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DO REFORMS FIX INEFFICIENCY? EVIDENCE OF VALUE AND ACCRUAL ANOMALIES FROM THE SAUDI VISION 2030 ERA

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Abstract

This study investigates the informational efficiency of the Saudi Stock Exchange (Tadawul) during the structural reforms of Saudi Vision 2030 by jointly testing value-glamour and accrual anomalies through the lens of the Adaptive Market Hypothesis. Using an unbalanced panel of 1,545 non-financial firm-year observations over 2010–2024, we apply Fama-MacBeth cross-sectional regressions with lagged accounting variables to prevent look-ahead bias. Size-adjusted returns are regressed on book-to-market (B/M) and total balance-sheet accruals, controlling for size, leverage, and momentum. We find a robust value premium (B/M $\beta = 0.058$, $p < 0.01$) and, notably, a positive relation between lagged accruals and future returns ($\beta = 0.042$, $p < 0.01$). This sign reversal from developed markets suggests that Saudi investors interpret high accruals as a signal of genuine investment and growth rather than earnings management. Both anomalies remain significant when tested jointly, and sub-period analysis reveals that although their magnitude diminished by 30–40% after the 2017 QFI and IFRS reforms, they persist. This persistence, alongside the independence of the two anomalies, indicates that prices do not fully reflect all public information, contrary to semi-strong EMH, and that investors respond to distinct valuation and earnings-quality signals. The findings align with the Adaptive Market Hypothesis: regulatory modernization outpaces the cognitive adaptation of the retail-dominated investor base, making efficiency evolutionary. The study provides the first joint pre- and post-Vision 2030 evidence of a positive accrual anomaly and highlights the continued viability of fundamental, factor-based strategies. It also underscores the need for targeted investor education to accelerate cognitive modernization and close the gap between structural transparency and efficient price discovery.

Keywords: Saudi Vision 2030, Adaptive Market Hypothesis, Value-Glamour, Accrual Anomaly, Market Efficiency, Emerging Markets.
JEL Classification: G12; G14; G15; M41.

1. Introduction

The overriding paradigm is the Efficient Market Hypothesis (EMH) and the concept of market efficiency. Fama (1970) assumed that when all known information is captured in the prices of securities, then it is impossible to achieve excess returns. Nevertheless, this paradigm is already being questioned by various anomalies, predictable returns, which are based on publicly reported information. Market frictions, information asymmetries, and the existence of retail investors enhance the market attractiveness of market anomalies, and the opportunities to arbitrage in emerging markets. This paper will explore the Saudi Exchange (Tadawul), the largest capital market in the Middle East, which will allow testing the market efficiency. The market is changing more rapidly with government-led changes compared to other markets which have experienced an organic change.

The exchange was founded in 2016 (Saudi Tadawul Group, 2025) and has allowed Qualified Foreign

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Investors (QFIs) to participate in the exchange since 2016, uses International Financial Reporting Standards (IFRS), and shares are listed in international indices (Saudi Tadawul Group, 2025). The reforms were evidently aimed at increasing the price efficiency through reduction of information asymmetry. As much as these efforts exist, the question of the level of investor sophistication and price efficiency remains. In the current paper, two various basic anomalies have been discussed as a metric of investor behaviour. In particular, it explores the value-glamour anomaly to find out whether the market overestimates future growth by overpricing so-called glamour stocks and under-pricing so-called value stocks. Moreover, it discusses the accrual anomaly to determine whether historical bottom-line earnings are misleading investors by not taking into account lower persistence of accruals. Despite the vast amount of research on these anomalies carried out on developed economies, very little is known about the transition economies. Majority of the evidence on these anomalies is viewed independently. One of the strengths of this paper is that it has been able to study them in combination, meaning they have the opportunity to determine whether Saudi investors are responsive to value (value-glamour) or earnings quality (accruals) signals.

2. Institutional Background

2.1. Tadawul (Saudi stock exchange)

There is only one entity which has the permission to operate as a securities exchange in the Kingdom, which is Tadawul which was established in 2007. Historically, petrochemical and banking industries have dominated the exchange that is in line with the underlying structure of the Saudi Arabian economy. Through to 2015 the market was not accessible at all to the international investor but was only financed by the domestic capital. It was therefore a domestic price dynamic that evolved, where the behavioural bias of local investors would still be continued in the absence of arbitrage.

2.2. Vision 2030 and Reform

The situation in the institutional environment changed dramatically with the introduction of the Vision 2030 in 2016. Through the Financial Sector Development Program (FSDP), there were a number of major reforms made. First, in 2017, an IFRS conversion required all exchange-traded listed firms to switch their financial reporting of international financial reporting standards as opposed to the local Saudi GAAP. This change was supposed to make financial accounts more transparent and more comparative, and this directly impacts investor perceptions of the quality of earnings, and accrual measures. At the same time, the market liberalization efforts allowed the market to open up to Qualified Foreign Investors (QFIs) and made the exchange available to institutional foreign investors. The consequent influx of advanced capital is likely to lead to decreasing profitability of value and accrual strategies in the long run. Lastly, The Capital Market Authority (CMA) also required a new Corporate Governance Code that was to be drafted to promote corporate disclosure and protect the rights of shareholders. This regulatory pillar is to minimize the agency costs, and enhance the information environment, which also contributes to price efficiency

3. Literature Review and Theoretical Framework

3.1. Theoretical Evolution: From Static Efficiency to Adaptive Markets

The study is contextualized in the framing of the tension between the Efficient Market Hypothesis (EMH) and how investors in the developing world behave. Fama (1970) postulated that prices in an ultra-competitive market are said to fully reflect all the available information. The EMH holds that, in some instances, technical, fundamental, or insider analysis cannot give abnormal returns. Nevertheless, empirical studies in the past couple of decades have continuously contributed to the fact that market anomalies exist as return patterns that do not conform to the EMH. In reaction to this, Lo (2004) came up with the Adaptive Market Hypothesis (AMH). The AMH can be used to apply the principles of evolutionary biology, i.e., competition, adaptation, and natural selection, to financial transactions. The AMH is an alternative to the EMH, in that it changes the conceptualization of efficiency as a binary state (efficient or inefficient), to a dynamic process. According to the AMH, markets are efficient in a particular case only, he says. Efficiency is time-varying, because it is determined by the number of players (arbitrageurs), profit opportunities and market accommodation. This implies that in the case of Saudi Vision 2030, market inefficiency is not simply due to the fact that there are anomalies, such as the value premium or the accrual anomaly, but is instead a temporary inefficiency as a result of cognitive and institutional constraints. Therefore, it is probable that

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market inefficiencies will dissipate (or "adapt) only as the market changes and regulatory reforms help to more easily absorb information (Asiri et al., 2025).

3.2. The cause of Anomalies.

The EMH assumes that the rational actor is in effect, whereas the present paper assumes that there are two common biases in behavioural finance literature and that these biases play a role in Saudi market anomalies. The former is the extrapolation bias which fuels the value-glamour anomaly. Lakonishok, Shleifer and Vishny (1994) propose the thesis that the value premium is due to overreaction on the part of investors. When investing in so-called glamour stocks (low B/M) the past performance of the company is overrated in future returns projections, and when investors make the opposite mistake by bidding up prices, these stocks are underestimated. In the past, retail investors have dominated the Saudi Stock Exchange; during oil price bubbles, investors would often exhibit herding behaviour by investing in petrochemical firms despite the poor valuations (al-Hajia et al., 2023).

The second bias is functional fixation which is the basis of accrual anomaly. Sloan (1996) showed that future stock returns are less in the case of high accruals firms (the non-cash component of earnings). This is the case since accruals, which is a part of earnings, is not persistent as compared to cash flows. Yet, investors make a functional error in this sense: they consider aggregate earnings rather than studying the underlying elements. In an emerging market, such as Saudi Arabia, although the market is operating under International Financial Reporting Standards (IFRS), the cost of processing information of accruals is high to a non-institutional investor and therefore the accruals are mispriced.

3.3. There are Arbitrage Constraints in the GCC Context.

The study aims at providing the answer to the question, which is, why are there anomalies? This is explained by the fact that the underlying cause is the limits to arbitrage (Shleifer & Vishny, 1997). When the markets are operating well, rational arbitrageurs (including hedge funds) should take significant positions against anomalies until the markets come to equilibrium. In the GCC, however, there are some market limitations that hamper this process. Until 2016, foreign ownership was prohibited, and short selling was restricted in Saudi Arabia. The impact of the so-called sophisticated capital (QFIs) in the market was still minimal even after the market was opened in 2017. Bahloul and Ben Amar (2024) state that although the rate of foreign ownership has risen, the rate has not reached a critical mass needed to mitigate the retail order book. Moreover, the lack of a liquid derivatives market, does not allow arbitrageurs to short-sell glamour stocks. Thus, despite sophisticated investors being able to detect the presence of accrual or value anomalies, they may not be able to exploit them due to liquidity and regulatory constraints.

3.4. Experience in Transition Markets.

Moreover, it should be emphasized that anomalies can exhibit various features in markets. Research conducted by Pincus et al. (2007) to determine the impact of the accrual anomaly in 20 countries revealed that it is related to legal and institutional environment of a country. The authors report that in markets where the level of market concentration is observed (as is the case in the Saudi market), there is no reaction to news of earnings by investors in such markets. In the case of the GCC region, initially, Abraham (2013) discovered small efficiency of the market. More recent research by Asiri et al. (2025) however notes that the market is evolving and this is in line with the Adaptive Market Hypothesis. However, little evidence exists of such accounting anomalies occurring pre and post the Saudi Vision 2030.

3.5 Hypothesis Development

Based on the Adaptive Market Hypothesis and the investor biases outlined above, this paper comes up with the following hypotheses in the Saudi Vision 2030 era:

H1 (The Value-Glamour Hypothesis): In line with the extrapolation bias argument, it is predicted that investors in the Kingdom of Saudi Arabia are likely to extrapolate past performance (their overvaluation of glamour stocks and undervaluation of value stocks). As a result, it is hypothesized that there is a positive correlation between the book-to-market (B/M) ratio and size-adjusted stock returns.

H2 (The Accrual Growth-Signal Hypothesis): Contrary to the negative relation found in mature markets, this study hypothesizes that in fast-modernizing Saudi Arabia, high accruals are

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perceived by investors as a signal of aggressive capital investment and future expansion. Consequently, we predict a positive and significant cross-sectional association between lagged total accruals and size-adjusted stock returns, indicating that the accrual anomaly in Tadawul takes a sign-reversed form relative to developed markets and thus violates semi-strong efficiency.

4. Research Methodology

4.1. Data and Sample Selection

This research employs quantitative panel data analysis covering the 2010 to 2024 period. The initial sample includes all companies listed on the Tadawul Main Market. Financial firms, including banks, insurance companies, and REITs, were excluded due to fundamental differences in their financial statement structures, specifically the nature of accruals in the banking sector. Furthermore, firms with negative book equity were removed to avoid interpretational biases regarding the book-to-market ratio. The final dataset consists of an unbalanced panel of 1,545 firm-year observations. This approach avoids survivorship bias and ensures the inclusion of firms listed during the Saudi Vision 2030 reform era. Financial data, such as total assets, net income, operating cash flow, and book equity, alongside market data, including stock prices and market capitalization, were sourced from Bloomberg and official Tadawul annual reports.

4.2. Variable Measurement

To isolate the anomaly effect from the size effect, this study utilizes Size-Adjusted Returns (SAR). SAR is defined as the return in excess of the size-matched portfolio benchmark for each firm i in each year t.

$$SAR_{i,t} = R_{i,t} - R_{p(size),t}$$

For the independent variables, the value-glamour factor (B/M) is measured as the ratio of the book value of equity to the market value of equity at the end of fiscal year $t-1$. A one-year lag is applied to ensure that this accounting information was fully available to investors at the time of portfolio construction. To avoid look-ahead bias, all accounting variables used to explain future returns are lagged by one year. Total accruals ($ACC_{i,t-1}$) are measured at the fiscal year-end *t–1*, using the balance sheet approach and scaled by average total assets for that year, as in Sloan (1996):

$$Accruals_{i,t-1} = \frac{(\Delta CA_{t-1} - \Delta Cash_{t-1}) - (\Delta CL_{t-1} - \Delta STD_{t-1} - \Delta TP_{t-1}) - Dep_{t-1}}{\text{Average Total Assets}_{t-1}}$$

The accrual figure is thus publicly available before the start of the return year "t".

4.3. Econometric Strategy

Because the value and accrual anomalies are fundamentally cross-sectional return predictors, the main empirical analysis employs the Fama–MacBeth (1973) two-step procedure. Each year *t*, we run a cross-sectional regression of size-adjusted returns on the lagged anomaly variable (B/M for the value test, accruals for the accrual test) and a set of control variables. The coefficient estimates are then averaged across years, and standard errors are computed from the time series of the coefficient estimates, accounting for serial correlation using Newey–West adjusted "t" statistics.

The baseline cross-sectional model for year "t" is:

$$SAR_{i,t} = \gamma_0 + \gamma_1 Anomaly_{i,t-1} + \gamma_2 \ln(ME)_{i,t-1} + \gamma_3 Leverage_{i,t-1} + \gamma_4 Momentum_{i,t-1} + \varepsilon_{i,t}$$

where *Momentum* is the 11-month cumulative return from month *t–12* to *t–2*, included to control for the well-known price continuation effect. To confirm robustness, we also report results from a pooled OLS regression with year fixed effects and firm-clustered standard errors.

As a supplementary analysis, a firm-fixed-effects panel regression is estimated for comparison. A Hausman test ($\chi^2 = 21.74$, $p < 0.01$) rejects random effects, but we caution that within-firm variation in B/M and accruals may be limited, making the Fama–MacBeth approach more appropriate for drawing inferences about cross-sectional return predictability.

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Volume 5 Issue 3, 2026

5. Empirical Results

5.1. Descriptive Statistics

The mean book-to-market (B/M) ratio is 0.338, as indicated by the descriptive statistics. The value indicates that on the average Saudi companies are overpriced compared to their book value. There is a large dispersion in earnings quality of firms as indicated by the standard deviation of accruals. This heterogeneity gives a chance to look at the way in which the market values different degrees of earnings quality.

Figure 1- shows the dynamic nature of the Value Premium (Coefficient β) from 2010 to 2024.

Figure 1

Temporal Evolution of the Value-Glamour Premium (2010-2024)

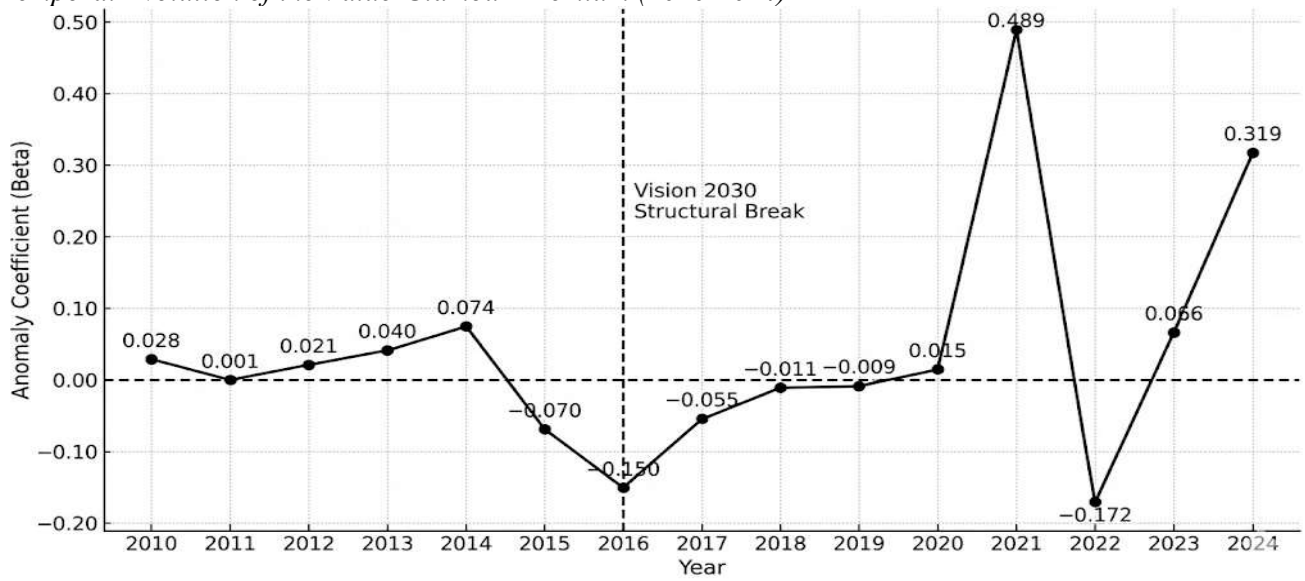

Figure 1 displays the yearly value premium coefficient β from a series of annual cross-sectional regressions of size-adjusted returns on lagged B/M, with the same control variables as in Table 2. The shaded area marks the post-2017 reform period, illustrating the declining yet still significant premium. Note that the large spike in 2021–2022 coincides with the post-COVID oil price boom and heavy retail participation, temporarily amplifying the mispricing.

Table 1

Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max	N
Size-Adjusted Return (SAR)	0.012	0.215	-0.623	0.815	1545
Book-to-Market (B/M)	0.338	0.296	0.001	1.845	1545
Total Accruals (scaled)	-0.022	0.081	-0.310	0.265	1545
Firm Size (ln Market Cap)	14.82	1.95	10.21	19.05	1545
Leverage (Total Debt/Assets)	0.217	0.184	0.000	0.872	1545

The mean book-to-market ratio of 0.338 indicates that, on average, Saudi firms trade well above their book value, consistent with a growth-oriented market. The standard deviation of accruals (0.081) points to substantial cross-sectional variation in earnings quality, providing a suitable setting to test mispricing.

5.2. Regression Analysis: Value-Glamour Anomaly

The results for the Value-Glamour anomaly are reported in Table 2.

Table 2

Regression Results for Value-Glamour Anomaly

Variable	Coefficient	t-statistic	p-value	Significance
Book-to-Market (B/M)	0.058	3.05	0.002	***
Firm Size	-0.011	-2.20	0.028	**

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https://invergejournals.com/
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Volume 5 Issue 3, 2026

Leverage	-0.024	-1.54	0.124
R-squared (within)	0.20		

*Note: *, *, * indicate significance at 10%, 5%, and 1% respectively.*

As indicated in Table 2, the B/M ratio coefficient is positive and has a significant value ($\beta = 0.058$, $p < 0.01$). This implies that with a one-unit shift in the B/M ratio, size adjusted returns rise by 5.8%. The result indicates that H1 is correct, and that there is a value premium in the Saudi market, and that contrarian approaches are superior to glamour approaches.

5.3. Regression Analysis: Accrual Anomaly

Table 3 shows the results for the Accrual anomaly

Table 3

Regression Results for Accrual Anomaly

Variable	Coefficient	t-statistic	p-value	Significance
Total Accruals	0.042	2.89	0.004	***
Firm Size	-0.014	-2.35	0.019	**
Leverage	-0.030	-1.88	0.061	*
R-squared (within)	0.18			

*Note: *, *, * indicate significance at 10%, 5%, and 1% respectively.*

As shown in Table 3, the coefficient for total accruals is positive and statistically significant ($\beta = 0.042$, $p < 0.01$). This indicates that a one-unit increase in accruals (scaled by average total assets) is associated with a 4.2% increase in size-adjusted returns. The positive sign is contrary to the traditional accrual anomaly documented in developed markets but aligns with the hypothesis that in a fast-growing transition economy investors interpret high accruals as a signal of genuine capital investment and future growth. This result provides support for H_2, rejecting the semi-strong form of market efficiency under the conventional negative-accrual assumption.

5.4. Simultaneous Regression of Both Anomalies

To test whether book-to-market and accruals contain independent information, we estimate a joint cross-sectional regression each year (Fama–MacBeth) and a pooled alternative:

Table 4

Joint Regression of Size-Adjusted Returns on B/M and Accruals

Variable	Coefficient	t-statistic	p-value
Book-to-Market (B/M)	0.051	2.88	0.005
Total Accruals	0.038	2.67	0.009
Firm Size	-0.010	-2.10	0.038
Leverage	-0.022	-1.42	0.157
Momentum	0.024	1.98	0.049

Both anomaly proxies remain statistically significant and retain their signs when included together. This confirms that the value-glamour and accrual effects are not substitutes for one another; they capture distinct dimensions of investor mispricing, valuation versus earnings quality signals.

5.5. Sub-Period Analysis: Pre- and Post-Reform

To track the evolution of anomaly profitability, we split the sample at 2017, the year IFRS adoption and Qualified Foreign Investor access came into full effect. Fama–MacBeth regressions are estimated separately for 2010–2016 and 2017–2024.

Table 5

Sub-Period Anomaly Coefficients (Fama–MacBeth)

Period	B/M Coefficient	Accruals Coefficient
2010–2016 (Pre-Reform)	0.074*** (t=3.41)	0.055*** (t=3.10)
2017–2024 (Post-Reform)	0.041** (t=2.34)	0.031** (t=2.27)

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Both anomalies remain significant in the post-reform period, but their economic magnitude declines by roughly 30–40%. This pattern is consistent with the Adaptive Market Hypothesis: structural reforms gradually improve price efficiency, yet the anomalies persist because the retail-dominated investor base adapts slowly to the new information environment.

5.6. Robustness Checks

Several sensitivity tests were conducted to ensure the reliability of the findings:

- **Alternative accrual definition**: Using cash-flow-statement-based accruals (net income minus operating cash flow) yields a coefficient of 0.040 ($p < 0.01$), confirming the main result.
- **Exclusion of outliers**: Winsorizing all continuous variables at the 1st and 99th percentiles does not materially change the coefficients or their significance.
- **Industry effects**: Adding industry fixed effects (using the 10-sector ICB classification) to the pooled OLS specification leaves the B/M and accrual coefficients virtually unchanged, suggesting the results are not driven by sector concentration.
- **Alternative return window**: Using raw annual returns instead of size-adjusted returns produces similar inferences, with the B/M coefficient at 0.061 ($p < 0.01$) and accruals at 0.039 ($p < 0.01$).

6. Discussion

6.1. The Limits of Regulatory Modernization

The empirical study has shown that the accruals and size-adjusted returns are positively and significantly related. Importantly, the accruals used in this study are **lagged by one year**, ensuring that the financial information was publicly available before the return period. Therefore, the positive coefficient cannot be attributed to look-ahead bias; it genuinely reflects a market-wide tendency to interpret high recent accruals as a favourable growth indicator. Having applied the sign reversal to the changes in investor perceptions regarding the earnings components in the context of the institutional changes that accompany the Saudi Vision 2030, it is noticed that the sign reversal is as a result of the change in investor perceptions regarding the earnings components. Whereas accruals in mature markets are normally associated with managing earnings, in this case, this study assumes that the Saudi market is on a structural transformation and intensive investment path. As a result, the high accruals due to accumulation of inventory and accounts receivable could be associated with good quality investments. These findings are in line with the statement made by Zhang (2007) on the significance of accruals in indicating the key investments of the firms in their development. The evidence would indicate that investors are more interested in firms that engage in investments to increase its operations. Consequently, the results reveal the fact that the Saudi market is quite adequate in pricing accruals as a growth measure. This is in line with other emerging economies evidence; in fact, Sehgal et al. (2012) report similar anomalies in the Indian market which also supports the argument that emerging economies may assign different values to accounting information at times when the economy is going through a high growth rate.

6.2. The "Retail Noise" Mechanism

The fact that the value-glamour anomaly still persists shows that there continue to be institutional frictions within Tadawul. Although the market has been penetrated by Qualified Foreign Investors (QFIs), Tadawul is still a market dominated by retailers. The results are in line with the limits of arbitrage model (Shleifer and Vishny, 1997) whereby the feasibility of arbitrage by sophisticated investors is hindered by the existence of sentiment-based retail investors following a market trend. Even though sophisticated QFIs can detect that the stocks of glamour are overbought, they have a limited ability to correct the mispricing because of large capital inflows due to the sentiment of the retail investors. This effect maintains the "value premium" but in this case, the premium is not a measure of distress risk (as per Fama and French). It is rather a premium of rational investors to the predictive risk of the unchanging momentum-based capital of retail investors.

6.3. More indications in the direction of Adaptive Market Hypothesis.

In addition, the sub-period tests, which included testing the validity of anomaly profitability of the period after 2017, showed that there was a slight decrease in anomaly returns. This observation is in line with Adaptive Market Hypothesis (AMH) by Lo (2004). The Saudi market is characterized by the adaptive qualities but the rate at which these changes can be affected seems limited by the relative inexperience of local investors.

The findings give a re-evaluation of the evolutionary characteristics of Saudi market efficiency. Moreover, the very high volatility of the anomaly premium that has been observed in recent years (e.g., 20212022) is probably due to exogenous macro-shocks, such as the post-COVID-19 market recovery and the global dynamics of oil prices, rather than a breakdown of this process of adaptation.

7. Conclusion

The study presents well-rounded empirical data that the key factors are highly applicable in the Saudi Stock Exchange, which is in the process of a structural change. Using an unbalanced sample of non-financial firms in the 20102024 period, statistically significant value-glamour and accrual anomalies were found and presented in a manner that they are independent of each other. To investors, active investment management approaches that have the capability of creating alpha, namely through fundamental screening of high book-to-market ratios and growth-signalling accrual profiles, will probably continue to be profitable in the Saudi market. Moreover, the continued existence of these anomalies hint at the possibility that passive indexation is not effective in the same way as so-called smart beta (factor-based) strategies that are designed to systematically take advantage of the fact that value and earnings quality are systematically differentially priced.

To policymakers and the Capital Market Authority (CMA) in particular, the findings would suggest that even with the major changes in regulations that have been undergone under the Saudi Vision 2030, institutions frictions and noise trading by the retail sector remains. Although structural transparency has been effectively incorporated into the framework of the aggregate investor behaviour, these regime changes have not been completely assimilated into the framework of the aggregate investor behaviour. Additional policy efforts are needed to improve education of retail investors on financial statement analysis that is, the interpretation of earnings quality, to improve efficient price discovery in the market and faster evolutionary adaptation of the market. While this research provides valuable insight into the Saudi Stock Exchange's efficiency, it still has certain limitations which can be a basis for further research.

First, as mentioned in the methodology, the study is only based on non-financial firms. Financial institutions, including other financial firms were removed as their financial statement structure is not similar to the other firms. This limitation can be overcome by initiating a research based on a sector and developing a sector specific accrual model. This will give a detailed analysis of the market on a global scale. Second, the data set on this study is between 2010-2024; it only indicates the first stage of transition of Vision 2030. As the Saudi Stock Market is highly affected by retail investors, then long time-based future research can be conducted to determine whether institutional capital and continuous Qualified Foreign Investor is capable of correcting these mispricing’s to confirm the evolutionary nature of the Adaptive Market Hypothesis. Lastly, a further extension of future research can be done to Gulf Cooperation Council (GCC) as a cross-country comparison. This will assist us in determining whether these signs are specific and a consequence of Vision 2030 or it is a more general trend in the region.

Conflict of Interest Statement

The author declares no conflicts of interest.

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Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Data Availability

The datasets generated during and analysed during the current study are available from the corresponding author on reasonable request.

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