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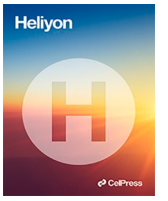

Can ETFs mitigate stock Co-movement? An analysis of an emerging market

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A B S T R A C T

This research paper aims to examine the impact of exchange-traded funds (ETFs) on stock movements in Iran, particularly during periods of stability and turbulence. The study utilizes a sample of 38 active funds listed on the Tehran Stock Exchange that invest in stocks, covering the period from 2015Q4 to 2023Q2. The GMM panel regression method is used to analyze the data. The results indicate that ETFs in Iran decrease co-movement during stable markets, but increase it during turbulent times. This may have significant implications for ETF investors and market regulators, as higher stock volatility reduces the diversification benefits that ETFs offer. Market regulators should be vigilant of elevated levels of stock co-movement during periods of turmoil, particularly in emerging economies where financial markets are more vulnerable.

1. Introduction

The necessity for a product that would enable individuals to trade a diversified portfolio of assets on the stock market was highlighted by the stock market crash of 1987, also known as Black Monday. The exchange-traded fund ( ) was the first product introduced for this purpose and is considered a significant innovation in modern financial markets [1–4]. The global assets of ETFs exceeded 7.74 trillion dollars at the end of 2020, and the number of ETFs listed on exchanges worldwide reached 7602 [5].

In an ETF, the shares trade on an exchange, and their prices fluctuate based on supply and demand. However, the value of the ETF is based on the value of the underlying securities it holds. The ETF issuer creates and redeems shares of the ETF in response to changes in demand. When there is high demand for the ETF shares, the issuer creates new shares by buying the underlying securities and issuing new shares to the Authorized Participants (APs) who then sell them on the exchange. Conversely, when there is low demand for the ETF shares, the issuer redeems shares by buying back the ETF shares from the APs and returning the underlying securities [6].

This structure creates an arbitrage opportunity because the ETF's share price may not always perfectly reflect the value of the underlying securities. When the ETF's share price trades at a premium to the worth of its underlying securities, an AP can purchase the underlying securities, swap them for ETF shares, and sell those shares on the exchange for a profit. Conversely, when the ETF's share price is lower than the value of its underlying securities, an AP can buy ETF shares on the exchange, redeem them for the underlying securities, and sell those securities for a profit. This arbitrage mechanism aids in maintaining the ETF's share price in tandem with the value of its underlying securities.

However, the process of arbitrage can have negative impacts on the stock co-movement. To carry out arbitrage, a participant in the market must exchange the entire group of underlying stocks as a single unit, and this can elevate the correlation of asset returns and greatly diminish the benefits of diversification offered by ETFs. This is because the arbitrage mechanism can cause the prices of the

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underlying securities to move in tandem with the ETF share price, rather than reflecting their individual fundamentals. As a result, the ETF structure can create a feedback loop where the ETF share price affects the underlying security prices, which in turn affects the ETF share price. This can lead to increased volatility and reduced diversification benefits [7,8].

Although ETFs have experienced swift expansion, studies on their effects on the stock market are still in the early phases of development [9,10]. Previous studies have demonstrated that ETFs can elevate stock market correlation and volatility [7,11–14]. However, certain scholars have suggested that the emergence of innovative and well-crafted ETFs may lead to a demand substitution effect, ultimately reducing the co-movement [15]. Consequently, this study aims to investigate how ETFs affect the interdependence among stock returns in the emerging Iranian market. The study also explores how ETFs behave during both market turbulence and stability, and the consequences that follow.

The investigation adds to the existing body of research on the economic implications of ETFs by scrutinizing their impact on the co-movement of Iranian stock returns, a topic that has not been explored previously. Moreover, this study enhances the scarce literature on how ETFs affect developing markets. The Tehran stock market differs in trading mechanisms, investor composition, and ETFs activity from developed financial markets, which may lead to notable variations in the effect of ETFs on market interdependence. The study takes into account endogeneity issues of liquidity variables and book-to-market ratio and employs the generalized method of moments (GMM) estimator to ensure consistent estimators. The study's findings have implications for market efficiency and can furnish valuable insights for policymakers and investors in emerging markets.

2. Review of literature

However, the phenomenon of stock co-movement has been studied in various studies such as Uddin et al. [16], Spelta et al. [17], Esmaeilpour Moghadam et al. [18], Gkillas et al. [19], and Gong and Dai [20], but research on the effect of ETFs on stock movements is limited. The swift expansion of ETFs has captured the interest of investors, regulators, and academics globally, leading to a surge in studies on their effects on the stock market. Although a few investigations have evaluated the effect of ETFs on the pricing efficiency of securities, research on the overall market-level consequences of ETF activity is still relatively new. Most of the existing studies have concentrated on ETF markets in the United States, providing a valuable context for the global interest in ETFs.

Previous studies conducted by Hasbrouck [21], Tse et al. [22], Fang and Sanger [23], and Xu and Yin [24] have shown evidence of the potential effects of ETF markets on the price performance of the underlying index and its price discovery process. Box et al. [25] investigated the transmission of shocks from ETFs to their portfolios based on a sample of 423 ETFs in the United States. Their findings indicated that there was no significant correlation between ETF transactions and asset prices. According to Malamud [15], the demand substitution effect from the introduction of new and improved ETFs may lead to a reduction in co-movement and volatility. This phenomenon has been witnessed in cases where ETFs were previously illiquid with substantial deviations from net asset value. With the emergence of new, highly liquid ETFs that have gained greater acceptance from investors, this trend may continue.

In Zhao et al.'s [26] study of China's stock market, it was found that ETF activity led to a reduction in stock-specific volatility but an increase in systemic fluctuations. Despite this, the overall volatility was reduced due to the greater reduction of specific volatility over the increase of systemic volatility. Nonetheless, Glosten et al. [27] contended that ETFs disseminate macroeconomic fundamental information to the stock market via arbitrage trades, resulting in a rise in market interdependence. Jhunjhunwala and Sethi's [28] research verified that the intensification of the ETFs' market interdependence effect occurs solely during turbulent market phases. Marta and Riva [29] found that ETFs increase the movement of their component stocks. Rhodes and Mason's [30] study confirmed the increasing synergy between ETFs and bonds.

Ben-David et al.'s [31] examination of non-fundamental shocks and arbitrage activities between ETFs and index stocks showed that ETFs cause shocks to be transmitted to their portfolio of securities, resulting in higher volatility for stocks belonging to ETFs. According to Israeli et al. [32], ETFs escalate transaction expenses and deteriorate market effectiveness, with a 1 % rise in ETF ownership resulting in a 9 % surge in return interdependence.

Staer and Sotille's [33] study investigated the relationship between ETF arbitrage and asset co-movement by introducing a new measure of relative liquidity. Their findings demonstrated that an increase in this criterion led to a rise in co-movement. Shim's [34] study confirmed this relationship and found it to be stronger in larger market capitalization stocks held by active ETFs. Da and Shive's [8] research revealed that ETFs generate a rise in return interdependence and diminish diversification advantages through persistent arbitrage actions, particularly for minor and illiquid stocks. Bhattacharya and O'Hara [35] found that ETFs promote information transmission in the market and herd movement. Harada and Okimoto's [36] research demonstrated that the Bank of Japan's procurement of stocks using ETFs had a notable impact on stock prices. These studies underscore the need for further research to gain a comprehensive understanding of the impact of ETFs, particularly in emerging market economies like Iran. Thus, our investigation seeks to bridge this research gap by exploring how ETFs affect stock movements in the Tehran Stock Exchange, which has not been previously analyzed. The Tehran Stock Exchange differs from mature capital markets in terms of trading systems, investor structure, and ETF activity, which may result in a significant difference in the effect of ETF activity on market fluctuations. Furthermore, this study accounts for the endogeneity of liquidity variables and book-to-market ratio and employs the GMM estimator to ensure consistent estimators, thus overcoming the limitations of previous studies. The implications of this study's findings for market efficiency can provide valuable insights for policymakers and investors in emerging markets.

3. Research methodology

3.1. Variables construction

This research investigates the impact of ETFs that invest in stocks within the Tehran Stock Exchange. The study considers two variables related to ETFs: ETF ownership and ETF flows. The ownership of ETFs can be defined as the percentage of a company's total market value that is held by all ETFs, which can be expressed mathematically as equation (1):

$$\text{Ownership}_{it} = \frac{\sum_{n=1}^{N} Holds_{i.j.t}}{MCap_{i.t}} \tag{1}$$

In this context, *Holds* refers to the overall worth of the investments held by the j-th ETF, while *MCap* denotes the market value. The symbols 'i' and 't' represent the stock and time period, respectively. A higher percentage of ETF ownership indicates that the ETF has a greater investment in that particular stock, which can potentially impact stock movements [7].

The level of ETF trading and arbitrage intensity can be estimated by examining the changes in ETF ownership over a specific period, which is represented by the ETF flow metric. This metric offers valuable information about the level of trading activity and arbitrage opportunities in ETFs. It is calculated by measuring the variation in ETF ownership, represented by equation (2):

$$Flow_{it} = abs(\text{Ownership}_{it} - \text{Ownership}_{it-1}) \tag{2}$$

ETF portfolio composition can be altered by changes in ETF flows, which have the potential to impact both individual stock prices and market movements [27].

The co-movement of stock returns can be assessed using various variables such as stock beta, Sratio, and Sync. Stock beta is estimated using the capital asset pricing model, which is sourced from the Rahavard Novin database. Sratio is calculated by dividing the total variance of the stock return by its specific variance and reflects the share of systematic (market) risk and specific risk in the total stock risk. This measure is used to understand the degree of stock co-movement and exposure to systematic risk, with a higher value indicating a greater degree of co-movement with the market. Conversely, a lower value indicates a lower degree of co-movement with the market, with specific risk playing a more significant role in total stock risk [8,28]. Lastly, the Sync metric is employed to illustrate the degree to which variations in returns of stock are explained by returns of market. The Sync measure, denoted as equation (3), is computed by using the adjusted R_{it}^2 obtained from the regression of stock returns on market returns.

$$\text{Sync}_{it} = log\left(\frac{R_{it}^2}{1 - R_{it}^2}\right) \tag{3}$$

3.2. Model

To assess the influence of ETFs on the interdependence of securities returns, the study utilizes the following regression models, represented by equations (4) and (5):

$$\text{Comovement}_{it} = C + \beta_1 \text{Ownership}_{it-1} + \beta_2 Size_{it-1} + \beta_3 Bm_{it-1} + \beta_4 Vot_{it-1} + \beta_5 Tover_{it-1} + \beta_6 Illiq_{it-1} + \varepsilon_{it} \tag{4}$$

$$\text{Comovement}_{it} = C + \beta_1 Flow_{it-1} + \beta_2 Size_{it-1} + \beta_3 Bm_{it-1} + \beta_4 Vot_{it-1} + \beta_5 Tover_{it-1} + \beta_6 Illiq_{it-1} + \varepsilon_{it} \tag{5}$$

Several control variables are included in the regression to evaluate the effect of ETFs on the interdependence of securities returns, namely *Size* (natural log of market value of shares), *Bm* (book-to-market ratio of stocks), *Vot* (stock volatility calculated as the standard deviation of stock returns), *Tover* (stock turnover), and *Illiq* (effect of illiquidity). To account for the impact of stock illiquidity, the study calculates Amihud's [37] illiquidity variable as the ratio of return to stock trading volume and included it as a control variable in the model. Additionally, the study calculates the turbulence index variable (*high_TSE*) based on the study of Dana and Pozdnyakova [38], using the fluctuations of the total index of the Tehran stock market. A value of one is assigned if the index fluctuation in a given period exceeded the highest quartile, and zero is assigned otherwise. The interactive term of ETF variables and the disturbance index is then added to the regression models to assess the effect of ETFs on the interdependence of securities returns. The resulting equations are labeled as (6) and (7):

$$\text{Comovement}_{it} = C + \beta_1 \text{Ownership}_{it-1} + \beta_2 \text{Ownership}_{it-1} * high\_TSE + \beta_3 Size_{it-1} + \beta_4 Bm_{it-1} + \beta_5 Vot_{it-1} + \beta_6 Tover_{it-1} + \beta_7 Illiq_{it-1} + \varepsilon_{it} \tag{6}$$

$$\text{Comovement}_{it} = C + \beta_1 Flow_{it-1} + \beta_2 Flow_{it-1} * high\_TSE + \beta_3 Size_{it-1} + \beta_4 Bm_{it-1} + \beta_5 Vot_{it-1} + \beta_6 Tover_{it-1} + \beta_7 Illiq_{it-1} + \varepsilon_{it} \tag{7}$$

The study uses the interactive term of ETF variables and turbulence index to assess the influence of ETFs on the interdependence of stock returns during periods of high volatility. On the other hand, ETF-related variables excluding the interaction effect, are utilized to evaluate the impact of ETFs in stable market phases. The data in this study is in panel form, and the literature on panel data analysis highlights potential issues caused by endogeneity, particularly for variables such as liquidity, size, and book-to-market ratio of stocks. To address this issue, the study employs the GMM estimator method. Inaccurate and inconsistent estimates can result from endogeneity bias, leading to incorrect theoretical interpretations and conclusions, and even wrong coefficient signs [39,40]. Endogeneity bias can

arise from various sources, but there are several techniques available to address it. For instance, the GMM model is suitable for panel data with dynamic endogeneity bias, while two-stage least squares (2SLS) and three-stage least squares (3SLS) are typically used for survey data. The GMM model, developed by Arellano and Bond [41] and Blundell and Bond [42], is a powerful tool for dynamic panel data, where the cause and effect relationship for underlying phenomena tends to change over time. Wintoki et al. [43] asserted that the GMM model is a reliable approach to address different sources of endogeneity such as unobserved heterogeneity, simultaneity, and dynamic endogeneity. By internally transforming the data through a statistical process that subtracts the present value of a variable from its past value, the GMM model diminishes endogeneity [44]. This transformation leads to a reduction in the number of observations, thereby enhancing the efficiency of the GMM model [45].

3.3. Data description

The number of stock-based ETFs available on the Tehran Stock Exchange has increased significantly from three in 2013 to 49 in 2023. Despite their presence since 2013, ETFs had a negligible impact until 2015Q4 due to their small assets. This study focuses on a sample of 38 ETFs due to data limitations. The study period spans from 2015Q4 to 2023Q2, during which only 304 out of 350 traded stocks held by ETFs were suitable for the study. The exclusion of stocks was due to extended suspension periods of 46 stocks during the study period. Portfolio reports of ETFs have been published on a monthly basis since the fourth quarter of 2017. This research used information from the final month of each quarter. Earlier reports were based on interim financial statements, which included one month of the subsequent quarter. However, these changes in reporting were insignificant, as the portfolio of ETFs did not undergo any substantial alterations. Data sources include Financial Information Processing of Iran[1], Rahavard Novin software, and Codal database[2]. The data related to ETFs portfolios were extracted from the Codal database, while the data related to stocks were extracted from Rahavard Novin software. Table 1 shows the descriptive statistics of the variables. The results indicate that the average β value of 1.175 shows higher volatility of the sample stocks when compared to the market's average. The sample companies are, on average, owned by ETFs at a rate of approximately one-third of the market value, with an average *Ownership* of 0.341. The *Size*, determined using the natural log of share market value, averages at 9.311. The *Bm* averages at 0.486, which means that the sample companies are not significantly undervalued concerning their book values. Additionally, the *Illiq* average value is 0.007, indicating that the liquidity of the sample stocks is not a significant issue.

4. Findings and discussion

Table 2 presents the correlation coefficients between the variables. Specifically, Ownership exhibits a significant negative correlation with β, *Sratio*, and Sync, while *Size* shows a significant negative correlation with the same three variables as well. *Illiq* is also significantly negatively correlated with *Size* and Ownership. Table 3 displays the results of the multicollinearity analyses, which were conducted using the variance inflation factor (VIF). The VIF was used to assess whether multicollinearity was a concern among the variables. The analysis reveals no evidence of multicollinearity issues among the variables, as indicated by the VIF values.

Tables 4–7 present the analysis of the GMM estimator-based regression results for the studied regressions. The dependent variables are beta in panel A, Sratio in panel B, and Sync in panel C. The non-significant results of the AR(2) and Hansen's tests indicate that the estimation results of the models are unbiased and consistent. The regression results presented in Table 4 investigate the effect of ETF ownership on metrics of co-movement in stock returns. The findings suggest that ETF ownership decreases the return co-movement in all three panels, leading to lower stock co-movement with higher ETF coverage. This supports Malamud's [15] demand substitution effect. Improved market structure and quality in Iran's ETF market have resulted in negative coefficients, which may be attributed to the demand substitution hypothesis instead of the previous situation of low transparency, high transaction costs, and lack of liquidity.

According to the demand substitution effect hypothesis, the introduction of ETFs may result in a reduction in the demand for individual stocks. This is because ETFs provide a convenient and cost-effective way for investors to gain exposure to a diversified portfolio of securities, thereby decreasing the need to hold individual stocks. This decline in demand for individual stocks could lead to lower stock prices and reduced stock co-movement. The hypothesis posits that the demand for ETFs substitutes for the demand for individual stocks, leading to a decrease in stock co-movement. ETFs are traded on exchanges like stocks and can be bought and sold throughout the trading day, making them more liquid than many individual stocks. In addition, ETFs usually have lower transaction costs than purchasing individual stocks, making them more cost-effective for investors.

The regression analysis results of the ETF flow variable on return co-movement criteria are presented in Table 5. The findings reveal that the ETF flow does not alter on the co-movement of stock returns in the three panels. The ETF flow variable measures the net inflow or outflow of funds into ETFs, and it is an indicator of the demand for ETFs. As such, it can be used as a proxy for investor sentiment towards the stock market. By examining the relationship between the ETF flow variable and stock returns, one can gain insights into how changes in investor sentiment affect the stock market. However, the results from the study mentioned earlier suggest that changes in investor sentiment, as reflected by the ETF flow variable, do not have a significant impact on the co-movement of stock returns. It is possible that other factors, such as macroeconomic events or company-specific news, exert a more significant influence on stock returns.

The study examines how ETFs impact the co-movement of stock returns under varying market conditions, particularly during

[1] www.fipiran.com.
[2] www.codal.ir.

Table 1
Descriptive statistics of the variables.

	β	*Sratio*	Sync	Ownership	*Flow*	Size	Bm	Illiq	Vot	Tover (X10)
Mean	1.175	1.634	0.301	0.341	0.063	9.311	0.486	0.007	0.134	0.014
Median	1.323	1.859	0.329	0.030	0.009	9.320	0.232	0.001	0.101	0.003
Maximum	3.121	5.045	0.904	0.459	0.077	16.124	2.064	5.089	0.489	0.231
Minimum	0.094	0.107	−0.817	0.010	0.001	7.876	0.006	0.000	0.004	0.000
Std. Dev.	0.488	0.804	0.503	0.480	0.141	1.526	0.312	0.093	0.076	0.006
Obs.	9424	9424	9424	9424	9424	9424	9424	9424	9424	9424

Table 2
Correlation analyses.

Variables	β	*Sratio*	Sync	Ownership	*Flow*	*Size*	*Bm*	*Illiq*	*Vot*	*Tover*
β	1.000									
Sratio	0.435***	1.000								
Sync	0.332***	0.045	1.000							
Ownership	−0.305**	−0.353**	−0.425**	1.000						
Flow	0.086	0.078	0.098	0.860***	1.000					
Size	−0.284***	−0.334**	−0.339***	0.798***	0.674**	1.000				
Bm	−0.104**	−0.136**	0.098***	0.045	0.378	−0.102**	1.000			
Illiq	0.081**	0.054	0.031	−0.523**	0.354	−0.639***	0.477	1.000		
Vot	−0.142***	−0.235**	−0.116**	−0.552**	−0.314	−0.744**	0.633	0.535	1.000	
Tover	0.121**	0.563	0.332	0.364**	0.242	0.690**	0.586	0.502	0.321**	1.000

The notations *** and ** indicate statistical significance at the 1 % and 5 % level, respectively.

Table 3
Multicollinearity analyses.

	Ownership	*Flow*	*Size*	*Bm*	*Illiq*	*Vot*	*Tover*
Variance Inflation Factors (VIF)	1.654	–	2.142	1.365	1.558	2.345	1.245
	–	1.009	2.810	2.866	1.031	2.101	1.063

The initial and second rows contain results for the multicollinearity test in regressions involving *Ownership* and *Flow* variables, respectively.

Table 4
Results of the estimation based on the ownership variable.

Variables	Panel A: β		Panel B: *Sratio*		Panel C: Sync	
	Coeff.	t-Ratio	Coeff.	t-Ratio	Coeff.	t-Ratio
C	0.471***	10.355	0.023***	19.201	−5.045***	−6.18
Ownership	−0.091***	−2.691	−0.116***	−2.861	−0.152***	−4.010
Size	−0.079**	−2.340	−0.128***	−5.320	−0.175***	−6.292
Bm	0.052**-	−2.122	−0.112**	−2.132	−0.077**	−2.381
Illiq	−0.007	−1.321	0.043	1.353	0.015	1.377
Vot	0.131***	3.442	0.139***	2.523	0.142***	3.807
Tover	0.031	1.124	0.042	1.032	−0.023	−0.876
AR(2) test (p-value)	0.917		0.524		0.721	
Hansen test (p-value)	0.137		0.144		0.187	

The panel model's estimation results were obtained from Equation (4). The notations *** and ** indicate statistical significance at the 1 % and 5 % level, respectively.

turbulent times. Table 6 shows the regression analysis findings of the ETF ownership variable on the co-movement measures of returns in both stable and turbulent market conditions. The findings indicate that the ETF ownership variable has a negative effect on the co-movement of stock returns only during market stability. Furthermore, the coefficients of the interaction term between ETF ownership and *high_TSE* are significant and positive, suggesting that ETFs elevate the interdependence of stocks during periods of market turmoil.

One possible explanation for the increased stock co-movement during turbulent market conditions due to ETFs is that they can create herding behavior among investors. When the market experiences a downturn, investors may become more risk-averse and look to quickly exit their positions. ETFs, which offer instant liquidity, can be an appealing option for such investors, leading to a large number of investors simultaneously selling their ETF shares. This results in downward pressure on the prices of the underlying assets held by the ETF. The structure of ETFs can also contribute to increased market volatility during times of turbulence. Although ETFs usually hold a diversified portfolio of assets, they trade throughout the day like individual stocks. This trading activity of ETF shares

Table 5
Results of the estimation based on the flow variable.

Variables	Panel A: β		Panel B: *Sratio*		Panel C: Sync	
	Coeff.	t-Ratio	Coeff.	t-Ratio	Coeff.	t-Ratio
C	−0.112***	−3.365	−0.153***	−3.321	−5.045***	−6.108
Flow	−0.010	−0.882	−0.006	−0.861	−0.066	−0.712
Size	−0.085**	−2.342	−0.363***	−3.321	−0.231***	−5.281
Bm	−0.012	−0.732	−0.105***	−2.859	−0.077**	−2.378
Illiq	−0.021	−1.493	−0.010	−0.689	0.058	1.425
Vot	0.124***	5.326	0.128**	2.318	0.119***	2.786
Tover	−0.021	−0.982	0.014	1.087	−0.017	−0.658
AR(2) test (p-value)	0.608		0.593		0.897	
Hansen test (p-value)	0.128		0.147		0.192	

The panel model's estimation results were obtained from Equation (5). The notations *** and ** indicate statistical significance at the 1 % and 5 % level, respectively.

Table 6
The impact of ETF ownership on return co-movement during market turmoil.

Variables	Panel A: β		Panel B: *Sratio*		Panel C: Sync	
	Coeff.	t-Ratio	Coeff.	t-Ratio	Coeff.	t-Ratio
C	−0.968***	−2.315	0.830***	2.291	0.506***	4.153
Ownership	−0.114**	−2.345	−0.198***	−2.816	−0.134***	−3.652
Ownership* *high_TSE*	0.156***	2.689	1.731***	2.903	0.048***	4.107
Size	0.090	1.291	−0.103**	−2.310	−0.214***	−3.109
Bm	−0.034	−0.354	−0.102***	−2.974	−0.063***	−2.763
Illiq	−0.012	−0.674	0.020	1.405	0.023**	2.342
Vot	0.287***	5.962	0.138***	3.132	0.132***	3.918
Tover	−0.052	−1.186	0.021	0.874	−0.061	−0.891
AR(2) test (p-value)	0.610		0.592		0.698	
Hansen test (p-value)	0.112		0.172		0.151	

The panel model's estimation results were obtained from Equation (6). The notations *** and ** indicate statistical significance at the 1 % and 5 % level, respectively.

Table 7
The impact of ETF flow on return co-movement during market turmoil.

Variables	Panel A: β		Panel B: *Sratio*		Panel C: Sync	
	Coeff.	t-Ratio	Coeff.	t-Ratio	Coeff.	t-Ratio
C	−0.071***	−7.328	−0.310***	−5.321	−0.689***	−7.112
Flow	−0.016	−1.086	−0.017	−1.134	−0.012	−0.897
Flow high_TSE*	0.035	0.659	0.624***	4.875	0.046	0.879
Size	−0.106	−1.458	−0.213***	−3.227	−0.245***	−4.687
Bm	−0.016	−0.532	−0.110***	−2.935	−0.059**	−2.291
Illiq	−0.008	−0.654	0.016	1.187	0.017	1.537
Vot	0.236***	6.478	0.124**	2.246	0.194***	2.872
Tover	−0.028	−1.364	0.029	0.937	−0.029	−0.876
AR(2) test (p-value)	0.689		0.648		0.876	
Hansen test (p-value)	0.178		0.125		0.165	

The panel model's estimation results were obtained from Equation (7). The notations *** and ** indicate statistical significance at the 1 % and 5 % level, respectively.

can influence the prices of the underlying assets, and vice versa, creating a feedback loop that amplifies market volatility, particularly during times of stress. Moreover, ETFs can create a crowding effect in the market, where numerous investors hold similar positions in the same assets or sectors through ETFs. During times of market turbulence, this crowding effect can further intensify the impact of market movements on the underlying assets, leading to increased co-movement among stocks.

Table 7 provides the regression analysis results of the ETF flow variable on the return co-movement criteria in both stable and turbulent market conditions. The findings demonstrate that the ETF flow variable does not significantly impact stock co-movement when the markets are stable. However, the interaction term coefficients of ETF flow and *high_TSE* are positive and significant, suggesting that ETFs increase stock co-movement during times of market turmoil. The study's results indicate that non-fundamental shocks resulting from ETF arbitrage activities offset the positive effects of the demand substitution hypothesis during times of market turbulence. ETF arbitrage activities can result in non-fundamental shocks that affect overall market performance. Such shocks may arise due to market distortions resulting from the creation and redemption of ETF shares. During this process, APs may buy or sell a

basket of underlying assets that reflect the ETF's holdings in exchange for new shares or cash. If the ETF's net asset value (NAV) significantly differs from the prices of the underlying assets, APs may engage in arbitrage activities to profit from the price differential. For instance, if the ETF's NAV is higher than the prices of the underlying assets, APs may purchase the underlying assets and exchange them for ETF shares, leading to increased demand for the underlying assets and a subsequent increase in their prices. Conversely, if the ETF's NAV is lower than the prices of the underlying assets, APs may sell the underlying assets and redeem ETF shares, leading to decreased demand for the underlying assets and a subsequent decrease in their prices. These arbitrage activities can cause temporary price distortions in the underlying assets, leading to non-fundamental shocks that impact overall market performance. Additionally, the creation and redemption process may require the purchase or sale of large quantities of underlying assets, leading to market imbalances and price volatility. These results align with the previous investigations by Da and Shive [8] and Jhunjhunwala and Sethi [28].

5. Conclusion

The proliferation and growth of ETFs as a financial innovation have been remarkable, and it is essential to comprehend their unintended impacts on financial components and markets. The objective of this research is to determine the influence of ETFs on the co-movement of stock returns in Iran's emerging market. The research applies two indicators of ETF, flow and ownership, along with three metrics of beta, Sratio, and Sync to gauge stock interdependence. The study's regression analysis, based on the GMM estimator method, demonstrates that ETFs have varying effects on stock co-movement, Contingent upon market circumstances. During stable market phases, ETFs tend to reduce stock co-movement, while during turbulent periods, the opposite effect is observed. The study's results are trustworthy, as they have undergone rigorous testing, including the use of different criteria and specification conditions. The study's robustness checks confirm the reliability of the findings, providing confidence in the validity and accuracy of the results.

This study supports the demand substitution hypothesis of Malamud [15], which proposes that the introduction of newer and better-designed ETFs could replace the demand for poorly designed funds and impact co-movements in the stock market. In Iran's ETF market, newer funds with high liquidity have gained popularity, leading to a transitional phase in the market. However, during periods of high volatility when mispricing is common, stronger non-fundamental shocks caused by ETFs can overcome the positive demand-substitution forces and increase stock co-movement.

This study's findings have significant implications for investors who use ETFs to diversify their portfolios at a lower cost. Market regulators should be vigilant of elevated levels of stock co-movement during periods of turmoil, particularly in emerging economies where financial markets are more vulnerable. These issues are relevant from a policy-making perspective. The study's results emphasize the importance of monitoring the impact of ETFs during market turbulence and taking appropriate measures to mitigate any potential negative consequences. These findings are noteworthy for investors, policymakers, and market regulators, providing valuable insights into ETF performance in emerging markets. While the study provides valuable insights into the impact of ETFs on stock co-movement in the Iranian emerging market, there are several limitations that should be addressed in future research to provide a more comprehensive understanding of this complex relationship. The study's focus on the Iranian market may limit the generalizability of the findings to other emerging markets or contexts. To address this limitation, future research could examine the impact of ETFs on stock co-movement in other emerging markets or across different types of ETFs such as sector ETFs, international ETFs, smart beta ETFs, and leveraged ETFs.

Data availability statement

The data on ETFs portfolios was retrieved from the Codal website and the data on stocks was obtained from Rahavard Novin software.

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CRediT authorship contribution statement

Hadi Esmaeilpour Moghadam: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Validation, Visualization, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

[1] S. Huang, M. O'-Hara, Z. Zhong, Innovation and informed trading: evidence from industry ETFs, Rev. Financ. Stud. 34 (3) (2021) 1280–1316, https://doi.org/10.1093/rfs/hhaa077.

[2] S. Bhojraj, P. Mohanram, S. Zhang, Etfs and information transfer across firms, J. Account. Econ. 70 (2020) 2–3, https://doi.org/10.1016/j.jacceco.2020.101336.
[3] K. Zawadzki, The performance of etfs on developed and emerging markets with consideration of regional diversity, Quantitative Finance and Economics 4 (3) (2020) 515–525, https://doi.org/10.3934/qfe.2020024.
[4] M. Lettau, A. Madhavan, Exchange-traded funds 101 for economists, J. Econ. Perspect. 32 (2018) 135–153, https://doi.org/10.1257/jep.32.1.135.
[5] ETFGI, ETFGI Report 2020, 2020 available at: https://etfgi.com/news/press-releases/2021/01/etfgireports-assets-invested-etfs-and-etps-listed-globally-reach-new.
[6] R.S. Antoniewicz, J. Heinrichs, Understanding exchange-traded funds: how ETFs work, ICI Research Perspective 20 (2014) 11–13, https://doi.org/10.2139/ssrn.2523540.
[7] I. Ben-David, F. Franzoni, R. Moussawi, Do ETFs increase volatility? J. Finance 73 (6) (2018) 2471–2535, https://doi.org/10.1111/jofi.12727.
[8] Z. Da, S. Shive, Exchange traded funds and asset return correlations, Eur. Financ. Manag. 24 (2018) 136–168, https://doi.org/10.1111/eufm.12137.
[9] L.J. Liebi, The effect of ETFs on financial markets: a literature review, Financ. Mark. Portfolio Manag. 34 (2) (2020) 165–178, https://doi.org/10.1007/s11408-020-00349-1.
[10] S. Nallareddy, Discussion of ETFs and information transfer across firms, J. Account. Econ. 70 (2020), 101358, https://doi.org/10.1016/j.jacceco.2020.101358.
[11] C.-C. Lin, M.-H. Chiang, Volatility effect of etfs on the constituents of the underlying taiwan 50 index, Appl. Financ. Econ. 15 (18) (2005) 1315–1322, https://doi.org/10.1080/09603100500389630.
[12] J. Chen, C. Huang, An analysis of the spillover effects of exchange-traded funds, Appl. Econ. 42 (2010) 1155–1168, https://doi.org/10.1080/00036840701721182.
[13] J.-H. Chen, The spillover and leverage effects of ethical exchange traded fund, Appl. Econ. Lett. 18 (2011) 983–987, https://doi.org/10.1080/13504851.2010.520663.
[14] R.J. Curcio, R.I. Anderson, H. Guirguis, Stock price volatility of banks and other financials emanating from the inception ofLeveraged, inverse, and traditional ETFs, The Journal of Index Investing 5 (1) (2014) 12–31.
[15] S. Malamud, A dynamic equilibrium model of ETFs, SSRN Electron. J. (2015), https://doi.org/10.2139/ssrn.2662433.
[16] M. Uddin, A. Chowdhury, K. Anderson, K. Chaudhuri, The effect of COVID–19 pandemic on global stock market volatility: can economic strength help to manage the uncertainty? J. Bus. Res. 128 (2021) 31–44, https://doi.org/10.1016/j.jbusres.2021.01.061.
[17] A. Spelta, A. Flori, N. Pecora, F. Pammolli, Financial crises: uncovering self-organized patterns and predicting stock markets instability, J. Bus. Res. 129 (2021) 736–756, https://doi.org/10.1016/j.jbusres.2019.10.043.
[18] E. Esmaeilpour Moghadam, T. Mohammadi, M.F. Kashani, A. Shakeri, Complex networks analysis in Iran stock market: the application of centrality, Phys. Stat. Mech. Appl. 531 (2019), 121800, https://doi.org/10.1016/j.physa.2019.121800.
[19] K. Gkillas, A. Tsagkanos, D.I. Vortelinos, Integration and risk contagion in financial crises: evidence from international stock markets, J. Bus. Res. 104 (2019) 350–365, https://doi.org/10.1016/j.jbusres.2019.07.031.
[20] P. Gong, J. Dai, Monetary policy, exchange rate fluctuation, and herding behavior in the stock market, J. Bus. Res. 76 (2017) 34–43, https://doi.org/10.1016/j.jbusres.2017.02.018.
[21] J. Hasbrouck, Intraday price formation in U.S. equity index markets, J. Finance 58 (2003) 2375–2399, https://doi.org/10.1046/j.1540-6261.2003.00609.x.
[22] Y. Tse, P. Bandyopadhyay, Y.-P. Shen, Intraday price discovery in the DJIA index markets, J. Bus. Finance Account. 33 (2006) 1572–1585, https://doi.org/10.1111/j.1468-5957.2006.00639.x.
[23] Y. Fang, G.C. Sanger, Index Price Discovery in the Cash Market, Working Paper, 2012. Retrieved from, http://ssrn.com/abstract=1926287.
[24] L. Xu, X. Yin, Does ETF trading affect the efficiency of the underlying index? Int. Rev. Financ. Anal. 51 (2017) 82–101, https://doi.org/10.1016/j.irfa.2017.02.009.
[25] T. Box, R. Davis, R. Evans, A. Lynch, Intraday arbitrage between ETFs and their underlying portfolios, J. Financ. Econ. 141 (3) (2021) 1078–1095, https://doi.org/10.1016/j.jfineco.2021.04.023.
[26] X. Zhao, G. Ran, B. Shen, X. Li, Does ETF activity reduce stock price volatility—evidence from the A-share market, Appl. Econ. 54 (52) (2022) 6036–6053, https://doi.org/10.1080/00036846.2022.2056129.
[27] L. Glosten, S. Nallareddy, Y. Zou, ETF activity and informational efficiency of underlying securities, Manag. Sci. 67 (2021) 22–47, https://doi.org/10.1287/mnsc.2019.3427.
[28] S. Jhunjhunwala, A. Sethi, Do ETFs affect the return co-movement of their underlying assets? Evidence from an emerging market, Manag. Finance 48 (2022) 1661–1686, https://doi.org/10.1108/MF-01-2022-0003.
[29] T. Marta, F. Riva, Do ETFs increase the comovements of their underlying assets? Evidence from a switch in ETF replication technique, Evidence from a Switch in ETF Replication Technique, in: Proceedings of the EUROFIDAI-ESSEC Paris December Finance Meeting 2022, Université Paris-Dauphine Research Paper, (4079302), 2022, https://doi.org/10.2139/ssrn.4079302.
[30] M.E. Rhodes, J.R. Mason, ETF ownership and firm-specific information in corporate bond returns, J. Financ. Mark. 63 (2023), 100772, https://doi.org/10.1016/j.finmar.2022.100772.
[31] I. Ben-David, F. Franzoni, R. Moussawi, Hedge fund stock trading in the financial crisis of 2007–2009, Rev. Financ. Stud. 25 (2012) 1–54, https://doi.org/10.1093/rfs/hhr114.
[32] D. Israeli, C.M.C. Lee, S.A. Sridharan, Is there a dark side to exchange traded funds? An information perspective, Rev. Account. Stud. 22 (2017) 1048–1083, https://doi.org/10.1007/s11142-017-9400-8.
[33] A. Staer, P. Sottile, Equivalent volume and comovement, Q. Rev. Econ. Finance 68 (2018) 143–157, https://doi.org/10.1016/j.qref.2017.11.001.
[34] J.J. Shim, Arbitrage Comovement, Available at: SSRN 3287912, 2020, https://doi.org/10.2139/ssrn.3287912.
[35] A. Bhattacharya, M. O'Hara, Can ETFs Increase Market Fragility? Effect of Information Linkages in ETF Markets, Available at: SSRN, 2018, https://doi.org/10.2139/ssrn.2740699.
[36] K. Harada, T. Okimoto, The BOJ's ETF purchases and its effects on Nikkei 225 stocks, Int. Rev. Financ. Anal. 77 (2021), 101826, https://doi.org/10.1016/j.irfa.2021.101826.
[37] Y. Amihud, Illiquidity and stock returns: cross-section and time-series effects, J. Financ. Mark. 5 (2002) 31–56, https://doi.org/10.1016/S1386-4181(01)00024-6.
[38] K. Dana, G. Pozdnyakova, Signal or Noise: the Effect of iShares Ownership on the Volatility of the Underlying Stocks during Market Turmoil, SSE Riga, Riga, 2020.
[39] M. Ketokivi, C.N. McIntosh, Addressing the endogeneity dilemma in operations management research: theoretical, empirical, and pragmatic considerations, J. Oper. Manag. 52 (2017) 1–14, https://doi.org/10.1016/j.jom.2017.05.001.
[40] S. Ullah, P. Akhtar, G. Zaefarian, Dealing with endogeneity bias: the generalized method of moments (GMM) for panel data, Ind. Market. Manag. 71 (2018) 69–78, https://doi.org/10.1016/j.indmarman.2017.11.010.
[41] M. Arellano, S. Bond, Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations, Rev. Econ. Stud. 58 (2) (1991) 277–297, https://doi.org/10.2307/2297968.
[42] R. Blundell, S. Bond, Initial conditions and moment restrictions in dynamic panel data models, J. Econom. 87 (1) (1998) 115–143, https://doi.org/10.1016/S0304-4076(98)00009-8.
[43] M.B. Wintoki, J.S. Linck, J.M. Netter, Endogeneity and the dynamics of internal corporate governance, J. Financ. Econ. 3 (105) (2012) 581–606, https://doi.org/10.1016/j.jfineco.2012.03.005.
[44] D. Roodman, How to do xtabond2: an introduction to difference and system GMM in Stata, STATA J. 9 (1) (2009) 86–136, https://doi.org/10.1177/1536867X0900900106.
[45] J.M. Wooldridge, Introductory Econometrics: A Modern Approach, Cengage Learning, Boston, 2012.