IS THE RISK OF THE GAP BETWEEN CLOSING AND OPENING PRICES PRICED?

Gustavo Silva Araujo[*]

Aziz Baruque[†]

Abstract

The objective of this work is to analyze whether the risk of differences (gaps) between the closing price and the opening price of the subsequent day is priced in the Brazilian stock market. This inquiry stems from the recognition that an investor is impacted by the volatility of these gaps. Long and Short strategies are simulated, entailing long positions in stocks with higher gap risks and short positions on those with lower gap risks. The one-year volatility of daily gap returns is utilized to define the portfolio for the subsequent year, and to categorize the strategy into long and short positions. The results reveal that the strategy generates negative abnormal returns across all models (CAPM, Fama-French Three Factor Model and Fama-French Extended Model), indicating that not only the gap risk is not priced in the Brazilian market, but also that stocks with lower gap risk outperform those with higher gap risk.

keywords: gap between closing and opening prices, CAPM, FAMA-FRENCH, asset pricing, stock risk.

[*] Central Bank of Brazil and EPGE/FGV. E-mail: gustavo.araujo@bcb.gov.br

[†] EPGE/FGV. E-mail: aziz@poli.ufrj.br

1 INTRODUCTION

Asset pricing stands as one of the foremost topics of discussion among researchers, investors, firm executives, and other market participants due to its relevance and influence on investment decisions and project evaluations. This study aims to analyze whether the risk associated with variations between the closing price and the opening price of the subsequent day is priced in the Brazilian market. This risk is incurred by investors who maintain their positions invested in assets on the stock exchange, as well as speculators in the futures market, who are passively subject to differences between the closing price and the opening price of the following day (hereinafter referred to as price gap).

To verify whether this price gap is priced in the Brazilian market, we employed three models: CAPM, Fama-French Three Factor Model and the Fama-French Model plus the Momentum and Liquidity factors (Fama-French Extended Model). To our knowledge, this study marks the first attempt to assess whether the variations between the closing and opening prices of stocks on the subsequent day are priced.

The study tests the hypothesis that the risk associated with the price gap is indeed priced by simulating a mutual fund that employs the standard deviation of the price gap of each stock as a metric for decision-making in a long and short strategy (L&S). The objective is to quantitatively analyze the generation of abnormal returns from the L&S strategy in the period from 2001 to 2020, thereby examining whether the market players price this risk.

A Long and Short (L&S) investment strategy is characterized by assuming two opposite positions of equal value without requiring capital. In this study, a long position is taken in stocks with higher gap volatilities while a short position is taken in stocks with lower gap volatilities. It operates as a paired trading approach uncorrelated with the market (a non-directional strategy).

The sample of our experiment consists of stocks that comprised the bovespa index (the main benchmark stock index of the Brazilian stock exchange) to mitigate the impact of illiquidity on stock prices. Each year, we construct a portfolio consisting of long and short positions in stocks with higher and lower gap volatilities, respectively. Portfolios are defined based on the previous year's gap volatilities.

The importance of the gap effect in the literature can be observed through works such as Bacidore and Lipson (2001), which describes the relationship between the stock prices of closing and opening auctions of the most important US exchanges (NYSE and NASDAQ).

Even though the paper does not use the price gap as a risk factor, it shows the importance of considering the gap between closing and opening prices for investors' strategies.

Similarly, Sumiyana (2009) employs a quantitative approach to analyze the opening and closing prices of financial assets across various markets around the world. The study demonstrates that opening and closing prices exhibit distinct behaviors in different markets and periods. It identifies price discontinuity between consecutive days' prices as a relevant event that investors passively endure when trading assets in the stock exchange. Furthermore, the study identifies the presence of seasonality effects, indicating that certain days of the week or months of the year may present distinct behavioral patterns of opening and closing prices. The author also identifies the importance of considering the liquidity of financial assets when analyzing opening and closing prices, noting that liquidity shortage can significantly influence the behavior of these prices. The study concludes that there are always noises and overreaction that influence closing and opening prices, and that investors typically correct for this within the first 30 minutes of the trading section. Opening prices tend to be more volatile due to economic events and news releases, while closing prices converge towards the general market trend.

Lou et al. (2014) analyze the heterogeneity of investors and their preferences for trading in different time intervals, which causes price distortions. The study categorizes the period into "overnight" (the period between market closing on the previous day and market opening on the following day) and "intraday" (market open throughout the day) revealing abnormal returns in momentum and short-term reversal strategies during the "overnight" period, while other strategies exhibit abnormal returns in the "intraday" period. These temporal patterns strategies create a challenge for neoclassical risk and return models.

The results of our study highlight the existence of negative abnormal returns of the L&S strategy in all three pricing models, indicating that gap risk is not priced in the Brazilian stock market. Furthermore, the study shows that portfolios long in stocks with lower gap risk and short in stocks with higher gap risk generate positive abnormal returns, contradicting the modern portfolio theory.

This work is structured as follows: section 2 presents the sample and the methodology, including the pricing models; section 3 shows the results of the L&S strategy; finally, in section 4, the final considerations are presented.

2 METHODOLOGY AND SAMPLE

This section is divided into two subsections: the first presents the asset pricing models used in this work, while the second addresses the sample used for the empirical exercise with the L&S strategy.

2.1 ASSET PRICE MODELS AND RISK FACTORS

To provide robustness to the results, three asset pricing models were used: the single-index model (derived from the Capital Asset Pricing Model - CAPM), the Fama-French (1993) three-factor model, and an extended Fama-French model that incorporates momentum and liquidity risk factors.[1]

The Capital Asset Pricing Model (CAPM) was developed by Sharpe (1964), Lintner (1965), and Mossin (1966), based on Markowitz's (1952) portfolio theory. The CAPM can be defined as the linear relationship wherein the expected return of an asset or portfolio is a function of its systematic risk (market risk):

$$\boldsymbol{E(R) = Rf + \beta\,[(E(Rm) - Rf)]}$$

where

- E(*R*) represents the expected return of an asset or a portfolio;
- *Rf* is the risk-free interest rate;
- β is the systematic risk of an asset or portfolio; and
- E(*Rm*) is the expected return of the market portfolio.

The CAPM indicates that the expected return of an asset or portfolio is a function of a single factor, its market risk (systematic risk). The single-index model used in this study is derived directly from CAPM:

$$\boldsymbol{R_{i,t} - Rf_t = \alpha_i + \beta_i\,(Rm_t - Rf_t) + \varepsilon_{i,t}} \qquad \textbf{(1)}$$

where index *t* refers to the dates of the time series sample, *i* refers to the asset or portfolio and $\boldsymbol{\varepsilon}$ is the residual. When comparing the model with CAPM, the expected value for $\boldsymbol{\alpha_i}$ is zero, and if $\boldsymbol{\alpha_i}$ is different from zero, there is some return that is not explained by the market factor,

[1] Fama and French published an extended model in Fama and French (2015).

called abnormal return.

Black et al. (1972) tested the CAPM and concluded that there is sufficiently strong evidence to reject the model, as the expected return would not be exactly proportional to beta. They stated that there are economic hypotheses consistent with the existence of other risk factors to explain asset returns.

Fama and French (1992) also found no evidence supporting the CAPM model and warned that investors should get closer to market reality. They highlighted the model's limitation of having only one independent variable. Fama and French (1993) suggested additional variables based on other studies to improve the model and help it to explain abnormal returns. Among all the studies, some listed below stand out.

Stattman (1980) and Rosenberg et al. (1985) found that US stocks returns are positively related to the market-to-book ratio. Chan et al. (1991) noted that this ratio had strong explanatory power for the average return of Japanese stocks. Bhandari (1988) argues that leverage helps explain the average stocks returns in tests that include market capitalization and market risk.

Banz (1981) inferred that market equity (market capitalization), calculated as the product of stock price and the number of shares held by the market, is relevant in explaining stock returns. According to the author, on average, the returns of firms with low market value are higher than those estimated by market risk. Conversely, for firms with high market capitalization, on average, returns are lower than those indicated by market risk.

Given all these criticisms about the CAPM, Fama and French (1993) assessed the potential impact of omitted variables cited in the literature. The authors concluded that firm size and the relationship between firm market value and book value could represent risk factors in a rational asset pricing environment. Thus, they developed a model capable of explaining stock returns incorporating three factors: (a) a factor linked to overall market performance (already present in the CAPM); (b) a factor associated with firm size; and (c) a factor related to the market-to-book ratio (P/B). Therefore, the factors added to the CAPM are:

- The SMB factor (Small Minus Big), which denotes the historical excess return of small-cap stocks compared to big-cap stocks; and
- The HML factor (High Minus Low), which refers to stocks with high market value relative to their book value (P/B). It represents the historical excess return of high P/B stocks compared to low P/B stocks.

The formula for the Fama-French 3 Factors model (1993) is as follows:

$$\boldsymbol{E(R) = Rf + \beta\,[(E(Rm) - Rf)] + \beta_s(SMB) + \beta_v(HML)}$$

The P/B ratio and firm size are linked to economic fundamentals. Firms with a high P/B ratio, indicating a high market value relative to book value, are associated with high and persistent returns. Additionally, firm size is correlated with profitability: According to the authors, returns on investments in small firms tend to surpass those in large firms, even when controlling for the P/B ratio.

In this study, we employ the model within a time series framework (equation 2):

$$\boldsymbol{R_{i,t} - Rf_t = \alpha_i + \beta_i\,(Rm_t - Rf_t) + \beta_s\,SMB_t + \beta_v HML_t + \varepsilon_{i,t}} \qquad \textbf{(2)}$$

Asset pricing models are continuously refined to enhance their ability to explain stock returns. In this study, two factors are added to the Fama-French model: momentum and liquidity.

Carhart (1997) introduced the momentum factor into the original Fama-French model. This factor is based on the idea that assets that have performed well in the past will continue to perform well in the future, and assets that have performed poorly will continue to perform poorly.

Some studies have incorporated the liquidity factor into asset pricing models. Liu (2006) proposed a two-factor model by integrating it into the CAPM framework. Similarly, Keene and Peterson (2007) added the liquidity risk premium to the Carhart model (1997). In both cases, there is an improvement in the explanatory power of the models. Less liquid assets demand higher returns compared to more liquid assets, as investors require a risk premium in terms of expected return to forgo liquidity. Therefore, the price of illiquid assets must drop sufficiently to attract investors. Thus, in equilibrium, expected returns are an increasing function of illiquidity.

In this study, we employ a model similar to Keene and Peterson (2007) and referred to as the Fama-French Extended Model (equation 3):

$$\boldsymbol{R_{i,t} - Rf_t = \alpha_i + \beta_i\,(Rm_t - Rf_t) + \beta_s\,SMB_t + \beta_v HML_t + \beta_w WML_t + \beta_i IML_t + \varepsilon_{i,t}} \qquad \textbf{(3)}$$

where

- WML_t is the factor related to the return premium on a portfolio long in stocks with high past returns (Winners) and short in stocks with low past returns (Losers); and
- IML_t is the liquidity factor related to the return premium on a portfolio long in less liquid stocks and short in more liquid stocks.

2.2 SAMPLE

We utilized daily opening and closing prices of each stock included in the Bovespa Index (IBOVESPA) from the year 2000 to 2020. The Ibovespa is the main index of the Brazilian stock exchange. Price series are adjusted for dividends and other similar events. We only utilized stocks comprising the IBOVESPA to form the L&S strategy portfolios. The stock codes forming the Ibovespa were collected from the Brazilian stock exchange website. In cases where both preferred and common stocks of the same firm were presented in the index, we use only the most liquid one.[2]

We extracted the risk factors, namely *SMB*, *HML*, *IML*, and *WML*, from the Nefin/FEA-USP website.[3] This website provides the historical daily returns of each of these factors. The risk-free rate (*Rf*) is the CDI (Brazilian overnight rate), and the market return (*Rm*) was calculated using the daily returns of the Ibovespa closing prices.

As mentioned earlier, the key measure for portfolio selection is the sample standard deviation of returns between the closing and next day opening prices (gaps) of each stock comprising the Ibovespa. Next, we present the methodology for defining the first portfolio (used in the year 2001 based on the year 2000 stock standard deviations) as an example. The portfolios of subsequent years are formed in the same manner.

We calculate the daily returns between the closing and opening prices of each asset included in the Ibovespa at the beginning of the year 2000 (the base year, in this case), for all trading days throughout the year. Using the standard deviations of these returns, we create a ranking to construct the year 2001 L&S portfolio.

The portfolio invested in 2001 (and similarly in other years) allocates the same amount of investment to each long position in a stock (those with higher volatility in the previous year) and the same amount to each short position in a stock (those with lower volatility in the previous

[2] Preferred stocks in the Brazilian stock market are those that carry voting rights.

[3] nefin.com.br. The methodology building the risk factors can be found at https://nefin.com.br/resources/NEFIN_methodology.pdf

year), resulting in a net zero value for the L&S portfolio. Only the extreme terciles of the ranking were used to compose the L&S portfolio, ensuring that stocks with similar standard deviations are not in opposite positions. In Table 1, we present the sample and the 2001 portfolio: the blue section represents the tercile of the sample with higher volatility, indicating the long stocks. Conversely, the red section in Table 1 represents the lower tercile, indicating the short stocks. This process is repeated with portfolios from 2001 onwards until 2020, always based on the composition of the Ibovespa from the beginning of the previous year, resulting in 20 different portfolios (one for each year) and 4,947 sample days. The Annex of this article contains the portfolios for each year, from 2001 to 2020.

2000 IBOV Index
ARCZ6
BBAS3
BBAS4
BBDC4
BESP4
BRAP4
BRDT4
BRHA4
CMIG3
CMIG4
CPLE6
CRGT5
CRTP5
CRUZ3
CSNA3
CSTB4
EBTP3
EBTP4
ELET3
ELET6
ELPL3
EMBR3
EMBR4
INEP4
ITSA4
LIGH3
PETR3
PETR4
PTIP4
SBSP3
TCOC4
TCSL4
TLCP4
TMCP4
TNEP4
TNLP3
TNLP4
TRPL4
USIM5
VALE5
VCPA4
VCPA4

2001 Portfolio
TNEP4
TCOC4
TMCP4
CRTP5
TCSL4
TRPL4
TLCP4
TNLP3
INEP4
EBTP3
CRGT5
CMIG3
CPLE6
BRDT4
CRUZ3
BBDC4
EMBR3
VCPA4
VALE5
ELET3
BBAS3
ITSA4
SBSP3
ARCZ6
BRAP4
PETR4

Table 1 - Composition of the Ibovespa in the year 2000 (left) and the 2001 portfolio: stocks highlighted in blue represent the tercile with the highest volatility (long position), while stocks highlighted in red represent the tercile with the lowest volatility (short position).

The daily return of the portfolio is simply the average of the returns of the assets, considering whether the asset is in a long or short position.

3. RESULTS

In this section, we present the results of the empirical exercise. As mentioned earlier, 20 portfolios were constructed, one for each year from 2001 to 2020, based on the stocks that comprised the Ibovespa in the previous year. The objective is to observe whether portfolios that are long in stocks with higher gap risk and short in those with lower gap risk yield abnormal returns. For a more comprehensive overview, Table 2 displays the returns of each year and the overall portfolio performance. Many negative returns can be noted, particularly in the first half of the sample.

Year	Return
2001	-26.53%
2002	-41.13%
2003	46.81%
2004	-12.44%
2005	-7.62%
2006	0.88%
2007	-15.70%
2008	-14.23%
2009	33.30%
2010	-11.00%
2011	-33.59%
2012	7.78%
2013	-26.03%
2014	-18.53%
2015	-37.53%
2016	61.03%
2017	17.37%
2018	12.19%
2019	0.92%
2020	7.71%
TOTAL RETURN:	-72.40%

Table 2 – Returns for Each Year and Total Return of the L&S Strategy, Long (Short) in Stocks with Higher (Lower) Gap Risk

To illustrate the relationship of the hypothetical Long & Short (L&S) portfolio with the macroeconomic context, Figure 1 depicts the cumulative performance of the strategy compared to the cumulative return of the Ibovespa. The figure illustrates that the strategy adopted by the L&S portfolios retains its fundamental characteristic of being non-directional (i.e., the strategy

does not follow the market). Overall, the Ibovespa shows a positive trend, while the L&S portfolio shows a negative trend. The Maximum Drawdown of the L&S portfolio, represented by the downward blue arrow, is much larger than that of the Ibovespa.[4] It is notable that the portfolio experienced a progressive loss of 91.40% of its value from its peak in January 2001 to September 2016, reaching its minimum point in that period.

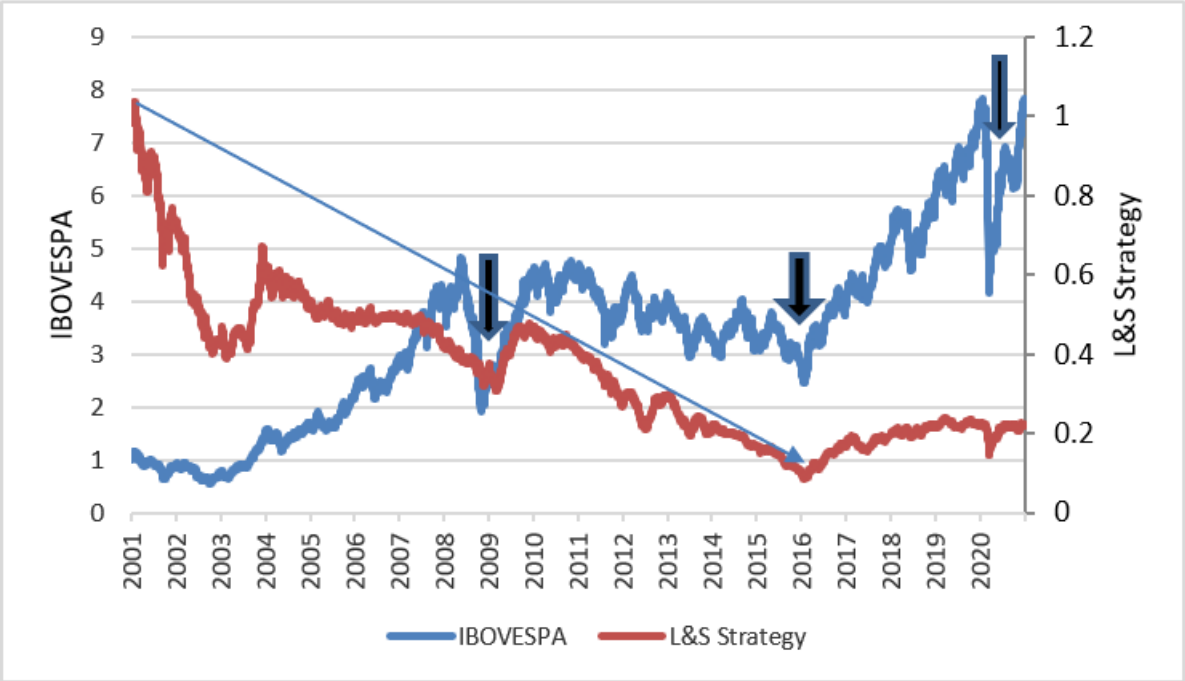

Figure 1- Ibovespa versus L&S Strategy, Long (Short) in Stocks with Higher (Lower) Gap Risk. Both portfolios start at 1.

Three extreme events were highlighted with black arrows: the "SubPrime Market Crisis" in 2008, the "Impeachment of President Dilma" in 2016, and the "Covid-19" crisis in 2020. These events represented crucial moments that substantially negatively impacted the Brazilian economy. During these periods, the strategy also had negative performance (moving in the same direction as the Ibovespa), but not as low as that of the Ibovespa. Figure 2 shows the standard deviation of returns of the L&S strategy. We can observe that, during crisis events, the level of risk increases.

[4] The maximum drawdown is the maximum loss that an investment can experience over a certain period of time.

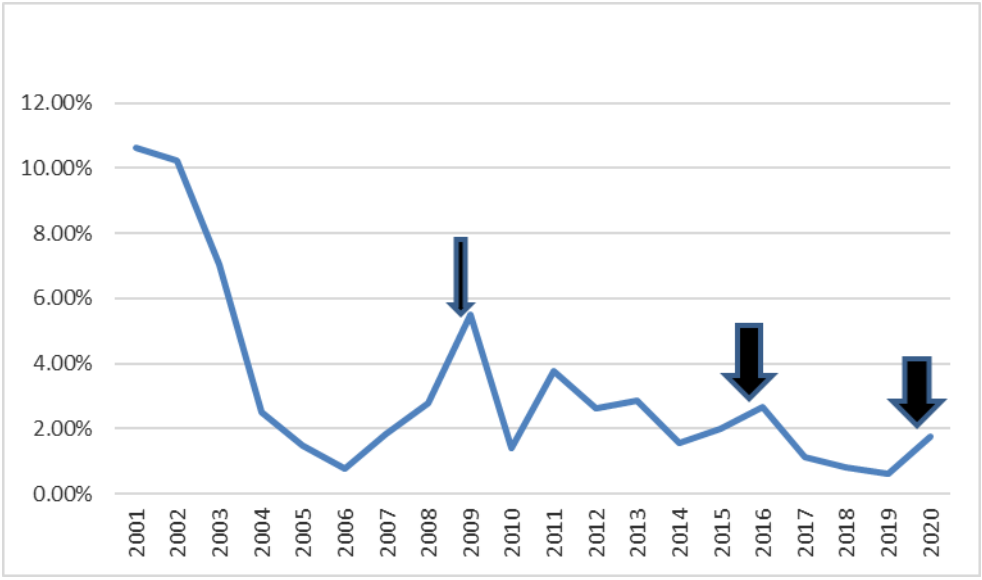

Figure 2- Annual Standard Deviation of Returns of the L&S Strategy that is Long (Short) in Stocks with Higher (Lower) Gap Risk

To assess whether the L&S strategy yields abnormal returns, we employed the three methodologies described in the previous section, represented by equations 1, 2, and 3: CAPM (single-index model), Fama-French Three Factor Model and Fama-French Extended Model. We utilized daily returns, comprising 4,947 observations from 2001 to 2020. All regressions are controlled for HAC (Heteroscedasticity and Autocorrelation). The results are presented in tables 3, 4, and 5.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.00072	0.000149	-4.81	1.58E-06
IBOV-CDI	0.3015	0.008317	36.25	2.28E-255
R^2	0.2099	Mean dependent variableiable		-0.0007
Adjusted R^2	0.2098	S.D. dependent variable		0.0118
S.E. of regression	0.0105	Akaike info criterion		-6.274
Sum squared resid	0.5455	Schwarz criterion		-6.271
Log likelihood	15520.29	Hannan-Quinn criter.		-6.273
F-statistic	1314.02	Durbin-Watson stat		1.9185
Prob(F-statistic)	2.28E-255			

Table 3 – Results of the Single-Index Model Regression: $R_{i,t} - Rf_t = \alpha_i + \beta_i (Rm_t - Rf_t) + \varepsilon_{i,t}$

Table 3 shows that the results of the Single-Index Model regression diverge from the study's hypothesis. They indicate that stocks with higher gap risk (greater volatility between closing and opening prices) generate lower risk-adjusted performance compared to stocks with lower gap risk: The linear regression produced a significant abnormal daily return of -0.072%,

indicating that the gap risk is not priced. Conversely, according to the model, buying the portfolio with less risk and selling the one with more risk generates abnormal returns.

The regression exhibits the lowest Adjusted R^2, approximately 21%, compared to the subsequent regressions. Hence, enhancing the model with the inclusion of additional risk factors in the upcoming multiple regressions could lead to improvement.

Table 4 presents the results of the Fama-French Three Factor Model regression, which provides a more comprehensive explanation of the L&S portfolio returns by incorporating the independent variables SMB and HML risk factors (note that the coefficients of these variables are statistically significant at 1%). With an Adjusted R^2 of approximately 34%, significantly higher than that of the previous regression, the model appears to better fit the data.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.00074	0.00014	-5.41	6.73E-08
SMB	0.41744	0.01480	28.21	1.85E-162
HML	0.08303	0.01621	5.12	3.12E-07
IBOV-CDI	0.32226	0.00792	40.68	0
R^2	0.3402	Mean dependent variable		-0.0007
Adjusted R^2	0.3398	S.D. dependent variable		0.0118
S.E. of regression	0.0096	Akaike info criterion		-6.453
Sum squared resid	0.4556	Schwarz criterion		-6.448
Log likelihood	15962.24	Hannan-Quinn criter.		-6.451
F-statistic	849.41	Durbin-Watson stat		1.967
Prob(F-statistic)	0			

Table 4 – Results of the Fama-French Three Factor Model Regression: $\boldsymbol{R_{i,t} - Rf_t = \alpha_i + \beta_i\,(Rm_t - Rf_t) + \beta_s\,SMB_t + \beta_v HML_t + \varepsilon_{i,t}}$

The results further contradict the study's hypothesis, as the portfolio exhibits a significant abnormal daily return of -0.074%, similar to the previous regression. Therefore, the conclusion stands once again that the gap risk remains unpriced. In fact, since the abnormal return is negative, the opposite appears to be true.

Table 5 presents the results of the Fama-French Extended Model regression. It exhibits the highest adjusted R^2, exceeding 37%, indicating that the model better explains the L&S portfolio returns with the addition of the risk factors IML and WML (these factors are also significant at 1%). The result for the abnormal daily return corroborates the conclusions of the previous regressions: it is negative and significant (-0.062%), contrary to the study's hypothesis. Therefore, not only is the gap risk not priced, but the risk-adjusted return is positive when investing in a portfolio long in assets with lower gap risk and short in assets with higher gap risk.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.00062	0.00013	-4.64	0
SMB	0.49349	0.02267	21.77	0
HML	0.08630	0.01589	5.43	0
IBOV-CDI	0.27265	0.00876	31.14	0
IML	-0.18602	0.02341	-7.95	0
WML	-0.19010	0.01318	-14.43	0
R^2	0.3749	Mean dependent variable		-0.0007
R^2 Ajustado	0.3743	S.D. dependent variable		0.0118
S.E. de Regressão	0.0093	Akaike info criterion		-6.506
Soma dos Quadrados do Resíduo	0.4316	Schwarz criterion		-6.498
Log de Probabilidades	16095.78	Hannan-Quinn criter.		-6.503
F-Estatístico	592.52	Durbin-Watson stat		1.987
Prob(F-statistic)	0			

Table 5 – Results of the Fama-French Extended Model Regression: $\boldsymbol{R_{i,t} - Rf_t = \alpha_i + \beta_i\,(Rm_t - Rf_t) + \beta_s\,SMB_t + \beta_v HML_t + \beta_w WML_t + \beta_i IML_t + \varepsilon_{i,t}}$

The findings, though robust (all three models yield similar results), contradict common sense: portfolios with lower gap risk yield higher abnormal returns than those with higher gap risk. Despite this potentially counterintuitive outcome, the study aligns with Blitz and Van Vliet (2007), who provide empirical evidence that stocks with lower volatility tend to generate better risk-adjusted returns compared to high-volatility stocks. Over the period from 1986 to 2006, Blitz and Van Vliet (2007) observe an annual difference of 12% in abnormal returns between portfolios composed of low and high volatility global stocks, favoring the lower-risk ones. This trend is observed across various regions, including markets in the United States, Europe, and Japan. The authors suggest that investors may be overpricing the value of more volatile stocks, potentially due to leverage constraints, inefficient investment processes, or behavioral biases.

4 CONCLUSION

In this study, we examine whether gap risk is priced in the Brazilian market. Here, “gap” refers to the disparity between the closing price and the subsequent day's opening price. We construct Long and Short portfolios with long positions taken in stocks exhibiting higher gap risks and short positions in those with lower gap risks. To observe if these portfolios yield risk-adjusted abnormal returns, three models are utilized: CAPM (Single-Index Model), the Fama-French Three-Factor Model, and an Extended Fama-French Model (incorporating momentum and liquidity factors).

The database contains the closing and opening prices of each business day over 20 years for the stocks that comprised the Bovespa index (Ibovespa) at the beginning of each year. The daily risk factors used were calculated using stocks from the Brazilian stock exchange.

The results indicate that not only the gap risk is not priced, but also that portfolios with long positions in stocks with lower gap risks and short positions in stocks with higher gap risks generate positive abnormal returns. In other words, we observe a scenario of lower risk leading to higher abnormal returns, contradicting our initial hypothesis and common investor intuition. This conclusion is robust, as consistent results are obtained across all three models studied. Although inconsistent with asset pricing theory, this result is in line with Blitz and Van Vilet (2007), who find evidence across American, European, and Japanese markets that stocks with lower volatility yield higher risk-adjusted returns.

REFERERENCES

BACIDORE, Jeffrey Michael; LIPSON, Marc L. The effects of opening and closing procedures on the NYSE and Nasdaq. **SSRN**: 257049, jan. 2001.

BANZ, Rolf W. The relationship between return and market value of common stocks. **Journal of Financial Economics**, v. 9, p. 3–18, mar. 1981.

BHANDARI, Laxmi Chand. Debt/Equity Ratio and Expected Common Stocks Returns: Empirical Evidence. **Journal of Finance**, v. 43, n. 2, p. 507-528, 1988.

BLACK, Fischer; JENSEN, Michael C.; SCHOLES, Myron. The capital asset pricing model: Some empirical tests. In: JENSEN, Michael ed. **Studies in the theory of capital markets**. p. New York: Praeger, 1972. 79–121.

BLITZ, David; VAN VLIET, Pim, The Volatility Effect: Lower Risk Without Lower Return (July 4, 2007). **Journal of Portfolio Management**, pp. 102-113, Fall 2007, ERIM Report Series Reference No. ERS-2007-044-F&A.

CARHART, M. M. On Persistence in Mutual Fund Performance. **Journal of Finance**, v. 52, n. 1 (Mar), p.57 – 82, 1997.

CHAN, Louis KC; HAMAO, Yasushi; LAKONISHOK, Josef. Fundamentals and stock returns in Japan. J**ournal of Finance**, v. 46, n. 5, p. 1739-1764, 1991.

FAMA, Eugene F.; FRENCH, Kenneth R. The cross-section of expected stock returns. **Journal of Finance,** v. 47, p. 427–65, jun. 1992.

FAMA, E. F.; FRENCH, K. R. Common Risk Factors in the Returns on Stocks and Bonds. **Jounal of Financial Economics**, v. 33, Feb, p. 3-56, 1993.

FAMA, E. F.; FRENCH, K. R. A five-factor asset pricing model. **Journal of Financial Economics**, v. 116, p. 1–22, 2015.

KEENE, A.; PETERSON, R. The importance of liquidity as a factor in asset pricing. **Journal of Financial Research**, v. 30, n. 1, p. 91-109, 2007.

LINTNER, John. The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets. **Review of Economics and Statistics**, v. 47, p. 13–37, fev. 1965.

LIU, W. A liquidity-augmented capital asset pricing model. **Journal of Financial Economics**, v. 82, p. 631–671, December. 2006.

LOU, Dong; POLK, Christopher; SKOURAS, Spyros. A tug of war: Overnight versus intraday expected returns. **Journal of Financial Economics**, v. 134, p. 192–213, 2019.

MARKOWITZ, HARRY. Portfolio Selection. **Journal of Finance**, edição volume 7, número 1, pág. 77-91, mar. 1952.

MOSSIN, J. Equilibrium in a Capital Asset Market. **Econometrica,** v. 34, n. 4, p. 768–783, 1966.

ROSENBERG, Barr; REID, Kenneth; LANSTEIN, Ronald. Persuasive evidence of market inefficiency. **The Journal of Portfolio Management**, v. 11, n. 3, p. 9-16, 1985.

SHARPE, W. F. Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk. **The Journal of Finance**, v. 19, n.3, p. 425–442, 1964.

STATTMAN, D. Book values and stock returns. **The Chicago MBA: A journal of Selected Papers**, v. 4, p. 25-45, 1980.

SUMIYANA, Sumiyana. The Behavior of Opening and Closing Prices Noise and Overreaction. **Gadjah Mada International Journal of Business.** v. 11, n. 1, p. 73–116, Jan./Abril. 2009.

APPENDIX – TABLES OF ANNUAL LONG & SHORT PORTFOLIOS – For each year, stocks in long positions are highlighted in blue, while those in short positions are highlighted in salmon.

2001 Portfolio
TNEP4
TCOC4
TMCP4
CRTP5
TCSL4
TRPL4
TLCP4
TNLP3
INEP4
EBTP3
CRGT5
CMIG3
CPLE6
BRDT4
CRUZ3
BBDC4
EMBR3
VCPA4
VALE5
ELET3
BBAS3
ITSA4
SBSP3
ARCZ6
BRAP4
PETR4

2002 Portfolio
CRTP5
TLCP4
TDBH4
EGIE3
CESP5
TIMS3
CMIG3
LIGH3
BRTP3
TRPL4
ELPL5
VIVO4
EBTP3
INEP4
TCOC4
CSNA3
ELET3
TMCP4
NETC4
TNLP3
CRUZ3
USIM5
TMAR5
BRAP4
BBAS4
SBSP3
VIVT4
GGBR4
CPLE6
ACES4
EMBR3
BBDC4
TNLP4
ITUB4
ABEV3
ITSA4
PETR4
VALE5

2003 Portfolio
AELP3
EBTP4
NETC4
INEP4
ELPL5
TIMS3
BRTP3
LIGH3
CSNA3
CMIG3
KLBN4
PTIP4
TLCP4
TCSL4
BRKM5
BBAS3
TMCP4
GGBR4
CLSC4
BRAP4
VCPA4
ELET6
OIBR4
VIVT4
EMBR3
TMAR5
ITSA4
PETR4
TNLP4
ITUB4
BBDC4
CRUZ3
VALE5
ABEV3

2004 Portfolio
NETC4
EBTP4
ELPL5
CESP5
LIGH3
EGIE3
CGAS5
KLBN4
CMIG3
ELET3
TCOC4
BRKM5
EMBR3
TLCP4
PTIP4
TRPL4
TIMS3
CPLE6
TMAR5
BRTP4
BBAS3
SBSP3
ACES4
VIVT4
CSTB4
VCPA4
OIBR4
GGBR4
ABEV3
CRUZ3
ITSA4
PETR4
TNLP4
BBDC4
VALE3
ITUB4

2005 Portfolio
NETC4
CSTB4
EBTP4
ELPL5
CESP5
LIGH3
EGIE3
CGAS5
KLBN4
CMET4
ELET3
BRTP3
TCOC4
BRKM5
EMBR3
TLCP4
PTIP4
BBAS3
SBSP3
CMIG3
ACES4
CSNA3
VIVO4
OIBR4
GGBR4
ABEV3
CRTP5
ITSA4
PETR4
TRPL4
BBDC4
VALE5
ITUB4
VCPA4

2006 Portfolio
KLBN4
CRUZ3
CSNA3
ELET6
ITUB4
CTAX4
VIVO4
BRTP4
ITSA4
CGAS5
EBTP4
BRAP4
PTIP4
BBDC4
ELPL5
TCOC4
PETR3
TNLP3
CLSC4
ACES4
CRTP5
USIM5
LIGH3
EMBR4
VCPA4
ABEV3
CMIG4
GGBR4
NETC4
VALE5
OIBR4
TMCP4
ATMP3
TRPL4
GOAU4
UBBR11

2007 Portfolio
TNLP3
BRTP3
LIGT3
VIVO4
TIMS3
BRFS3
TAMM4
ARCE3
TMCP4
CRUZ3
SDIA4
ELET3
BBAS3
TRPL4
EMBR3
SBSP3
CGAS5
CMIG3
CESP6
NETC4
ARCZ6
KLBN4
ACES4
OIBR4
GGBR4
PCAR4
BRKM5
BRAP4
UBBR11
ELPL4
ABEV3
ITSA4
ITUB4
BBDC4
PETR4
VALE3

2008 Portfolio
SYNE3
BRTP3
TIMS3
NETC4
TNLP3
LREN3
CSAN3
GFSA3
ALLL11
LIGT3
VIVO4
CYRE3
BBAS3
PETR4
SBSP3
NATU3
CCRO3
DURA4
GOAU4
VALE5
ITSA4
ITUB4
GGBR4
CMIG4
UBBR11
VIVT4
CPFE3
TCSL4
BNCA3
CLSC4
ARCZ6
BBDC4
CGAS5
ABEV3
EMBR3
ACES4

2009 Portfolio
B3SA3
JBSS3
RSID3
CYRE3
GFSA3
ARCZ6
VCPA4
GOLL4
CSAN3
BNCA3
SDIA4
CESP6
TIMS3
UBBR11
LREN3
BBAS3
AMER3
DURA4
ITUB4
LAME4
BRTP4
TAMM4
CCRO3
KLBN4
LIGT3
ELET3
PETR3
ABEV3
BRFS3
VIVO4
EMBR3
BRKM5
PCAR4
TNLP4
CPLE6
NATU3
CRUZ3
TRPL4
UGPA4
CPFE3
VIVT4
CLSC4
CMIG4
CGAS5

2010 Portfolio
TIMS3
CYRE3
RSID3
MMXM3
GFSA3
CSAN3
OIBR3
DXCO3
EMBR3
JBSS3
B3SA3
TAMM4
RDCD3
KLBN4
GOLL4
VIVO4
TCSL4
BRKM5
AMER3
VALE3
CPLE6
CCRO3
TNLP4
BBDC4
ITSA4
PCAR4
LAME4
ELET3
NATU3
CMIG4
CLSC4
UGPA4
TRPL4
PETR4
CRUZ3
CPFE3
LIGT3
VIVT4
CGAS5
ABEV3

2011 Portfolio
PRTX3
PRML3
TAMM4
TESA3
MMXM3
GOLL4
MRVE3
BISA3
JBSS3
PDGR3
GFSA3
AMER3
FIBR3
LREN3
ELET3
OGXP3
CSAN3
RSID3
TIMS3
TNLP3
KLBN4
USIM3
BRAP4
PCAR4
BRFS3
CSNA3
EMBR3
CPLE6
VALE3
VIVT4
BBAS3
NATU3
ITUB4
PETR4
CMIG4
CRUZ3
ITSA4
TRPL4
ELPL4
UGPA4
LIGT3
BBDC4
CPFE3
ABEV3

2012 Portfolio
GOLL4
HYPE3
MMXM3
RSID3
USIM3
AMER3
MRFG3
PDGR3
OGXP3
GFSA3
MRVE3
JBSS3
BISA3
LAME4
TESA3
CYRE3
LREN3
OIBR4
TMAR5
PRML3
BRKM5
DXCO3
BBAS3
ELET3
BRAP4
ELET6
ITUB4
BBDC4
CIEL3
NATU3
LIGT3
SBSP3
CCRO3
ITSA4
VALE3
VIVT4
CMIG4
CRUZ3
CPLE6
PETR4
UGPA3
CPFE3
ELPL4
TRPL4

2013 Portfolio
GFSA3
OGXP3
MMXM3
PDGR3
TESA3
GOLL4
RSID3
TRPL4
AMER3
MRVE3
BISA3
USIM3
JBSS3
MRFG3
PRML3
ELET3
CYRE3
OIBR3
HYPE3
BRKM5
CESP6
GOAU4
PETR4
DXCO3
KLBN4
VALE3
EMBR3
LIGT3
ITUB4
ITSA4
BRAP4
RENT3
CTIP3
BBDC4
PCAR4
BRFS3
CPFE3
CCRO3
NATU3
UGPA3
CSAN3
ABEV3
CRUZ3
VIVT4

2014 Portfolio
MMXM3
PRML3
AMER3
GFSA3
GOLL4
OIBR3
BISA3
RSID3
ELPL4
PDGR3
USIM3
MRVE3
CSNA3
ELET3
CPLE6
MRFG3
AEDU3
TESA3
PETR3
JBSS3
HGTX3
EMBR3
FIBR3
LIGT3
SANB11
BRAP4
KLBN4
GOAU4
CCRO3
HYPE3
VALE5
LAME4
ITUB4
CRUZ3
CTIP3
ITSA4
RENT3
BBDC4
NATU3
CIEL3
BBAS3
VIVT4
CPFE3
CSAN3
BRFS3
PCAR4
ABEV3
UGPA3

2015 Portfolio
RLOG3
RSID3
OIBR4
PETR4
ELET3
BBAS3
CSNA3
PDGR3
GOLL4
MRFG3
ALLL3
USIM5
GFSA3
JBSS3
CPLE6
BBDC3
ENBR3
B3SA3
TIMS3
CMIG4
SANB11
BRML3
MRVE3
YDUQ3
VALE3
BRKM5
HYPE3
FIBR3
LIGT3
POMO4
LAME4
EMBR3
BRFS3
EGIE3
QUAL3
CRUZ3
SUZB5
KLBN11
NATU3
BBSE3
LREN3
UGPA3
ABEV3
CIEL3
CTIP3
PCAR4

2016 Portfolio
OIBR3
RUMO3
CSNA3
USIM5
GOAU4
PETR4
YDUQ3
QUAL3
COGN3
VALE3
BRKM5
BRAP4
GGBR4
ECOR3
SMLS3
BBAS3
MRFG3
SBSP3
BRML3
CMIG4
BBDC4
CYRE3
ITUB4
RENT3
B3SA3
ITSA4
RADL3
FIBR3
EGIE3
VIVT4
LAME4
SUZB5
BRFS3
CIEL3
CTIP3
EQTL3
UGPA3
WEGE3
KLBN11
ABEV3

2017 Portfolio
RUMO3
USIM5
CSNA3
GOAU4
PETR4
GGBR4
JBSS3
BRAP4
VALE3
CMIG4
YDUQ3
BBAS3
ELET3
COGN3
SMLS3
CPLE6
CYRE3
EMBR3
FIBR3
LAME4
BBSE3
BRFS3
KLBN11
MULT3
ITSA4
MRVE3
ENBR3
CSAN3
CPFE3
WEGE3
HYPE3
VIVT4
RADL3
UGPA3
EQTL3
ABEV3
EGIE3
CTIP3

2018 Portfolio
MGLU3
ELET3
CMIG4
USIM5
VVAR11
CSNA3
BRAP4
GOAU4
RAIL3
JBSS3
YDUQ3
BBAS3
GGBR4
ECOR3
PETR4
CYRE3
SMLS3
LAME4
SANB11
NATU3
VALE3
MRVE3
MULT3
BBDC3
CIEL3
HYPE3
EMBR3
SUZB3
ITSA4
TIMS3
IGTA3
RADL3
KLBN11
ENBR3
TAEE11
UGPA3
WEGE3
EQTL3
VIVT4
EGIE3
ABEV3
CPFE3

2019 Portfolio
LOGG3
ELET3
VIIA3
GOLL4
PETR4
SUZB3
AMER3
SMLS3
USIM5
COGN3
YDUQ3
CMIG4
MRFG3
BRFS3
CSNA3
BRKM5
QUAL3
BBAS3
MGLU3
CIEL3
B3SA3
BRAP4
VALE3
BBDC4
TIMS3
CSAN3
IGTA3
MRVE3
MULT3
HYPE3
CPLE6
BRML3
FLRY3
WEGE3
ITUB4
ITSA4
BBSE3
FIBR3
KLBN11
EQTL3
VIVT4
ABEV3
EGIE3
TAEE11

2020 Portfolio
VIIA3
QUAL3
GOLL4
AMER3
JBSS3
CSNA3
BRKM5
SMLS3
MGLU3
YDUQ3
COGN3
SUZB3
CIEL3
MRVE3
CVCB3
ELET3
BPAC11
SBSP3
NTCO3
MRFG3
AZUL4
BRFS3
PCAR4
RAIL3
GNDI3
BBAS3
TIMS3
CSAN3
FLRY3
IGTA3
SANB11
BBDC4
ABEV3
CMIG4
EGIE3
WEGE3
BBSE3
ITUB4
KLBN11
ENBR3
EQTL3
VIVT4
TAEE11
ITSA4