the

significance of the momentum portfolios disappear, i.e., it failed to explain momentum.

Table VI was estimated including all independent variables and all controls. When the two independent variables are included, it is seen that only the unrealized gains became significant at 5%. In addition, the momentum portfolios also lost their significance (as in Table III).

In light of the exposed, I compare the results with what was obtained in the literature. For the case of the presence of disposition-effect in Brazil, it being significantly different from zero and that the median of PGR is 50% than the median of PLR is similar to what was found in [27] and [29]. The behavioral explanation is analogous to what was found by [2] and [25], since the inclusion of the unrealized capital gains variable g_t was able to get rid of the significance of the intermediate horizon returns ($r_{-52,-5}$) which is prone to momentum. Besides, g_t was positive in the results, which was also seen in the literature, showing that future returns are positively related to unrealized capital gains. Since the fund-flow variable was not significant in the tests (and momentum-prone returns did not lose its significance), I had results that are divergent from [3], which indicates that fund-flows are not enough to explain momentum.

V. Robustness Analysis

Since the main variable from the behavioral-based explanation of momentum appears to have a strong effect, I make further investigation upon its legitimacy. [2] make the provocation of whether the significance of the explanation of unrealized gains could be due to some alternative reasons. Since the unrealized capital gains depends of the reference value, which was estimated by an average of past prices weighted by turnovers, it is indirectly related to volumes. The relationship between volume and prices is a well-known research subject, such as in [41], hence, could the explanation of momentum be motivated by this volume effect? By the unrealized gains variable, high returns occur when in a distant horizon we had a considerable volume and a sudden spike in the price when it had no volume[5]. Thus, it is considered in the paper that if both the explanation of momentum and the coefficient of the unrealized gains variables comes entirely from the turnover part (i.e. the "volume-effect), it would be an indication that extra explanations could arise.

For instance, if the reference value was estimated by an average of turnovers, it could still deliver the volume effect, but it would fail to deliver the time-series effect of the unrealized gains variable (that uses, in the weighting process, one turnover for each week). Thus, I inspect this matter by regressing the main equation, but changing g_t for a variable that captures only the volume-effect, $\overline{g_t}$, that would take the reference value by taking the average yearly turnover, instead of weekly turnovers.

Regarding the results from Table VII, by the inclusion of the unrealized gains variable with the average of turnovers as the weighting-base for the reference price, $\overline{g_t}$, the returns of the momentum portfolio (i.e. intermediate horizon) has lost its significance (just like Table V). However, $\overline{g_t}$ failed to have a significant coefficient as explainable variable. Thus, despite its inclusion making the momentum disappear, since it did not manage to be significant, it could not replace unrealized gains as the main explainable variable.

TABLE VII: Robustness Check – Alternative Explanation

Table VII: $r_t = a_0 + a_1 r_{-4:-1} + a_2 r_{-52:-5} + a_3 r_{-156:-53} + a_4 V_{avrg} + a_5 s + a_6 \overline{g_{t-1}}$

Variable	Coef.	Std. Err.	*t*	*P*>*t*	[95% Conf.	Interval]
$r_{-4,-1}$	-0.008	0.013	-0.630	0.528	-0.035	0.018
$r_{-52,-5}$	0.001	0.003	0.280	0.784	-0.005	0.007
$r_{-156,-53}$	0.001	0.002	0.600	0.550	-0.003	0.005
V_{avrg}	0.020	0.023	0.890	0.374	-0.025	0.065
s_{t-1}	0.000	0.000	-0.290	0.774	-0.001	0.001
$\overline{g_t}$	0.001	0.002	0.500	0.617	-0.003	0.005
a_0	0.001	0.006	0.170	0.865	-0.012	0.014

VI. Concluding Remarks

Through the literature and the presented results, I have evidence to confirm the importance of the phenomenon of momentum in prices, considering that it is an anomaly that still has no closed explanation and continues to have a wide repercussion in both the academy and the market. The present work aimed to compare two of the most recent and important explanations for this phenomenon.

In addition to being a phenomenon widely documented and discussed in the literature in the case of developed countries, momentum is also observed very frequently in emerging markets. From Fig. 2, it is observed how expressive this anomaly is, given that in the last few years it has been very strong in Brazil, which is the focus of this work. When in comparison with the American market, from Fig. 3, it is evident that the presence of momentum in Brazil is stronger.

Two important explanations for momentum have been brought to be compared empirically for the case of the Brazilian financial market: the behavioral explanation through disposition-effect, such as in [2]; and the capital-fund flow-based explanation, from papers such as [3], when it was first presented.

Following the arguments of [2] and presenting results for the Brazilian case in Tables II-VI, I contribute to increase the range of evidences of behavioral effects to explain momentum, an anomaly that is of extreme importance for Financial Economics.

Applying [3]'s methodology to the Brazilian market, a statistically significant explanation for momentum through fund-flow investments was not obtained. Further studies must still be done to corroborate this kind of explanation in the case of Brazil and other developing countries.

By Table VI, with the inclusion of all controls and explanatory variables, the momentum was explained significantly, with only the unrealized gains variable being significant. When comparing the results of Tables III, IV and V, it is possible to observe that the evidence appoints the main inductor of the momentum explanation as the variable of unrealized gains, referring to the explanation through the behavior bias of disposition-effect. It is observed that future studies are still needed to verify additional explanations for momentum, also in view of different markets and scenarios. The results are robust taking into consideration additional explanation to the proxy variable for disposition-effect and

[5]Like is noted in [2], volume is considerably persistent, consequently is the stocks with low volume that present the most extreme gains.

robustness checks of subperiods.

The importance and recognition of behavioral phenomena is growing in both the market and academy, as evidenced by the Nobel laureate in 2017 Richard Thaler, and the increasing use of behavioral-based models in the financial market. It is shown here that even an anomaly with the robustness of momentum can have an explanation within the behavioral framework. The frequent use of non-rational investment strategies for individual investors and even institutional investors in developed and emerging markets contributes for this.

The traditional economic and financial theory, of rational agents and maximizing a usual value function, needs adaptations in the case of applications to the real world, in order to bear in mind, the phenomena that escape the general case, as is the case of momentum. The tools from the behavioral literature have much to help with these adaptations.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Francisco Pitthan conducted the research, data treatment, analysis and wrote the paper.

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Francisco Pitthan is a PhD candidate in economics at Katholieke Universiteit Leuven in Belgium and holder of Baloise Insurance's chair for Financial Well-Being. He was born in Porto Alegre, Brazil. He holds a B.Sc. in economics from UFRGS (Brazil) and finance from Université Paris 8 (France), besides an M.Sc in economics from both University of São Paulo (Brazil) and Université Catholique de Louvain (Belgium).

Previous to his experience in academia, he also worked in the industry as a Management Consultant in projects in Brazil and Chile with work presented in boards of directors in Brazil, Chile, UK and France, in sectors such as oil & gas, banking & finance, commodities and industrial.