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Study of the CoAnomaly in Tehran Stock Exchange

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ABSTRACT

Anomaly correlation is among the essential topics that must be paid attention to in investment. Given the investment portfolio, the return is considered to be more than the expected return, and the premium risk of portfolio components, and portfolio components, and the correlation between portfolio components are investigated so that one can eventually achieve the optimal portfolio. The present study investigates the CoAnomaly in Tehran Stock Exchange. For this purpose, a simple measure of time series risk was presented as CoAnomaly (anomaly correlation) for stock market trade anomalies. This measure is the mean time-varying made up of 12 anomalies. Since the correlation between the underlying assets determines the portfolio variance, CoAnomaly is an important state variable for arbitrators that have a diverse anomaly portfolio to enhance performance. The information and data required in this study were obtained from the information on the firms listed in Tehran Stock Exchange over 2011-2020. Empirically, We show that, CoAnomaly is persistent and forecasts long-run aggregate volatility of the diversified anomaly portfolio. CoAnomaly positively predicts future average anomaly returns in the time series. On the other hand, results revealed that an increase in the CoAnomaly increases anomaly variance over the short term and long term. On the other hand, results revealed that an increase in the CoAnomaly increases anomaly variance over the short term and long term.

Keywords: portfolio risk, portfolio return, anomaly correlation (CoAnomaly)

1. Introduction

The word anomaly means deviation from the common rules (Hornby, 2015), and refers to a pattern in the mean stock return that is inconsistent with the conventional models in the asset pricing literature in the financial field (Siderberg and Doherty, 2015). In fact, market anomalies are the result of empirical studies that are inconsistent with the asset pricing theory (Saghafi and Shari, 2004). In this regard, Benz (1981) and Basso (1983) introduced the firm size as an anomaly for the capital asset pricing model. Later, book value to market value was also introduced as an anomaly by Rosenberg, Ride, and Lanstein (1985). Debond and Tahler (1985) introduced long-term return changes, Sloan (1996) suggested accruals, and Jagdish and Titman (1993) suggested momentum as an anomaly as well. This trend expanded so quickly that Cochrane (2011) compared the state of the introduced anomalies and the state of the studies conducted in this regard to a zoo of anomalies. In this regard, Harvet et al. (2015) studied the 313 first-grade published and unpublished articles since 1968, identified 315 variables whose relationship with expected return was studied, made a harsh criticism on anomaly identification methodology, and reported that stricter criteria are to be used for anomaly identification.

The root of anomaly can be traced back to the efficient market hypothesis which was first introduced in 1900 by Bachelor, a French mathematician (Campbell et al., 1997). Bachiler conducted a follow-up study to model the changes in stock price and concluded that speculators had zero return in the market. This conclusion implies that the market evaluates assets using a Martingale system (Fama and French, 2008). Although the efficient market hypothesis's contents were mentioned over the seventh decade of the 20th century, Fama (1970) eventually took credit for formulating it. Fama (1970) revised the efficient market hypothesis and explained the relevant evidence. Fama believed that aside from maximizing their advantage, the actors in the market have rational expectations, and some react more when faced with new information while some react less in the same condition which indicates the randomness of reaction to the information and the net impact of this phenomenon prevents the realization of unusual gain. Thus, efficiency is the result of the market's fast and correct reaction to information (Telangi, 2004). Still, the efficient market theory pays no attempt to predict future returns. This hypothesis merely suggests that the current stock price is based on all the currently available information, and in other words, the price in the market is a true reflection of the news and facts on the stocks (Watts and Zimmerman, 1986).

An anomaly is in fact the deviation from a standard (Hornby, 2015). The observance of stable anomalies in nature results in the expansion of new theories in natural sciences, but the same cannot be said about human sciences. Human sciences criticize what theories cannot explain harshly and label them as anomalies (Miandari, 2010). This is why the models proposed in the financial fields are not completely successful in explaining return and its changes, and some factors influence return but have not been included in these models. These factors are considered the anomalies of the given model (Arab Salehi, Gogordchian, and Pourfakhrian, 2015). In other words, the factors that impact return but have not been mentioned in the asset pricing models are referred to as anomalies (Saghafi and Shari, 2004).

Thus the present study seeks to investigate the correlation risk of the anomalies in the capital market given the importance of the aforementioned.

Research background and literature

Capital market anomaly

The study of capital market anomaly starts from the initial CAPM evaluation and discovering the reasons for the emergence of risk in the market and market failure is accompanied by the identification of stock market anomaly factors by academics and those active in this area. Financial experts consider it difficult to adapt these anomalies to standard asset pricing models and propose various approaches to identify them including principal component analysis, factor model, behavioral financial analysis, capital asset pricing, etc. According to those active in these fields, arbitrators are not the only ones seeking opportunities to receive an excess return from the market, but some investors whose portfolio deviates from the market portfolio also adopt certain strategies to do so. The Exchangeable Trust Fund (ETF) industry) has also recently published factor-based "smart beta" products in which both long-term and micro investors have invested hoping to increase their sharp ratio (Cao, Hsu, Xiao and Zhan, 2018). There is a constant discussion over whether these anomalies demonstrate the real premium risk or create a return by compensating the factors of risk. The present study does not engage in this discussion and merely applies the consensus interpretation of the quantitative

stock investors in the neutrality market believing that these anomalies induce alpha values given the market portfolio.

Results indicate that these anomalies are abused by expert investors to obtain arbitrage positions in the market. McLean and Pontiff (2016) argue that the anomaly return is lower after release. Given the complex nature of the factors of anomaly, some scholars believe that investors are aware of the systematic (endogenous) risk and internalize their behavior's impact. Kojen and Yogo (2015) demonstrated that managers with large assets have managed to induce the largest returns and volatilities from their micro-capitals using anomalies. Stein (2009) states that leverage and congestion can disrupt market efficiency and reasons that capital regulations help deal with this issue. Both empirical and theoretical evidence indicates the arbitrators' destabilizing impacts (Vianus & Woolley, 2013; Lou & Polk, 2013).

The measure of the suitable risk to access costs and profit is necessary for the exchange of these anomalies. However, recent studies indicate the failure of suitable variance risk pricing in the macro-economy and financial economy. Dave-Becker et al. (2017) figured that publishing news on the future variance over the various horizons of three months to 14 years was useless throughout 1966-2014, and only the transient and unexpected variance had a significant price. Berger et al. (2017) demonstrated that shock does not leave a significant impact on the economy under uncertain conditions, even if the shocks inflicted on realized stock market volatilities consistent with the wide range of VAR particular specifications have a contractile nature. On the other hand, the increase with mean correlation simultaneously with the change in assets indicates to what extent the investors can diversify and supply the future premium risk. Correlation risk is widely studied. Pollet and Wilson (2010) indicated that the mean correlation between daily stock return predicts the three-month stock return surplus since individual risks and the correlations between them determine the market risk. These researchers initially measured cumulative risk measurement error and demonstrated that real cumulative risk changes manifest through the changes in stock return correlation. Still, anomaly portfolio is evaluated from arbitrators' perspective, and it is observed that mean correlation is a significant state variant that acts as a predictor in time series and priced risk at the cross-section. Drissen et al. (2009) examined the impact of various events on the correlation risk between index option and individual stock option and realized that risk occurrence explains the cross-section of the index and stock options well. Borashi et al. (2010) proposed a theoretical model indicating that the degree of correlation is random in various industries, countries, or asset classes. Borashi et al. (2013) found that hedge funds' ability to generate a neutral market return is usually associated with significant correlation risk, which explains the unusually high returns in the previous models and estimates the negative and negative market price in correlation risk. Adrian and Brunmeier (2016) proposed the measure of CoVaR –the Value at Risk of financial market- for systematic risk, on the condition that other institutions are troubled.

However, most research on the correlation risk mainly focuses on the correlation risk in the aggregate stock market. This paper takes a novel perspective of looking at the anomaly space from the scope of a portfolio manager chasing market neutrality and studies the time-series predictability and cross-sectional pricing together. As a closely related research, Stambaugh et al. (2012) find that investor sentiment positively predicts anomaly returns and argue that short-sale impediments contribute to their finding as their effect concentrates on the short legs of anomalies. My result is different from theirs in the sense that the predictability of CoAnomaly shows up for both long legs and short legs, which is in line with the basic trade-off between risk and expected return. Sotes Paladino (2017) explores the optimal dynamic investment problem when mispricing assets are correlated, in which he considers a constant correlation structure. On the other hand, this paper highlights the importance of time-variation in the correlation structure.

Stock market anomalies refer to the short-term portfolio which includes which had the features of securities and is known as a return predictor. Considering that these anomalies create returns beyond the standard risk concepts, a large portion of the literature has concentrated on the understanding and identification of the reasons behind anomalies. Researchers have recently started to study multiple anomalies simultaneously; however, they still mainly focus on increasing dimensionality in the anomaly environment, evaluating a new factor considering the existing factors, or comparing trade risks/costs of each of these anomalies (Gou, 2019).

Correlation risk

Investors own asset portfolios with various premium risks to obtain various benefits. Even in the vase of asset volatility, the advantages of diversification and portfolio development can vary across time depending on the asset return correlation structure. Since return correlation varies between assets over time, investors are always inclined to pay more premium risk for securities with a higher return. Thus, investors are willing to pay premium risk for securities with good performance in portfolios with high correlation. Krishnan et al. (2009) tested this hypothesis empirically and discovered that although correlation in a portfolio can increase total portfolio return in case of good portfolio performance, it can also lead to a price slump and negative return across the entire portfolio when the market is weak and under various risk factors.

Correlations are important for diversification. There is significant evidence indicating that the correlation between assets varies over time. For instance, Gutzmann, Lee, and Rowan Horst (2005) investigated major global stock markets and realized that correlations vary significantly over time, and the advantages of diversification also vary due to the different nature of correlations. There is also evidence indicating that the correlation between assets generally increases in bear markets and during finical crises (Longen & Solnick, 2001; Ang & Bakart, 2002).

An increase in asset correlations can lower diversification benefits for investors, and increase market volatility. If diversification opportunities diminish in states of nature when they are most needed, investors would want to hedge against such states. If correlation between assets is a systematic risk factor, investors would pay a premium for securities that offer higher payouts in states of high asset correlations (Krishnan et al., 2009). Krishnan et al. (2009) claim that investors pay a higher risk premium for stocks that have a greater reaction to increased correlation. Through their study on the asset return correlation pricing, they found that investors consider this correlation as a negative premium risk. This result indicates that investors prefer to invest in stocks that are prone to increased correlation and reduced diversification advantages.

Correlations are covariances scaled by the product of asset return volatilities. If returns follow a one-factor model, correlations are increasing in asset betas and market variance and decreasing in idiosyncratic asset volatility, everything else equal. Therefore, it is important to control for market variance and asset volatility when examining the price of correlation risk.

Research literature

Gou (2018) demonstrates that the average time-varying correlation between the stock market abnormalities – which he calls correlation risk in the stock market abnormalities- predicts future abnormalities and the future variance3 of cumulative abnormality portfolio. In other words, when engaged with the correlation risk in the stock market anomalies, this variable predicts two paths for anomaly investors to change the investment opportunity simultaneously: the profit resulting from a higher expected return and the loss resulting from a large cumulative variance. The interim risk coverage of an arbitrageur that seeks absolute neutral returns in the market and invests in short-term stock market anomalies in the general capital framework is studied to investigate the power of each of these two impacts.

Naderi Bani et al. (2017) examined the accounting anomaly test of the Fama & French three-factor model at the firm level using a hierarchical Bayesian approach and a standard Markov chain Monte Carlo simulation to test the hypotheses. Results of this study indicated that size, profitability, book value to market value, current accruals, asset growth, investments, the number of released shares, and foreign financing are considered as anomalies for the Fama & French three-factor model at the firm level.

Mir Askari, Mahfoozi, and Shabani Nejad (2018) examined the synchronicity relationship between return distribution and stock price. Their results suggested that firms with high stock price synchronicity are more likely to create a positive sequence than firms with low synchronicity. Besides, a positive relationship was observed between the synchronicity of skewness and stock price. Thus, investors appear to express a less intense reaction to negative news in firms with high stock price synchronicity compared to firms with low synchronicity. High stock synchronicity indicates that the market information reflected on the stock return is higher and the risk that the investors take is systematic.

In a study entitled “the sources of momentum”, Badri, Dolou, and Aghajani (2018) presented evidence on risk adjustment to explain the surplus return of price momentum and style momentum (size, industry, and book to market value) using a times series regression based on the Fama & French three-factor model (1993)

and Wang and Wu model (2010). Results indicated that return adjustment on risk conventionally leads to increased return based on the Fama & French three-factor model (1993) in most of the strategies of price, size, and industry momentum, while the use of adjusted returns using the Wang and Wu model (2010) reduces the surplus return of these strategies, so the risk-oriented explanation of momentum cannot be strongly dismissed since a part of the impossibility to attribute the surplus return momentum to the risk factor is influenced by how the risk is adjusted. However, in the case of the book value to market value momentum, the risk adjustment method cannot be considered as an explanation for the risk-oriented rejection of the mentioned strategies' surplus return.

Matin Fard and Salahvarzi (2018) tested the impact of stock price synchronicity on the risk of stock price decline. This study used the financial data of 190 firms over 2010-2015 (654 firm-year). Hybrid multivariate regression was used to test the research hypotheses. Results generally indicated that stock price synchronicity was an influential factor on stock price reduction risk. Other results of this study indicated that the negative skewness coefficient of stock return and profitability index had a significant and positive impact on the stock price reduction risk, the ratio of institutional investors' investment and firm size harmed stock price reduction risk (an inverse relationship was observed), and growth opportunities and financial leverage had no significant relationship with stock price reduction risk.

Shams and Esfandiari Moqaddam (2017) studied the impact of herding behavior on the performance of investment firms based on modern and postmodern portfolio hypotheses. This study used the monthly statistical data of 24 investment firms and the Lakonishok (1992) model over 2009-2015 to investigate the impact of herding behavior on these firms. For this purpose, research variables were first examined in terms of stationarity. Then, the Estimated Generalized Least Squares (EGLS) method and the Generalized Method of Moments (GMM) were used to analyze data and test the hypotheses. Results indicated that heredity behavior in investment firms left significant negative impacts on performance criteria based on both modern and postmodern theories.

Doustdar et al. (2017) examined the impact of heredity behavior on the risk-taking of the managers of investment firms listed in the Tehran Stock Exchange in their study. They used structural equation modeling with the approach of Partial Least Squares (PLS) to analyze the hypotheses proposed in the research conceptual model. Their results indicated an inverse relationship between risk-taking and heredity behavior of investment firms' managers.

Foroughi et al. (2016) conducted a study entitled "market anomalies and abnormal returns". For this purpose, they investigated the impact of the variables relevant to the sentimental tendencies of investors on firms' stock prices using multiple regression. They examined the concept of future return abnormality and investigated whether the variables that count as abnormality indices in the market predict future return in the same direction as to future profit or growth in future profits. If this consistency is confirmed, it can be concluded that the return predicted by these variables is not abnormal, and is rather the return that must be realized based on prediction (required return). Their results indicated that the variables of working capital accruals, stock return trend, foreign financing, and the return on assets have managed to predict future return, profit, and growth in the same direction significantly. This indicates that the return predicted by these variables is not abnormal and is completely consistent with rational expectations.

Zanjirdar and Khojasteh (2016) examined the impact of institutional investors' heredity behavior on stock return. Studying the impact of this behavior on firms' stock return was quite necessary considering the capital market's key role in the macroeconomics of studying investors' behaviors in terms of the tendency to imitate others and the formation of the heredity behavior, which was conducted using Huang and Salamon model for 49 firms over 2009-2012. This study was applied research in terms of research objective, correlation research in terms of method and nature, and used the Kolmogorov-Smirnov test to test data distribution normality and t-test to examine statistical research hypotheses. Results indicated a significant relationship between institutional investors' heredity behavior and stock returns, and this relationship was more significant in large firms compared to small firms and in firms with high financial leverage compared to the ones with low financial leverage.

Nikbakht et al. (2016) studied the impact of investors' sentimental behavior and accounting information on the stock price. In this study, the mechanism of the impact of investors' sentimental

behavior and accounting information on the stock price was investigated based on the residual income valuation model. The data obtained from the firms listed on Tehran Stock Exchange over 2009-2014 was used in this study to obtain the index of investors' sentimental behavior and investigate its impact on the growth vision for the expected earning and expected return. Besides, the common impact of investors' sentimental behavior and accounting information on stock price was studied using correlations. Results indicated that investors' sentimental behavior changes the growth of expected earning and thus impacts firms' stock price.

Jahangiri and Rad (2014) investigated the behavior of a group of investors over 2006-2011. A regression model was used in this study, and results indicated that the investors in Tehran Stock Exchange had group behavior. Other results revealed that the investors' group behavior is more significant in the incremental market compared to the declining market.

Badri and Fathollahi (2014) studied stock return momentum in Tehran Stock Exchange over 2001-2010. The momentum study was conducted using the portfolio development method including 6,438 stock portfolios and the portfolio return average test over the 10 years of 2001-2010. Evidence indicated that in the sample consisting of 94 firms that made up the majority of the Tehran Stock Market value, the trading strategies based on return momentum were profitable over the short-term to mid-term. The Fama & French three-factor risk model (1994) is incapable of explaining the momentum until the middle-term, and momentum return surplus after controlling the risk is considered a challenge for the market efficiency hypothesis. Therefore, return momentum can be explained by behavioral models until the middle-term, and market reactivity can induce momentum. The momentum disappears in the long term and return strategies based on return momentum become insignificant.

Heidarpour et al. (2014) conducted a study on the impact of investors' sentimental tendencies on stock return over 2001-2009. This study investigated the impact of investors' sentimental tendencies on the stock return of portfolios sorted by size, price, book value to market value, and the ratio of institutional ownership over 2001-2009. The monthly return of each portfolio was calculated based on the firm's monthly return and the equal weight approach, and time-series multivariate regression was performed on the model to estimate the respective coefficients. For this purpose, the four factors of the market portfolio, book value to market value, firm size, and investors' sentimental tendencies were used to explain the return. Results indicated a significant and positive relationship between investors' sentimental tendencies and firm return in small firms, book value to market value, and low institutional ownership ratio.

Sarlak et al. (2012) investigated the impact of investors' sentimental decision-making and fundamental technique variables on stock return over 2005-2010. This study investigated the impact of investors' sentimental decision-making (Arms) and fundamental technique variables on stock return over 2005-2010. Among the research variables, the three variables of Arms, asset return rate, and the change percentage of current assets to current liabilities had a relationship with stock return. The relationship between all three variables (Arms, asset return rate, and the change percentage of current assets to current liabilities) and stock return in the Tehran Stock Exchange was consistent with the documents mentioned in financial literature as expected. Results that the Arms variables as the index of investors' sentimental decision making, asset return rate, and the change percentage of current assets to current liabilities had a significant relationship with firms' stock return.

Saiidi and Farhanian (2011) used heredity beta as an index of heredity behavior and monthly returns over 2003-2007 to investigate the presence of heredity behavior in Tehran Stock Returns. This study considered the market index and used heredity beta as a criterion for identifying heredity. The authors used the moving window method with a 24-month window size (proposed by Huang and Salmon (2006)). The heredity values in this study were calculated and evaluated for each month over 2003-2007. Results indicated the presence of heredity behavior over this period.

Izadinia and Hajian (2009) investigated the existence of heredity behavior in the Tehran Stock Exchange over 2001-2008. Their research method was based on reducing the cross-sectional standard deviation of stock return to its average during market tension periods compared to other periods. They found that stock return standard deviation does not vary significantly between highly-fluctuating periods with severe price crashes compared to highly-fluctuating periods with a considerable price increase. In other words, intense stock market volatilities did not have a relationship with the expression of heredity behavior.

Eslami Bidgoli and Shahriari (2007) investigated investors' heredity behavior in Tehran Stock Exchange over 2001-2005. Market return and firms' stock return over daily, weekly, and monthly periods were used for this purpose. Moreover, the heredity behavior was studied over increment and decrement market volatilities over daily, weekly, and monthly periods. Results indicated the existence of heredity behavior over market recession periods. However, no evidence of this behavior was found during market prosperity periods. Besides, heredity behaviors were only observed in daily returns.

Zou et al. (2020) investigated oil price shocks, investors' sentiments, and anomalies in oil and gas industry asset pricing. They concluded that the high risk and costs of arbitrage had significant deterrent impacts on oil and gas industry arbitrage, as well as practical investment and policymaking consequences for firm managers, policymakers, and investors.

In a study entitled "re-measuring anomaly", Hu et al. (2018) reinvestigated the 447 anomalies introduced in the financial literature. They concluded that many of the anomalies would no longer be categorized as anomalies if other suitable methods are used. According to them, 85% of the anomalies mentioned in the literature are not anomalies and their categorizations as anomalies have stemmed from methodological problems and researchers' intention to reach specific conclusions.

Rashid, Bint Saeed, Yousef, and Javad (2018) investigated the synchronicity relationship between voluntary disclosure and stock price. Results indicated that not only public information, but also private information influence stock price, and make for a U-shaped relationship between synchronicity and voluntary disclosure. Results also indicated a positive and significant relationship between firm voluntary disclosure level and stock price synchronicity. Gou et al. (2018) combined several machine learning techniques and asset and factor prediction and figured that these factors create added value in terms of achieving positive return positive prediction outside of the R2 sample.

Campbell et al. (2018) used Vector Autoregression (VAR) to estimate the midterm CAOM with random volatility on the factor of investment focusing on 34 stock market anomalies. Discount rates and cash flow news was implemented using a bottom-up approach to compensate for the anomaly portfolios' balancing nature, which means the news was estimated at the stock level and was cumulated to the anomaly level. After the news was gathered at the portfolio level, it was observed that the anomaly return is mainly driven by cash flow news.

Kozak et al. (2012) investigated the Strong Discount Factor (SDC) which summarizes a large number of cross-sectional stock yield predictors' common descriptive power drawing inspiration from the machine learning literature. These techniques indicated no superior performance over the 1/N strategy, particularly in the recent sample periods.

Barroso et al. (2017) demonstrated that the congestion mechanism can explain the momentum trap risk using fungal judgments. When faced with a "restrained" strategy such as value, arbitrators buy stocks with a high book to market value ratio (B/M) and sell stocks with a low book to market value ratio (B/M), which lowers value spread and is considered a natural value strategy restraint. Gasson, Skype, and Weinman (2017) investigated the instability relationship and synchronicity measurement of stock price. Results indicated that stock price synchronicity measurement decreased with stock instability according to the R2 market model, and the traditional solutions used to correct beta were not influential on instability effects in R2 correction.

Gallariotis et al. (2016) investigated stock market liquidity and heredity behavior. Results indicated a significant and positive relationship between liquidity and heredity behavior, specifically before and after a crisis, and this impact was more prominent in the United States market. Huang (2015) used spread momentum and the difference between 25% and 75% distributions in stock accumulation returns to deal with arbitrage activity and demonstrated that more momentum activity was associated with stronger returns.

In their study entitled "the impacts of behavioral problems and national culture on investors' decisions: behavior in international stock markets", Ching and Lin (2015) searched for the impacts of national culture and investors' behavioral problems, and the decision-making process in international stock markets with four unique features. Results of these four features indicated that only 18 cases of heredity behaviors were significant in the first 50% of the market stock, which was more prevalent in Confucius stock markets with low complexity and people with considerable heredity behavior. Then, they investigated national heredity

behavior such as masculinity, power distance to individualism, and other aspects. They eventually found that behavioral problems such as over-optimism, false self-confidence, and effect setting significantly dominated the heredity tendencies over investors. Empirical results suggested that heredity behavior tendency varies between the investors.

Yao et al. (2014) studied heredity behavior in the Chinese stock market. They used daily data from 199-2008. Results indicated a heredity behavior in the Chinese stock market, and this behavior was stronger in the industry compared to the market. Their results also revealed that heredity behavior was stronger for small and large firms. Besides, results revealed that heredity behavior was stronger for growth stocks compared to value stocks.

Jalasi and Ben Saeedi (2014) investigated heredity behavior and trading volume in the American capital market. Their results indicated a heredity behavior and trading volume in the capital market. Results also revealed that trading volume contributes to the asymmetric increase of heredity behavior. Belasco et al. (2012) used daily data to investigate the factors influencing heredity behavior in the Spanish stock market over 1997-2003. They discovered that heredity behavior was influenced by past returns, investors' mentality, and sentiments, and their tendency to imitate.

Al-Shaboul (2012) investigated heredity behavior and asymmetric effects in the Australian capital market. He studied 251 listed firms over 2003-2010 and used daily and monthly data to test the hypotheses. His results indicated that there was asymmetrical heredity behavior in the Australian capital market. Results also revealed that investors express asymmetrical behavior in response to financial crises while no asymmetrical response is observed towards fundamental variables (profit on each share, firm size, price to profit ratio, and book to market value).

Zakamoline and Kickbaker (2009) investigated portfolio performance using the generalized Sharp ratio. This study revealed that the generalized Sharp model performed better compared to the regular momentum strategy in selecting the right portfolio, and the generalized Sharp ratio is capable of covering the normal Sharp ratio's shortcomings.

Chan et al. (2003) studied the factors influencing heredity behavior in the Chinese capital market and concluded that the relative return scatter declines in the case of momentum existence. However, little evidence was obtained regarding the existence of heredity behavior.

Research methodology

The present study which was conducted aiming to explain investment based on the factors inducing an anomaly in the stock exchange- is a retrospective study in terms of time, result-oriented in terms of result, and post-event in terms of type. The study is also descriptive in terms of data collection, a correlation study in terms of research method, and an exploratory survey in terms of execution.

The data required to test research hypotheses were collected through desk research. To create the CoAnomaly at each point in time, the average partial correlation between the anomaly return values was calculated over a period using daily data. Hence, this measure evaluates the amount of anomalies' shifting degree over time and responds to the question of whether CoAnomaly can predict a diverse anomaly portfolio's total future variance for up to one year.

New and old momentum strategy returns were used to demonstrate the predictability of the strong momentum gap after several known momentum prediction factors such as market status and volatility were controlled.

The statistical models used in this study to explain the investment anomaly performance include the Capital Asset Pricing Model (CAPM), Vector Autoregression (VAR), and Sharp and Beta ratios. Vector Autoregression (VAR) is used to estimate midterm CAPM with random volatilities on the investment factor focusing on 19 anomalies of the stock market. To calculate the real value of each of the anomalies in the anomaly portfolio in the third hypothesis, the Vector Autoregression model was first used to calculate the shocks and volatilities regarding the changes on cash flows, and the volatilities of the portfolio are thus obtained given the cash flow shocks. The difference between the cash flow shocks and discount rates is the market premium risk in the anomaly portfolio. Then, the beta of each anomaly is calculated and the CAPM model is used to value each of the anomalies in the anomaly portfolio so that each asset's risk in the anomaly portfolio is specified.

After being sorted and categorized in Excel and eliminating or correcting outlier data and completing missing data, the data used in the study were described in the Eviews econometrics software using charts and

indices and analyzed based on the mentioned suitable statistical and financial econometric methods.

The statistical population of the present study includes the firms listed on stocks exchange over the 10 tears of 2011-2020. The following table demonstrates the statistical sample obtained through systematic eliminations.

Statistical sample	Number
All firms	563
Banks, insurance, investment firms, etc.	133
Firms with missing data over the ten years	188
Firms remaining in the sample	242

The assessment of CoAnomaly over the short term and long term:

$$CoAnomaly_t^{LS} = \frac{1}{N}\sum_{n=1}^{N} \underbrace{partialCorr_t(ret_n^{LS}, ret_{-n}^{LS}|MktRf)}_{\substack{\text{Average partial correlation} \\ \text{for anomaly } n \\ \text{with respect to all other anomalies } -n}} = \frac{1}{N}\sum_{n=1}^{N} \rho_{n,-n}^{LS},$$

$$CoAnomaly_t^{S} = \frac{1}{N}\sum_{n=1}^{N} partialCorr_t(ret_n^{S}, ret_{-n}^{S}|MktRf) = \frac{1}{N}\sum_{n=1}^{N} \rho_{n,-n}^{S},$$

$CoAnomaly_t^{L}$: Long-term CoAnomaly
$CoAnomaly_t^{S}$: Short-term CoAnomaly
$CoAnomaly_t^{LS}$: Short-term and Long-term CoAnomaly

Determining CoaAnomaly and cumulative variance:

The following equation was used to determine CoAnomaly and cumulative variance. This model can investigate CoAnomaly over the short term and long term.

$$CoAnomaly_t = \alpha + \beta_1 CoAnomaly_{t-1} + \sum_p \beta_P \times controls_{p.t-1} + t \times Trend + \varepsilon_t$$

$$Aggr.var_{EAR.t} = \alpha + \beta_1 CoAnomaly_t + \beta_2 \times Avg.Var_t + \beta_3 \times CoAnomaly_t \times Avg.Var_t + \varepsilon_t$$

$CoAnomaly_t$: CoAnomaly at the time t-1
To calculate CoAnomaly, market premium risk and return rate must first be calculated, and the correlation of the market with each of the anomalies should then be evaluated.
$Aggr.var$: Total anomaly variance
Evaluation of the CoAnomaly variance
$Avg.Var_t$: Average variance
Which is obtained by calculating the mean market variance.

The control variables in this model include:
Sentiment: the indicator of investors' sentiment or tendency which is obtained from the relationship between good and bad news and trade volume using the T-GARCH test.
VI= is a criterion of volatility overflow measurement in the market which is obtained considering the total index using a GARCH model. The risk extracted from this model is used as the volatility surplus.

$$VIX = \sqrt{\frac{2e^{rT}}{T}\left(\int_0^F \frac{P(K)}{K^2}dK + \int_0^\infty \frac{C(K)}{K^2}dK\right)}$$

Where T represents the average number of days in a month, r is the risk-free return rate, F represents the price estimation for the next 30 days, and K demonstrates 30 days until maturity.
TED: The gap between interest rates on interbank loans and short-term government liabilities
HFRet: The stock market index
Mktrealized vol: Realized quarterly market variance which is calculated using daily returns
Liquidity: market liquidity
Trend: price direction over a period. How a variable change over time must be estimated to calculate this time-series regression model.
In this study, the return surplus is first calculated using the difference between market premium risk and return, and CoAnomaly is thus obtained. Then, the momentum

gap and various factors in the market are investigated and the return is examined with each of the studied anomalies. Eventually, the impact of news and investors' sentiments over the short term and long term on the induction of anomaly in the market and opportunities for arbitrators is studied.
The anomaly portfolio in the present study included 12 anomalies mentioned below:
Atgrowth: asset growth

$$\text{Total asset growth} = \frac{\text{Total Assets}}{\text{Total Assets y} - 1} - 1$$

Ato: asset turnover

$$Asset\ Turnover = \frac{net\ sales\ revenue}{average\ total\ assets}$$

β: Beta

$$\beta = \frac{cov(r_i, r_m)}{var(r_m)}$$

Where r_i is the dependent variable and represents the share return trend, r_m represents market return. β is the regression line gradient that indicates the changes in share return rate against the market changes. The beta coefficient for a share can also be calculated from the following equation:

Volatilities

Volatilities are usually calculated using variance and standard deviation. Standard deviation is the square root of variance.
Daily volatilities are calculated as follows:

$$\text{Volatility} = \sqrt{\sigma^2}$$

Annual volatilities are calculated as follows:

$$\text{Volatility} = \sqrt{225} \times \sqrt{\sigma^2}$$

Netoa= net operational assets

The total assets of a company
- All liabilities
- All financial assets
+ All financial liabilities
= Net operating assets

PEAD: the abnormal return (adjusted for the stock return) of long-term stocks which are calculated based on cumulative quarterly abnormal returns. For this purpose, the adjusted market model was used to calculate firm stocks' cumulative abnormal returns. In this model, market returns are assumed to be the results of the expected firm stock return process over each period, so the difference between market return and real return demonstrates the abnormal return on the stocks of firm i over time t. The method used in the present study is inspired by the methodologies of Ritter (1991), Kouli and Sourt (2004), Drabts et al. (2005), and Forte and Loncani (2005), and calculated the market-adjusted return of stocks i over the t^{th} month as follows:

$$PEAD_{i.t} = r_{i.t} - r_{m.t}$$

Where
$r_{i.t}$: the stock return of firm i over the month t
$r_{m.t}$: price index return and cash return of Tehran Stock Exchange over the month t
Gprofit: gross profit (Gprofit=Revenue-Costs of Goods Sol)
Roa: return on assets
Return on assets demonstrates the efficiency of firm management in the employment of all the available resources to achieve profit, and is calculated as follows (Jianti et al., 2011):

$$ROA = \frac{Net\ Profit}{Total\ Asset}$$

Roe: return on equity

$$ROE_{i.t} = \frac{Net\ Profit}{Equity}$$

Rome: return on the market

$$ROM = \frac{\text{TEPIX}_t - \text{TEPIX}_{t-1}}{\text{TEPIX}_{t-1}}$$

Size: firm size (Size= log (assets))
Value= firm value

$$NAV = \frac{(Assets\ -\ Liabilities)}{Total\ number\ of\ outstanding\ shares}$$

Research hypotheses

Considering the aforementioned, research hypotheses are as follows:

1) CoAnomaly stability predicts the total volatilities of anomaly portfolio
2) CoAnomaly leads to the positive prediction of mean future CoAnomlay in the time-series

Research findings

Descriptive statistics

Table 1 summarized the descriptive statistics on the variables used in the present study. This table illustrates the values of mean, mode, maximum, minimum, standard deviation, skewness, elongation, probability, and Jerk-Bra probability statistic, respectively.

As Table 4.1 demonstrates, the standard deviations of the variables indicate that among the research variables, the gap between interest rates and interbank loans had a higher standard deviation. The variables of CoAnomaly over short term, stock market index, and the interbank loan had elongation, and the other variables were at the normal level with no elongation. Besides, all the variables except the gap between interest rates and interbank loans had skewness. The Jerk-Bra test statistics confirmed the normality of research variables, but the fact that their P-value was lower than 0.05 indicated that they were not normal.

Table 1: descriptive statistics of the research variables

P	Jerk-Bra statistic	Skewness	Elongation	Standard deviation	Minimum	Maximum	Mean	Mode	
0.000	321.296	3.239	0.890	0.030	0.000	0.069	0.000	0.000	CoAnomaly over the long term
0.000	372000000	1930.964	-٤2.915	4.461	-٢05.933	0.788	0.379	0.242	CoAnomaly over the short term
0.000	7730.273	9.805	2.797	399821.600	23756.300	2078547	77589.200	222204.800	Stock market index
0.000	1324824	116.879	9.152	10352248	4948	189000000	447121.500	2906816	Market liquidity
0.000	1300.487	4.672	1.601	0.821	9.068	12.340	9.604	9.869	Realized variance
0.000	23711.710	16.658	3.589	27100000	9690000	205000000	11200000	20800000	Investors' sentiments
0.000	100.349	3.382	0.464	53635174	986000000	1200000000	1080000000	1080000000	The gap between interest rates and interbank loans
0.000	1300.487	4.672	1.601	0.821	9.068	12.340	9.604	9.869	Market volatility overflow

Shapiro-Wilk normality test

The philosophy of the Shapiro-Wilk test is similar to the quantile-quantile chart. This test considers a regression between the ordinal statistics of data and the expected values of normal distribution ordinal statistics of data. The test statistics are similar to the determination coefficient in regression whose higher values indicate the closeness of data distribution to the normal distribution and small test statistic values reject the null hypothesis (data distribution normality).

The Shapiro-Wilk test is based on a regression relationship or correlation analysis between ordinal statistics and their expected values.

Table 2: the Shapiro-Wilk normality test

Variables	Statistic	Degree of freedom	Sig
Market direction	2.98	516	0.00
Stock market index	4.45	516	0.00
Total anomaly variance	0.819	516	0.00
Realized variance	0.588	516	0.00
Volatility spillover index	0.652	516	0.00
Market liquidity	0.562	516	0.00
The gap between interest rates and interbank loans	0.037	516	0.00
Investors' sentiments	0.762	516	0.00
CoAnomaly over the short term	0.882	516	0.00

CoAnomaly over the long term	0.68	516	0.00

The Shapiro-Wilk test significance levels demonstrated in this table as Sig. that are higher than 0.05 usually mean that data can be considered normal with a high level of certainty. Otherwise, one could not say that the data is distributed normally. Thus, the H0 hypothesis indicating the normality of variables was rejected at the confidence level of 95%, which indicates that the dependent variable is not normally distributed, and non-parametric tests must be used to investigate the correlation between the variables.

Correlation test between research variables

Spearman correlation has been used in this section to examine the correlation between research variables analyzed using SPSS v.25. Table 4.3 demonstrates the matrix of the correlation coefficients between research variables.

As demonstrated in the table above, short-term CoAnomaly has a significant and inverse relationship with price direction over a period, market liquidity, and the gap between interest rates and interbank loans and government debt. On the other hand, it has a significant and direct relationship with total anomaly variance. Furthermore, long-term CoAnomaly revealed to have a significant and direct relationship with price direction over a period, total anomaly variance, the mean-variance of market liquidity, and the gap between interest rates and interbank loans and government debt.

Table 3: Spearman correlation

	Short-term CoAnomaly		Long-term CoAnomaly	
	Correlation coefficient	**statistic**	**Correlation coefficient**	**statistic**
Market direction	-.044*	.029	.044*	.029
Stock market index	-.037	.070	.016	.434
Total anomaly variance	.038	.062	.251**	.000
Realized variance	-.037	.068	.018	.366
Volatility spillover index	-.037	.068	.018	.366
Market liquidity	-.071**	.001	.076**	.000
The gap between interest rates and interbank loans	-.358**	.000	.061**	.003
Investors' sentiments	-.030	.142	.004	.841

Reliability test

In this section, the stationarity or reliability test on research variables is explained. The Hadri test was used to examine reliability. Table 4 demonstrates the results of this test.

According to the results of Table 4, all variables are stationary since the P-value is lower than 0.05. This means that the mean and variance of variables have been stable over time and their covariance has remained fixed over the years. Thus, using the variables in the model would not induce false regression.

Table 4: Hadri test results

Variables	T statistic	P-value
Market direction	17.114	0.000
Stock market index	10.566	0.000
Total anomaly variance	12.399	0.000
Realized variance	16.203	0.000
Volatility spillover index	16.203	0.000
Market liquidity	7.952	0.000
The gap between interest rates and interbank loans	8.462	0.000
Investors' sentiments	19.274	0.000
CoAnomaly over the short term	6.885	0.000
CoAnomaly over the long term	7.032	0.000

Chaw test

To determine the proper regression estimation model, it must first be evaluated whether there are individual heterogeneities. Panel data is used in case of heterogeneity and pooled data is used otherwise. Therefore, the Chaw test was is used to determine the application of the fixed effects model versus the

integration of all models (integrated). The assumption of this test are as follows:
H0: the pooled model
H1: the panel model

Table 5: Results of the Chaw test

	Test restful	Prob.	D.F.	Statistic value	Effects test
The first hypothesis	Panel data model	0.000 0.000	(85,410) 85	22.274302 457.393	Period F Period Chi-square
The second hypothesis	Pooled data model	0.000 0.000	(117,999) 117	11.595661 975.358599	Period F Period Chi-square

Results of the Chaw model indicate that the P-value is less than 0.05 in the model, thus H0 is rejected and H1 is confirmed, indicating that there are individual heterogeneities and the panel data method must be used to estimate the model. Thus, the Hausman test was conducted to determine whether the fixed effect model or the random effect model must be used in the next stage.

The Hausman test

The Hausman test determines whether there is a relationship between the model's independent variables and estimated regression error. The assumptions of this test are as follows:
H0: Random effects
H1: Fixed effects

Table 6: Results of the Hausman test

Hypotheses	Test result	P-value	Degree of freedom	Chi-square statistic
The first hypothesis	Fixed effects model	0.0987	12	18.598
The second hypothesis	Random effects model	0.0398	11	20.425

As table 4.7 demonstrates, P values are lower than 0.05 which indicates a relationship between the model's independent variables and estimated regression error. Thus, H0 is rejected and H1 is confirmed, indicating that the fixed effects model is the best method to test the hypotheses according to the results of Chaw and Hausman tests.

Testing research hypotheses

The first research hypothesis

The first research hypothesis indicates that CoAnomaly stability predicts the total volatilities of the anomaly portfolio. This hypothesis is estimated using panel data as demonstrated in model 1:

$$CoAnomaly_t = \alpha + \beta_1 CoAnomaly_{t-1} + \sum_p \beta_P \times controls_{p.t-1} + t \times Trend + \varepsilon_t$$

Study of CoAnomaly over the long term

According to Table 7, the F statistic, and the significance level which is lower than 0.05, the null hypothesis is significant at the confidence level of 95% and is well capable of explaining the dependent variable based on the existing data. Besides, considering that the coefficient of determination, around 84% of the changes in the dependent variable is explained by independent and control variables. The 1.916 value obtained for the Durbin-Watson statistic also indicates that the residuals in regression are not auto-correlated. Given the t-statistic, CoAnomaly is 96.214 over the long term and its significance level is lower than 0.05 (0.000), so the stability of CoAnomaly is capable of predicting total volatilities in the anomaly portfolio. Thus, the first research hypothesis is confirmed. Moreover, a significant and inverse relationship was observed between CoAnomaly and investors' sentiments given that the t-statistic of investors' sentiment was -2.310 and its significance was 0.029 which is lower than 0.05. in the first model of the research, CoAnomaly revealed to have a significant and inverse relationship with the gap between interest rates and interbank loans with a t-statistic of -24.598 and a significance of 0.000, and a significant and direct relationship with market volatility surplus with a t-statistic of 4.159 and a significance of 0.000; however, other control variables in the model revealed to have no significant relationship with CoAnomaly given that their significance levels were higher than 0.05.

Table 7: results of estimating the first research model for CoAnomaly over the long term

	Variables	Coefficient	Standard error	t Statistic	P-value.	result
Intercept	C	0.040	0.005	7.237	0.000	
CoAnomaly	COANOMALYT-1	0.151	0.002	96.214	0.000	Confirmed
Investors' sentiment	SENTIMENT	0.000	0.000	-2.310	0.029	Confirmed
The gap between interest rates and short-term debt	TED	0.000	0.000	-24.598	0.000	Confirmed
Market volatility surplus	VI	0.000	0.000	4.159	0.000	Confirmed
Realized variance	HER	0.000	0.000	-0.903	0.368	Rejected
Stock market index	MHTE	0.001	0.001	1.025	0.306	Rejected
Market liquidity	LIQUIDE	0.000	0.000	1.158	0.248	Rejected
Market direction	TREND	0.001	0.001	1.360	0.175	Rejected
000.0 :probability	20.936 ::F test		Coefficient of determination		0.844	
Durbin-Watson	1.916		Adjusted coefficient of determination 0.803			

Study of CoAnomaly over the short term

According to Table 8, the F statistic, and the significance level which is lower than 0.05, the null hypothesis is significant at the confidence level of 95% and is well capable of explaining the dependent variable based on the existing data. Besides, considering that the coefficient of determination, around 62% of the changes in the dependent variable is explained by independent and control variables. The 1.95 value obtained for the Durbin-Watson statistic also indicates that the residuals in regression are not auto-correlated. The t-statistic indicates that CoAnomaly had a value of 2.219 and a significance level of less than 0.05 (0.027) over the short term, so it was capable of predicting the total anomaly portfolio. Therefore, the first hypothesis is confirmed. Besides, a significant and direct relationship was observed between CoAnomaly and investors' sentiments given that the t-statistic of investors' sentiment was 2.332 and its significance was 0.047 which is lower than 0.05. in the first model of the research, CoAnomaly was revealed to have a significant and inverse relationship with the gap between interest rates and short-term debt with a t-statistic of -3.433 and a significance of 0.001; however, other control variables in the model were revealed to have no significant relationship with CoAnomaly given that their significance levels were higher than 0.05.

Table 8: results of estimating the first research model for CoAnomaly over the short term

	Variables	Coefficient	Standard error	t Statistic	P-value.	result
Intercept	C	0.334	0.165	2.019	0.044	
CoAnomaly	COANOMALYST	0.259	0.117	2.219	0.027	Confirmed
Investors' sentiment	SENTIMENT	0.000	0.000	2.332	۰.۰۴۷	Confirmed
The gap between interest rates and short-term debt	TED	0.000	0.000	-3.433	0.001	Confirmed
Market volatility surplus	MHTE	0.011	0.014	0.800	0.424	Rejected
Realized variance	HER	0.000	0.000	-1.543	0.123	Rejected
Stock market index	LIQUIDE	0.000	0.000	-5.607	0.000	Rejected
Market liquidity	TREND	-0.007	0.001	-5.783	0.000	Rejected

000.0 :probability 20.936 ::F test	Coefficient of determination 0.654
Durbin Watson 1.952	The adjusted coefficient of determination 0.623

The second research hypothesis

The second research hypothesis indicates that total anomaly variance increases as a result of CoAnomaly increase over the short term and long term. This hypothesis is estimated using panel data as demonstrated in model 2:

$$Aggr.var_{EAR.t} = \alpha + \beta_1 CoAnomaly_t + \beta_2 \times Avg.Var_t + \beta_3 \times CoAnomaly_t \times Avg.Var_t + \varepsilon_t$$

According to Table 9, the F statistic, and the significance level which is lower than 0.05, the null hypothesis is significant at the confidence level of 95% and is well capable of explaining the dependent variable based on the existing data. Besides, considering that the coefficient of determination, around 54% of the changes in the dependent variable is explained by independent and control variables. The 2.43 value obtained for the Durbin-Watson statistic also indicates that the residuals in regression are not auto-correlated. The t-statistic indicates that long-term CoAnomaly had a value of 10.795 and a significance level of less than 0.05 (0.000) over the short term, so it was capable of predicting the total anomaly portfolio. Therefore, the presence of a significant and direct relationship between long-term CoAnomaly and total anomaly variance is revealed the second hypothesis is confirmed, which means that increased CoAnomaly in the investment portfolio will increase the investment risk. Besides, a significant and direct relationship was observed between total anomaly variance and average variance considering that the t-statistic of avrage variance was 51.451 and the significance level was lower than 0.05 (0.005). Long-term CoAnomaly*average variance was also revealed to have a significant and inverse relationship with total anomaly variance given the t-statistic of -8.519 and a significance of less than 0.05 (0.000).

Table 9: results of estimating the second research hypothesis

	Variables	Coefficient	Standard error	t Statistic	P-value.	result
Intercept	C	0.000	0.000	1.433	0.152	
Long-term CoAnomaly	COANOMALYL	0.003	0.000	10.795	0.000	Confirmed
Mean-variance	AVERVAR	1.036	0.020	51.451	0.000	rejected
Long-term CoAnomaly*mean variance	COANOMALYAVGVAR	-2.878	0.338	-8.519	0.000	Confirmed
000.0 :probability 4.74334 :Test F			Coefficient of determination: 0.546			
Durbin-Watson: 2.4336			The adjusted coefficient of determination: 0.495			

Table 10: results of estimating the second research hypothesis

	Variables	Coefficient	Standard error	t Statistic	P-value.	result
Intercept	C	0.000	0.000	-8.843	0.000	
Long-term CoAnomaly	coanomalys	0.000	0.000	22.107	0.000	Confirmed
average variance	avervar	4.405	0.152	28.990	0.000	Confirmed
Long-term CoAnomaly*average variance	avervarcoanomalys	-8.397	0.371	-22.645	0.000	Confirmed
000.0 :probability F test: 4.74334			Coefficient of determination: 0.544			
Durbin-Watson: 2.5417			The adjusted coefficient of determination: 0.493			

According to Table 10, the F statistic, and the significance level which is lower than 0.05, the null hypothesis is significant at the confidence level of 95% and is well capable of explaining the dependent variable based on the existing data. Besides, considering that the coefficient of determination, around 54% of the changes in the dependent variable is explained by independent and control variables. The 2.54 value obtained for the Durbin-Watson statistic also indicates that the residuals in regression are not auto-correlated. The t-statistic indicates that long-term CoAnomaly had a value of 22.107 and a significance level of less than 0.05 (0.000) over the short term, so it was capable of predicting a total anomaly portfolio. Therefore, the presence of a significant and direct relationship between short-term CoAnomaly and total anomaly variance is revealed the second hypothesis is confirmed, which means that increased CoAnomaly in the investment portfolio over the short term will increase the investment risk. Moreover, a significant and direct relationship was observed between average variance and total anomaly variance is given the t statistic of average variance (28.990) and the fact that its significance level was lower than 0.05 (0.000). it was observed in the second model of the research that Long-term CoAnomaly*average variance had a significant and inverse relationship with total anomaly variance given the t-statistic of -22.645 and a significance level of less than 0.05 at 0.000.

Discussion and conclusion

The present study investigated the CoAnomaly risk in the Tehran Stock exchange. The first hypothesis examined whether CoAnomaly stability could predict the total volatilities of anomaly portfolios over the short term and long term. According to the results, CoAnomaly had short-term and long-term statistic values of 96.214 and 2.219 with significance levels of 0.000 and 0.027, respectively, which indicated that CoAnomaly could predict the total volatilities of anomaly portfolio and confirmed the first hypothesis.

The second hypothesis examined whether total anomaly variance increased as a result of an increase in CoAnomaly over the short term and long term. Results demonstrated that long-term CoAnomaly had a value f 10.795 and a significance level lower than 0.05 at 0.000, which demonstrates a significant and direct relationship between total anomaly variance and long-term CoAnomaly. The first hypothesis is thus accepted. Moreover, short-term CoAnomaly was revealed to have a value of 22.107 and a significance level of lower than 0.05 (0.000), which indicated demonstrates a significant and direct relationship between total anomaly variance and short-term CoAnomaly. Thus, the second research hypothesis was also confirmed.

We also find that return patterns are consistent with the idea that arbitrageurs take the CoAnomaly risk into account. These results together highlight the importance of the comovement among anomaly assets. These results show that the anomaly return dynamics can be rationalized in a portfolio view from the perspective of anomaly investors.

The fact that CoAnomaly is robustly priced across different assets has a strong asset pricing implication. The impact of professional asset managers is substantial since the risk they care about is incorporated into the prices of many assets both in the time series as well as the cross-section. There are policy implications for the CoAnomaly measure as well: regulators can use it to evaluate the likelihood that the stock market arbitrageurs destabilize the market if there is a market-wide shock to the correlation structure. Based on this measure, future research can explore the mechanisms and rationales behind the behaviors of the arbitrageurs with substantial impacts, which may, in turn, lead to a better understanding of financial markets.

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