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UNRAVELING THE ASYMMETRIC DYNAMICS OF OIL PRICE SHOCKS AND MARKET VOLATILITY ON STOCK RETURNS: EVIDENCE FROM NARDL PANEL APPROACH

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ABSTRACT

This study investigates the asymmetric interaction between oil price shocks and stock returns and market volatility in a heterogeneous panel of economies using the Nonlinear Autoregressive Distributed Lag (NARDL) panel model. Though the relationship between oil prices, market volatility, and stock returns has been thoroughly studied, the asymmetric effects—the manner in which positive and negative shocks have impacted stock returns differently—are not so extensively studied. By exploiting high-frequency data for multiple markets, we distinguish the short- and long-horizon asymmetries in oil price shock and volatility transmissions to equity returns.

We find that positive shocks to oil prices have a stronger and longer-lasting impact on equity returns than negative shocks, highlighting the implicit market reaction asymmetry. Similarly, we observe that market volatility increases have a stronger negative effect on stock returns compared to decreases, indicating the existence of risk aversion and investor sentiment. The panel NARDL approach enables us to account for cross-sectional heterogeneity and time effects and thus derive strong evidence of asymmetric spillovers.

These results are of concern to policymakers, portfolio managers, and investors since they yield insights into the selection of risk management policy and policy formulation with regard to offsetting the adverse effect of oil price volatility and market uncertainty on financial markets.
Keywords: *Oil Price Shocks, Market Volatility, Liquidity Shocks, Stock Returns, NARDL, Risk Premiums, Global Financial*

1. INTRODUCTION

The financial crisis in 2007 created a feedback loop that made it difficult to sell an asset in a distressed state. Liquidity did not only tighten for the asset, but other similar assets also lost liquidity. Furthermore, the market itself became illiquid, as agents demanded more liquidity than it could handle (Mpofu, 2024). This led to a rapid decline in this feedback loop, which twisted the market by creating severely mispriced assets. The complexity of this loop led agents to dismiss it until it was almost unraveling a year later, and even then, the reconstruction of the event was not straightforward. Was there a liquidity shock? If so, what caused it? Was there volatility in the market? Did this create feedback loops? If so, how did they interact? These questions motivate the desire to study the intricate interactions between these three agents: volatility, liquidity, and assets (Haroon, 2024).

The background assets will be stocks, denoted {1, 2, 3 ... N}. Each stock has a liquid market and a certain number of agents marketing and trading stocks. There are also market makers who provide liquidity to the market for stocks. A group of investors is in the market heading to take their positions in the stocks and a group of short-term traders planning a high-frequency strategy to rebalance their portfolios. In this scenario, the impact of market volatility on liquidity shocks in addition, the higher order effect of both on stock returns needs to be studied (Zaidi, et al., 2021).

The main objective of this work is to develop a model that can be resolved analytically in the limit that successfully captures many of the intricacies of such a system. In this model, each stock has its own idiosyncratic volatility that is structured as a random walk. A liquidity shock is introduced as a sudden move in any of the stocks forcing it to trade at the last price. It is argued that traders interpret the price action as stochastic coincidence and thus infer a "liquidity shock" on the asset. It is shown that as such a liquidity shock propagates along the volatility of the asset itself, it is amenable via a simple differential equation.

Beginning in the 1980s and accelerating through the late 1990s, the research of U.S. financial markets experienced an explosion of activity and interest. Market volatility was studied on a number of levels, from theory to application, across many disciplines. Panel data of financial stocks from the U.S. was gathered and analyzed through the lens of the geometric Brownian motion model. The primary focus was on the volatility, drift, and unidentified shocks to these stocks over time. As a secondary focus, the relationship between these measures and the keys for the long-term growth of an observed sub-market was explored. Volatility has always been a concern to market participants (Aworunse et al., 2023).

However, it became magnified in the U.S. stock markets of the late 1980s through the late 1990s. Beginning with the October 1987 crash and subsequent market microstructure sensing recommendations, emphasis has turned toward better understanding the causes, implications, and management of excess volatility at the micro level, and has transitioned further into the analysis of macro drivers of volatility linked with random shocks. Macro drivers of volatility have taken on increased significance in trade and commerce, as dispersion in volatility shocks translates directly into variations in profitability in the marketplace (Rahim et al., 2021).

This concentration of interest has spurred many inquiries, from the purely theoretical and macro to explorations at the micro level of high-frequency market executions and odd lot trades. Models looking at volatility on all these fronts have proliferated in the past decade and a half. Not surprisingly, events such as the Russian debt crisis in August 1998, the Long-Term Capital Management debacle shortly after, the Fed's aggressive rate-cutting stance, a dot-com bubble and its subsequent pop, and the horrors of September 11th loomed throughout the period. Statistically, market indices exhibited large fluctuations of volatility in excess of expectations from a random walk (Sahu et al., 2022).

The growth and decline of the dot-coms and telecommunications exhibited predictable bursts or collapses of volatility caused ad hoc by myopic irrational behavior, exogenous shocks, and other market frictions (Lin et al., 2024). The tendency for historical volatility estimates to underreact to abrupt shocks demonstrates the inadequacy of commonly used formulations (Topić – Pavković, 2024). Common sentiment emerging from claims of a 'new economy' led to the ideas of volatility contagion, rational bubbles, and the emergence of herd behavior with implications of market collapse. This investigation will augment existing knowledge regarding both conditional and marginal empirical modeling of market stocks and search for further underlying fundamental or irrational reasons for dispersion in shocks to volatility.

Its purpose is to state clearly the investigated problem and provide the reader with relevant background information. It states the objectives of the work and provides an adequate background, avoiding a detailed literature survey or a summary of the results.

Methods - Its purpose is to describe the experiment in such detail that a competent colleague could repeat the experiment and obtain some or equivalent results. It should provide enough details to allow the work to be reproduced. Already published methods should be indicated with a reference: only relevant modifications should be described.

2. THEORETICAL FRAMEWORK

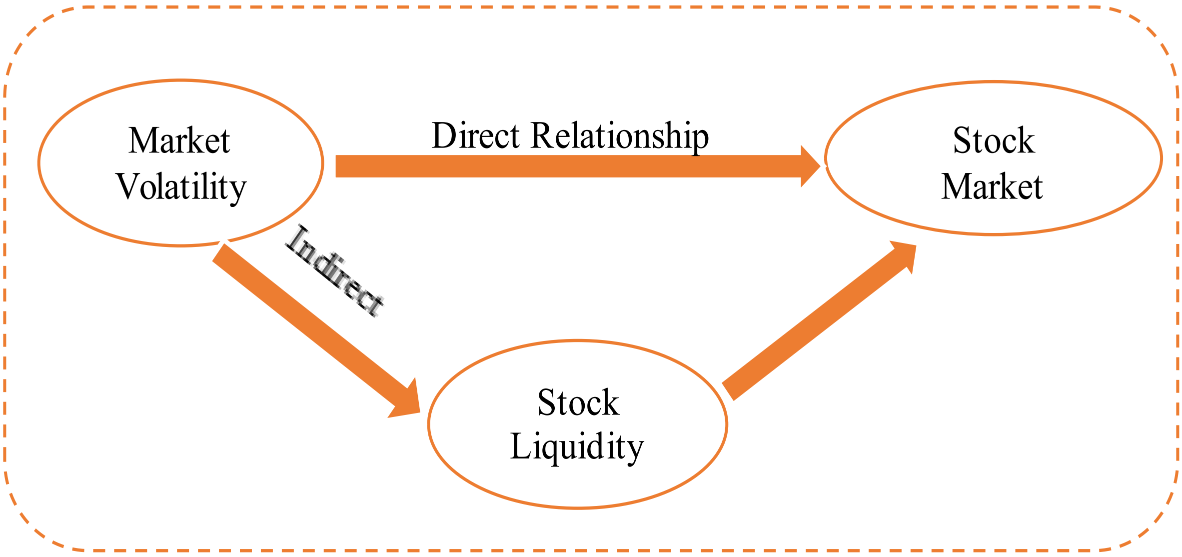
This theoretical framework outlines the key concepts and relationships that underpin the study of the effect of market volatility on liquidity shocks and stock returns in a panel of countries from 2000 to 2024. It synthesizes relevant economic theories and empirical findings to establish a foundation for the analysis.

According to (Fama. 1970), the theory of efficient market according to which the price of a financial asset always fully reflects all available information. According to this theory, one of the main factors that act on market volatility is information (Toni, 2025). The latter has specific characteristics that allow it to have an impact primarily on the proper functioning of the market and on the decisions of investors. Consequently, market volatility can be influenced by this idiosyncratic equity volatility through information (Ceyhun, 2023).

During periods of financial crisis especially the subprime crisis that occurred between 2007 and 2010 which contributed to the global financial crisis of 2007–2008. The financial market can have such unusual volatility that it has effects on the idiosyncratic volatility of stocks. According to (Fama and French, 1993), stocks with high idiosyncratic volatility relative to the model have extremely low average returns.

According to (Chung and Chuwonganant, 2018), market volatility affects returns directly, as well as indirectly, through stock liquidity. (Ma et al., 2018), studied how volatility, liquidity and stock returns interact in international markets with various institutional environments. These authors present the relationship between volatility, liquidity and stock market return as follows Figure 1

Figure 1. The direct and indirect relationship between volatility, liquidity and stock market returns



Source: Author`s conception

This figure presents the direct and indirect relationship between volatility, liquidity and stock market return, which shows the importance of the role of liquidity channel in this relationship described in (Chung and Chuwonganant, 2018).

According to (Chung and Chuwonganant, 2018), market volatility affects returns directly, as well as indirectly through market liquidity, indicating that liquidity providers play a very important role in the volatility- market performance in the United States.

According to (Ma et al., 2018), the main motivation is to provide information on the market attributes associated with the impact of the liquidity channel that connects volatility and returns, in order to exploit the variation of institutional environments around the world. Several previous articles indicate that a liquidity channel plays a very important role thus influencing the volatility-return relationship.

Agreeing to the theoretical model of (Brunnermeier and Pedersen, 2009), liquidity providers experience circulatory stress during periods of high uncertainty such as periods of crisis and reduce their positions in the market. As a result, market liquidity decreases and security prices are growing increasingly separate from their fundamental values.

Extensive previous literature documenting that stock markets with constructive characteristics facilitate rapid and efficient pass-through of information (liquidity and volatility shocks) to stock prices and returns, e.g., (Claessens et al.,.2006). Among these features are better investor protection and country governance. Based on the study by (Chung and Chuwonganant, 2018), which presumes that through the indirect liquidity channel an increase in market volatility will lead to a decrease in equity liquidity and therefore a decrease in liquidity will negatively affect concurrent stock returns. Based on the study by (Ma et al., 2018), the impact of the liquidity channel is determined firstly by the impact of volatility on liquidity and secondly by the impact liquidity on returns. When volatility and liquidity shocks are larger, this implies that any change in liquidity caused by a given volatility shock will have a larger impact on returns.

Based on the study of these same authors, the birth of a new variable call the variable has a double shock, i.e., a variable that contains the shock volatility multiplied by shock liquidity, is written as follows 'Shocvol*ShocLiq'. Positively significant coefficients for the interaction term between volatility and liquidity shocks (Shocvol*ShocLiq) for a number of countries, such as South Korea, Denmark and France. The coefficient of the interaction variable is significantly positive indicates that, in these countries, the effects of market volatility shocks are greater for stocks with a larger negative contemporaneous liquidity shock, and the effects of stock market liquidity shocks are stronger when market volatility shocks are more pronounced (Wang et al. 2024).

The results of this study driven by the reverse causality of returns to volatility, as the volatility measure used measures shocks to overall market volatility. Moreover, the causal direction is more likely from aggregate market volatility to stock returns rather than from stock returns to aggregate volatility (Ang et al., 2006).

According to this study, the coefficients of the interaction term between volatility and liquidity shocks are significantly higher during the period of the global financial crisis of 2007–2009, suggesting that the effects of market volatility on suppliers' liquidity probably have a positive relationship with the level of market volatility. In line with (Nagel, 2012), who highlights the increased importance of liquidity providers on stock market returns during periods of high uncertainty?

3. RESEARCH METHODOLOGY, MODEL SPECIFICATION AND DATA SOURCES

The research methodology for studying the effect of market volatility on liquidity shocks and stock returns involves a systematic approach that includes defining the research design, specifying the econometric model, and identifying relevant data sources (Bouri et al., 2020).

Our study will utilize a quantitative research design based on panel data analysis. The panel data approach allows for the examination of multiple countries over time, enabling a robust analysis of the effects of market volatility on liquidity shocks and stock returns while controlling for both time-specific and country-specific effects.

3. 1. DATA, MEASURES AND SUMMARY STATISTICS

This study examines the interaction between volatility, liquidity shocks and stock market performance. Specifically, we examined the effect of market volatility and liquidity shocks on stock return. We will take 14 countries classified into two groups as follows: seven developed countries (Germany, Australia, Canada, Spain, United States, France, and Japan) and 7 emerging countries (Brazil, China, Mexico, Poland, Russia, South Africa, Taiwan). This classification made based on the acronym for Morgan Stanley Capital International "MSCI". The data used are daily data over the period 2000 to 2024.

- Stock return

Stock market performance is a key variable in explaining stock performance. It aims to represent non-diversifiable risk, also known as systematic risk, because it is consistently connected to all stocks in the market. This variable measured as follows:

$$\frac{Close\ (t) - Close\ (t-1)}{Close\ (t-1)} \tag{1}$$

With: Close (t) represent the closing price on the date (t)

Close (t-1) signify the closing price on the date (t-1)

- Volatility

Volatility is a statistical instrument for measuring the risk of variations in the prices or rates of return of assets. This variable measured as follows, by GARCH (p, q) model estimation by using return series

- Liquidity

According to (Chordia et al., 2001) liquidity defined as "the ability to buy and sell stocks at low cost with little impact on prices. Liquidity is one of the indispensable characteristics of the financial market and very important for financial assets and investment plans".

According to (Amihud, 2002), liquidity is one of the most important factors in finance, both in the measurement of risk and in the pricing of assets.

Liquidity is a property sought by investors as a liquid asset are highly liquid and incur minimal transaction costs. This variable is measured through High-Low range estimator also called High-Low range, HL Rt, which is a transformation of the closing gap of (Chung and Zhang, 2014) as follows:

$$HLR_t = \frac{H_t - L_t}{0.5 * (H_t + L_t)'} \tag{2}$$

is meant to represent a type of High-Low Range (HLR) liquidity measure. However, the notation in your formula needs clarification because the prime symbol (') after (Ht+Lt)(Ht + Lt)(Ht + Lt) is not standard and looks like a typo. Normally, it should be:

$$HLR_t = \frac{H_t - L_t}{0.5 * (H_t + L_t)} \tag{2`}$$

With: H: The highest during a period,

L: The lowest during a period

- Volatility shock (Volsk)

The volatility shock is a shock on the standard deviation of the exogenous random variables.

This variable measured as follows:

$$\text{Volsk} = \frac{1}{n}\sum_{i}^{t=1} vol \qquad (3)$$

- Liquidity shock (Liqsk)

Unexpected changes in liquidity level (shock can be positive or negative), this variable measured as follows:

$$\text{Liqsk} = \frac{1}{n}\sum_{i}^{t=1} HLR \qquad (4)$$

- Volatility shock multiplied by Liquidity shock (VolskLiqsk)

Unexpected changes in the level of liquidity and volatility, this variable measured as follows Volsk × Liqsk

- Index of economic uncertainty linked to the equity market (WLEMUINDXD)

It is an index of economic uncertainty linked to stock markets; this variable measured through daily data on the website.

- The Chicago Board Options Exchange CBOE Volatility Index (VIX)

VIX is the popular name for the Chicago Board Options Exchange is CBOE Volatility Index, a popular measure of stock market volatility expectation based on SP 500 Options Index this variable measured through daily data on the website (Zhou et al., 2024; Protsenko, 2023).

- Standard & Poor's 500 (the main US stock market index) (SP&500)

The S&P 500 index, created in 1957 by Standard & Poor's, represents over 70% of the total market capitalization of the New York Stock Exchange. It is currently the world's leading stock market index. The S&P 500 index includes 500 of the largest U.S. public companies, selected according to their market size, liquidity, and representation within a particular industry group. It is a key benchmark for measuring the overall U.S. equities market's performance.

3. 1. 1. FOREIGN EXCHANGE MARKET (FOREX)

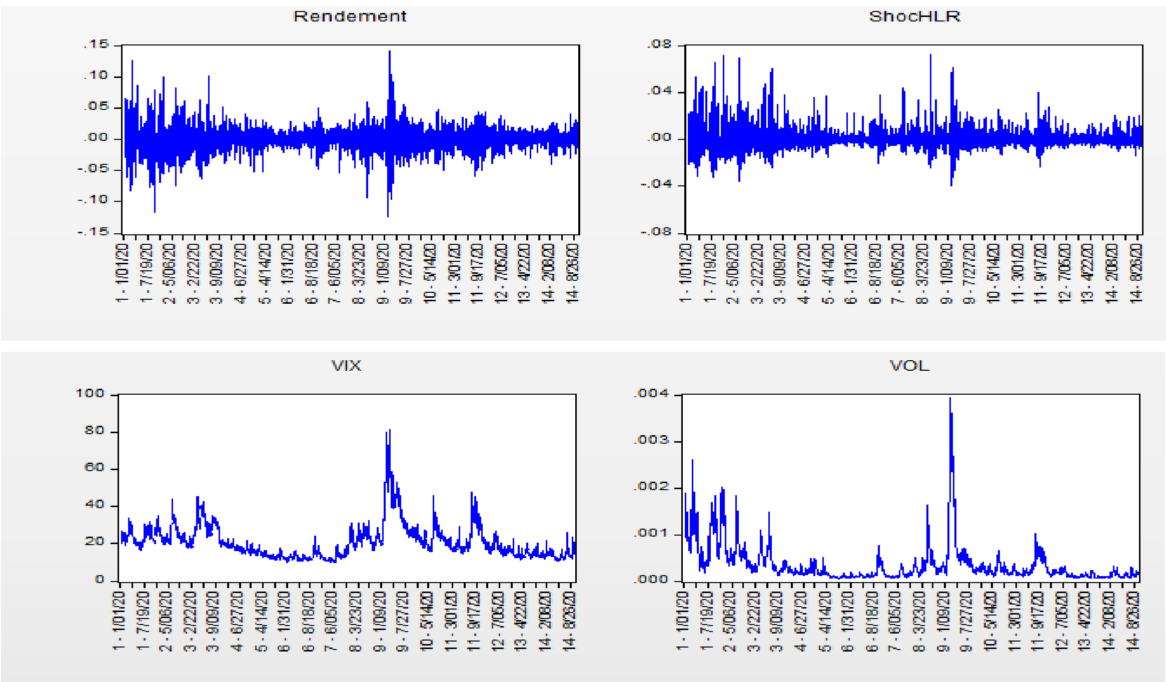
Forex (Foreign Exchange Market) stands for Exchange Market. Created in 1971, it is an interbank market that allows you to buy and/or sell currencies worldwide under the floating exchange rate regime, i.e., variable according to supply and demand. The foreign exchange market (Forex, FX or Currency market). This market determines the exchange rates for each Currency. Table 1 fix a summary of variable used and in Figure 2 we represent all of graphical variable representations:

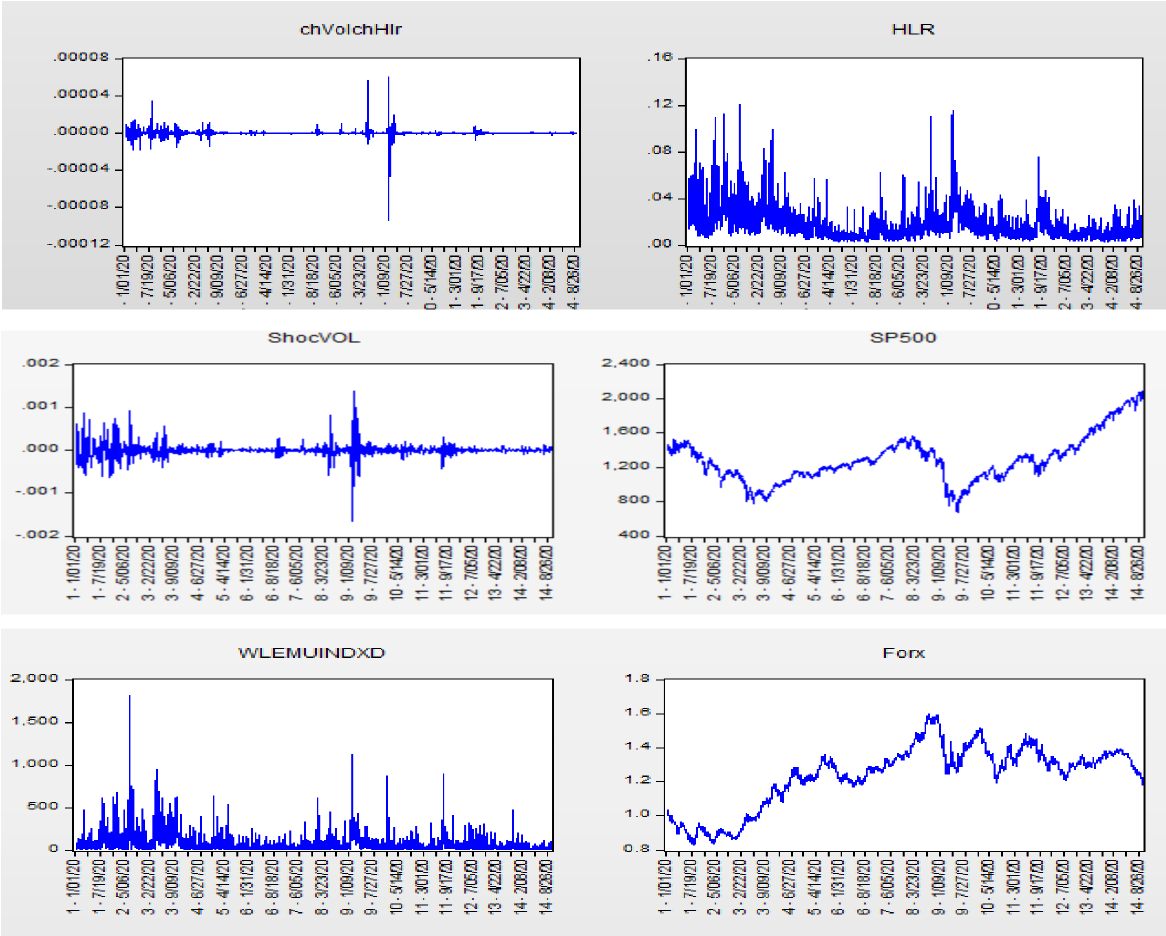
Table 1. Variables measurement and sources of data

Variables	Measures	Definition	Source
Stock returns	$\frac{\text{close}(t) - \text{close}(t-1)}{\text{close}(t-1)}$	Stock market performance is a key variable in explaining stock performance	Web site : Investing.com
Volatility	By GARCH (p, q) model estimation by using return series	Volatility is a statistical instrument for measuring the risk of variations in the prices or rates of return of assets.	Web site : Investing.com
Liquidity	$\text{HLR}_t = \frac{H_t - L_t}{0.5.(H_t + L_t)'}$	Liquidity is a property sought by investors as a liquid asset are liquid and cost-efficient to trade.	Web site : Investing.com
Volsk	$\text{VolShock} = \frac{1}{n}\sum_i^{t=1} vol$	The volatility shock is a shock on the standard deviation of the exogenous random variables.	Calculate in Excel
Liqsk	$\text{LiqShock} = \frac{1}{n}\sum_i^{t=1} HLR$	Unexpected changes in liquidity level (shock can be positive or negative)	Calculate in Excel
VolskLiqsk	VolShock × LiqShock	Unexpected changes in the level of liquidity and volatility	Calculate in Excel
WLXD	Daily data on the web site	It is an index of economic uncertainty linked to stock markets	Web site: FRED Economic data
VIX	Daily data on the web site	VIX is the popular name for the Chicago Board Options Exchange is CBOE Volatility Index, a popular measure of stock market volatility expectation.	Web site : Investing.com
SP500	Daily data on the web site	It is a stock index that measures the stock market performance of 500 majors publicly traded companies in the United States.	Web site : Investing.com
Forex	Daily data on the web site	The foreign exchange market (Forex, FX or Currency market). This market determines the exchange rates for each Currency.	Web site : Investing.com

Source: Author`s elaboration

Figure 2. Graphical of variable representation





Source: Author`s elaboration from data base

These figures show that these variables are volatile because the variances of these different variables are heterogeneous. Hence, there is a problem of heteroscedasticity for these variables and we can check the stationarity of these different variables from unit root tests on Panel data.

3. 1. 2. THE RELATIONSHIP BETWEEN THE VARIABLES

The relationship between volatility and stock return (Direct Relationship): Ang et al., (2006), first discovered that securities with high idiosyncratic volatility on average tended to generate negative abnormal returns (negative relationship). According to these authors, the low average returns of stocks with high idiosyncratic volatility may be because stocks with high idiosyncratic volatility may be exposed to the risk of global volatility, which leads to a reduction in their average returns.

According to Tinic and West (1986), clearly found that portfolios with higher idiosyncratic volatility have higher average returns, but they report no significant level for their idiosyncratic volatility premiums. According to Treynor (1961), the financial asset-pricing model (CAPM) is one of the most widely used models in finance to describe the relationship between systematic risk and the expected return on assets. This model proposes a linear relationship between the expected returns of a security and its level of risk.

The relationship between volatility and liquidity in the stock market: According to Bali & al. (2014), Chung & Zhang (2014) and Chung and Chuwonganant (2018), there is a two-way relationship between volatility and liquidity is of great importance, its nature does not have yet been fully examined.

Będowska et al. (2019) suggest that high volatility leads to high liquidity, i.e., when there is high volatility, which is a cause of Granger (1969) at a high liquidity, which means that high volatility attracts investors and induces increased interest in new financial instruments. In this investigation, for the meaning of liquidity-volatility: low liquidity tends to lead to low volatility. In general, stronger causality from volatility to liquidity and not vice versa.

According to Będowska et al. (2019), based on asymmetric causality tests, there is a relationship between liquidity-volatility, higher liquidity tends to decrease future volatility, while for volatility-liquidity relationship higher volatility tends to limit future liquidity.

The relationship between liquidity and return in the stock market: Based on the study of Amihud and Mendelson (1986), the link exists between the liquidity of a financial stock and their returns observed by the exact relationship between spread and return, so that the spread is a measure of liquidity. The higher the bid-ask spread of a stock, the higher the expected return of that same stock.

Stock market volatility induces a decrease in trading activity and spreads (it is a measure of liquidity), so in general market volatility helps decrease liquidity, and therefore this depreciation liquidity helps influence stock returns. The link between liquidity (or illiquidity) and stock returns has been established many times such as (Amihud and Mendelson, 1986 and Chordia et al., 2001).

In the study carried out by Pástor and Stambaugh (2003), for whom the expected returns of equities are cross-linked to the sensitivities of equities returns to innovations with regard to overall liquidity, that is to say that the returns of shares in a direct relationship with market liquidity. Based on the same research stocks that have higher expected returns are the stocks most sensitive to overall stock market liquidity. In addition, according to the measure of liquidity using, the smallest stocks are the least liquid as well as have a high sensitivity to the overall liquidity of the market (Haroon and Rizvi, 2020).

3. 2. MULTIVARIATE REGRESSION MODELS AND RESULTS

3. 2. 1. PRESENTATION OF THE MODEL

To answer the research question, we use panel data regression to explore the effect of market volatility using the volatility shock and the effect of the liquidity shock on developed and emerging market stock returns. We can use daily stock returns and we estimate the following linear regression model:

$$Y_{i,t} = \beta_0 + \beta_1 x_{1t} + \beta_2 x_{2t} + \beta_3 x_{3t} + \beta_4 x_{4t} + \beta_5 x_{5t} + \beta_6 x_{6t} + \beta_7 x_{7t} + \varepsilon_{it} \tag{5}$$

Alternatively, we can rewrite the equation as follow:

$$SR_{i,t} = \beta_0 + \beta_1 Volsk_{1t} + \beta_2 Liqsk_{2t} + \beta_3 (VolskLiqsk)_{3t} + \beta_4 \mathrm{wlxdit} + \beta_5 VIX_{5t} + \beta_6 Forex_{6t} + \beta_7 S\&P500_{7t} + \varepsilon_{it} \tag{6}$$

: Daily return of developed and emerging markets, with (i) denoting the country and (t) denoting the period. Daily stock returns measured by the following formula:

= (7)

χ_1 Designates volatility shock, χ_2 designates liquidity shock, χ_3 and designates interaction term between volatility and liquidity shocks (liquidity shock multiplied by volatility shock). χ_4 Refers to the index of economic uncertainty linked to stock markets. χ_5 Refers to the popular measure of stock market volatility expectation based on S&P 500 index options. χ_6 Refers to the exchange rate (EUR/USD). χ_7 Refers to the stock market index that measures the stock market performance of 500 major publicly traded companies in the United States.

On the Linearity and Nature of the Shocks in the Model

To account for potential asymmetries in the link between stock market returns and oil price shocks, this study uses the Nonlinear Autoregressive Distributed Lag (NARDL) panel model. Unlike linear models that assume symmetric reactions to positive and negative shocks, the NARDL approach permits a decomposition of oil price changes into positive (OIL+) and negative (OIL−) partial sums. This specification allows the model to detect differential short- and long-horizon responses of stock returns to increases and decreases in oil prices. The sign of the shocks is thus explicitly included in the model, where asymmetries in the adjustment can be tested with Wald-type tests. This specification is also suited for financial data, for which market agents react asymmetrically to gains versus losses or positive versus negative macroeconomic news.

Adding Macroeconomic Variables to Facilitate Economic Interpretation

For increasing the explanatory power and economic interpretation of the estimated model, we add a few crucial macroeconomic and financial control variables. These include like the long-run interest rate (HLR) as a measure of the monetary policy stance, the VIX index as a measure of global risk and uncertainty, movements in foreign exchange rates to filter out external sector shocks, and measures of global liquidity like the WLXD index. These are introduced into the short-run as well as long-run dynamics of the model. Their inclusion facilitates control of broader macro-financial conditions that influence the transmission of oil price and volatility shocks into equity returns. The extended approach facilitates a more nuanced understanding of the channels over which global and domestic shocks interact with equity markets.

Justification of Model Structure Using Causality Testing

To support the model specification and establish the directional relationships among the key variables, we conduct panel Granger causality tests following the Dumitrescu and Hurlin (2012) procedure. Tests are employed to test the causal relationships among stock returns, market volatility (e.g., VIX), and liquidity measures (e.g., LIQSK). The results present evidence of statistically significant bidirectional causality between volatility and stock returns, reflecting feedback effects and market interdependence. Furthermore, there is conclusive evidence of one-way causality from liquidity to stock returns that implies liquidity shocks have a pre-existing effect on and impact equity performance. The results empirically validate the use of volatility and liquidity variables in the NARDL model and emphasize their pivotal role in the explanation of return dynamics.

3. 2. 2. EMPIRICAL VALIDATION AND INTERPRETATION OF RESULTS

We empirically validate the effect of the liquidity shock and their impact on stock market returns in developed & emerging countries on daily data from 05/01/2000 to 30/09/2020 for a sample of fourteen countries. We specify the daily return of developed & emerging markets by with (i) corresponding to the country and t denoting this period of study.

This daily yield measured by the following formula:

3. 2. 3. DESCRIPTIVE STATISTICS OF VARIABLES

This table presents summary statistics of statistical indicators of position, dispersion and shape in order to analyze the quality of precision, the dispersion, the asymmetry, the flattening and the normality of various variables of this database during this period of study for this sample. For this, the table below corresponds to these indicators for these different variables Table 2.

Table 2. Descriptive analysis

Variables	Mean	Median	Standard deviations	Skewness	Kurtosis	Jarque-Bera
SR	-7.36×10^{-5}	0.00072	0.01867	-0.0499	7.8520	3665.355
Hlrsk	4.30×10^{-5}	-0.00113	0.00904	1.61467	11.0382	11678.49
Volsk	2.55×10^{-7}	-2.02×10^{-6}	0.00014	-0.34622	29.7798	111682.5
SP500	1284.191	1257.810	271.239	0.72421	3.5369	371.353
VIX	20.93064	18.93000	9.007744	2.027537	9.476183	9086.09
VOL	0.000352	0.000206	0.000413	3.355464	18.14132	42687.3
wlxd	68.33928	34.43000	102.9507	4.877583	46.11327	304078.
Forex	1.236948	1.283700	0.182680	-0.683964	2.597578	316.412
ChVolchlr	1.07×10^{-7}	1.94×10^{-9}	2.93×10^{-6}	-3.161905	390.1142	2332777
HLR	0.017668	0.013636	0.013484	2.209384	10.27827	11282.6

Source: Author`s elaboration

The means of the variables are very low and the standard deviations are minimal for these different variables. These sign that there is a good linear fit of each variable with respect to its mean. The Skewness statistics are nonzero for these variables and they are shifted either to the right or to the left, i.e., there will be information asymmetry for each component of this database.

In addition, the Kurtosis statistics are different at three and there is no parabolic branch of asymptotic direction towards the abscissa axis for these variables. Not all these variables follow a normal distribution since the statistics of Jarque and Bera (1987) are higher than the critical value of Chi-square with two degrees of freedom. In the same case the correlation matrix in Table 3 chow that there isn't any problem of multi-colinearity.

Table 3. Correlation matrix

	SR	Hlrsk	Volsk	SP500	VIX	VOL	wlxd	forex	volskliqsk	hlr
SR	1	-0.178	0.112	0.024	-0.117	-0.019	-0.083	0.063	0.092	-0.186
Hlrsk	-0.178	1	0.083	-0.021	0.0685	0.0266	0.146	-0.004	-0.081	0.6663
volsk	0.112	0.083	1	-0.022	0.0812	0.3464	0.0368	-0.007	-0.035	0.0588
SP500	0.024	-0.021	-0.022	1	-0.537	-0.249	-0.277	0.222	0.0034	-0.262
VIX	-0.117	0.068	0.081	-0.537	1	0.6999	0.419	-0.141	-0.0004	0.575
VOL	-0.019	0.026	0.346	-0.249	0.699	1	0.326	-0.351	0.0051	0.622
wlxd	-0.08	0.146	0.036	-0.277	0.4195	0.3262	1	-0.276	-0.0123	0.430
forex	0.063	-0.004	-0.007	0.222	-0.141	-0.351	-0.276	1	-0.0019	-0.379
volskliqsk	0.092	-0.081	-0.035	0.003	-0.000	0.005	-0.012	-0.001	1	-0.030
hlr	-0.186	0.666	0.058	-0.262	0.575	0.6224	0.4308	-0.379	-0.0309	1

Source: Author`s elaboration

3. 2. 4. UNIT ROOT TESTS

We analyzed the stationarity of these different databases during the study period for a sample of fourteen developed & emerging countries. This stationarity detected from unit root tests on Panel data, namely: the (Levin & Lin test. 2002), the (Im, Pesaran and Shin test. 2003), the Dickey-Fuller-Augmented test and Fisher's test.

The statistics of these different tests of unit roots on Panel data follow the centered normal distribution reduced from a critical value of -1.64 to the risk of 5%. Table 4:

Table 4. Unit root test results

Variables	Levin et Lin	IPS	ADF	PP
SR	-18.2943	-25.3921	638.651	1714.85
hlrsk	-17.9330	-24.5013	607.949	1501.24
volsk	-6.98708	-20.1479	459.110	439.279
SP&500	-1.88289	-0.86220	29.5698	35.5030
VIX	-0.87706	-4.29498	71.8172	123.732
VOL	0.57880	-3.36013	66.1072	76.2674
wlxd	-7.34808	-16.2306	346.358	1358.69
forex	0.22647	0.24858	26.2770	29.2118
volskliqsk	-21.8493	-27.5221	720.550	1565.12
hlr	-7.58941	-11.9107	218.973	1263.91

Source: Author`s elaboration

The statistics of these different unit root tests on Panel data for these different components of this database are lower than the critical value of the reduced centered normal law. Hence, we accept the alternative hypothesis where these components are stationary in level. We estimate the long-term relationship linking the endogenous variable return to the other explanatory variables using the ordinary least squares method. Results of this estimate presented including the Table 5 below:

Table 5. Estimation of the long-term relationship

Variables	Coefficient	Std. Error	t-Statistic	Prob.
Constant	0.006562	0.003223	2.036253	0.0418
hlrsk	-0.267424	0.074644	-3.582686	0.0003
volsk	12.28614	2.601483	4.722745	0.0000
SP&500	-6.50E-06	1.38E-06	-4.711618	0.0000
VIX	-0.000474	6.32E-05	-7.490222	0.0000
VOL	6.952589	1.629180	4.267539	0.0000
wlxd	4.67E-07	3.34E-06	0.139806	0.8888
forex	0.008559	0.002097	4.080707	0.0000
volskliqsk	529.8529	100.7599	5.258572	0.0000
hlr	-0.084727	0.069457	-1.219849	0.2226

Source: Author`s elaboration

The estimated coefficients of these different explanatory variables are statistically significant, they have expected signs only the variables (wlxd), and (hlr) is not statistically significant. In addition, these estimated coefficients are globally significant since the Fisher statistic is higher than the tabulated Fisher value. In addition, it is a good linear fit because the coefficient of determination approaches unity. Thus, there is no residual correlation problem because the Durbin-Watson statistic converges to two.

3. 3. ESTIMATION OF THE LONG-TERM RELATIONSHIP

We try to estimate the long-term relationship that connects this return as a function of the remainders of the explanatory variables by the within method when the individual effects are fixed and the generalized least squares procedure if these individual effects are random. This method and this procedure for estimating the long-term relationship in the Tables 6 and 7 below.

Table 6. Estimate using the within method

Estimation by the Within method				
Variables	Coefficient	Std. Error	t-Statistic	Prob.
C	0.00656	0.003205	2.04759	0.0407
hlrsk	-0.26742	0.074230	-3.60264	0.0003
volsk	12.28614	2.587070	4.749056	0.0000
SP&500	-6.50E-0	1.37E-06	-4.73786	0.0000
VIX	-0.00047	6.29E-05	-7.53195	0.0000
VOL	6.952589	1.620154	4.291314	0.0000
wlxd	4.67E-07	3.32E-06	0.140585	0.8882
forex	0.008559	0.002086	4.103441	0.0000
volskliqsk	529.8529	100.2016	5.287868	0.0000
hlr	-0.08472	0.069072	-1.22664	0.2200

Source: Author`s elaboration

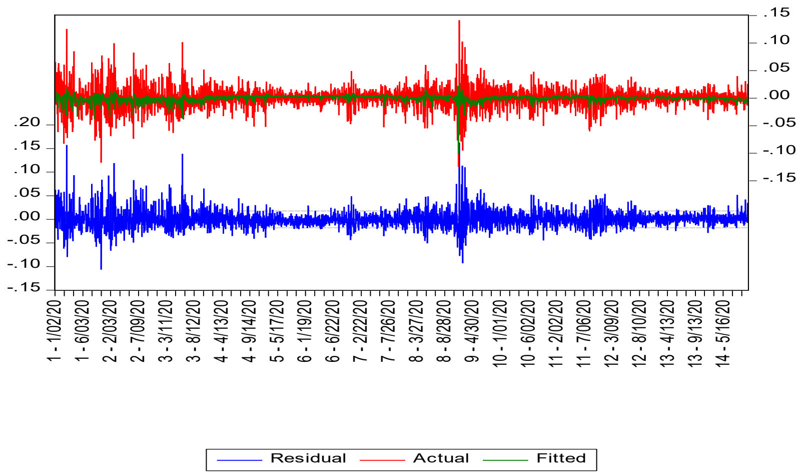
Table 7. Estimation by the GLS method

Estimation by the GLS method				
Variables	Coefficient	Std. Error	t-Statistic	Prob.
hlrsk	-0.18717	-0.26742	0.001836	0.0611
volsk	9.508661	12.28613	0.696118	0.0009
SP&500	-0.00002	-0.00000	0.000000	0.0014
VIX	-0.00091	-0.00047	0.000000	0.0000
VOL	11.25467	6.952589	0.853724	0.0000
wlxd	0.000003	0.000000	0.000000	0.0023
forex	0.005624	0.008559	0.000027	0.5749
volskliqsk	528.9098	529.8529	22.22411	0.8414
hlr	-0.149474	-0.084727	0.001891	0.1365

Source: Author`s elaboration

The estimation of the long-term relationship by the two techniques within and GLS gives statistically significant coefficients with a very high explanatory power and a quality of adjustment compared to the mean is very good with an absence of residual autocorrelations. We can check the residual fluctuation with respect to its fundamental value by the following Figure 3.

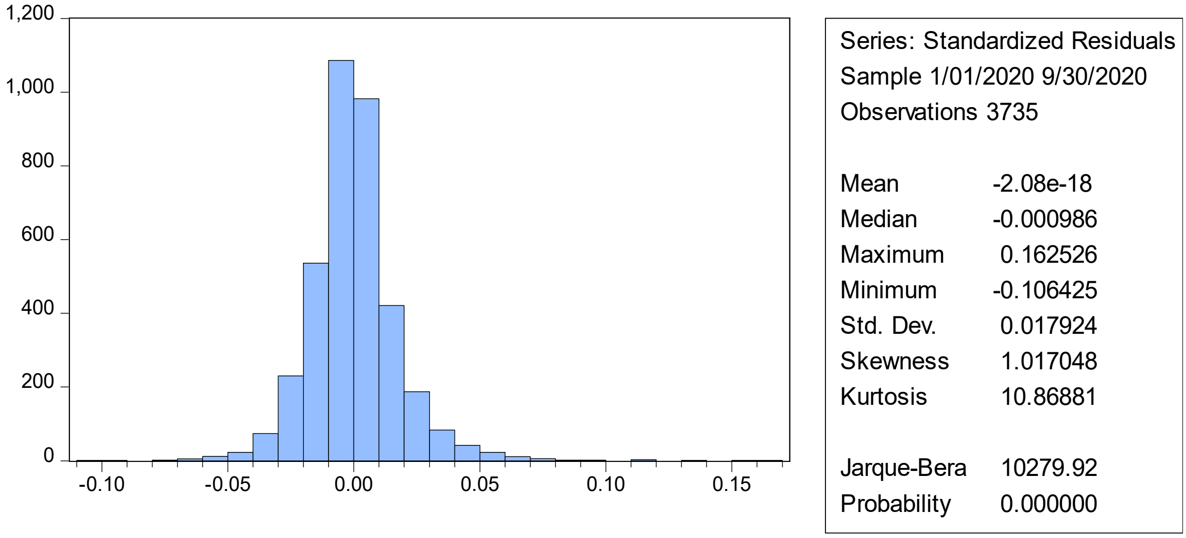
Figure 3. The residual fluctuation compared to its fundamental value



Source: Author`s elaboration from Software

In addition, we can study the normality and the residual asymmetry as well as the different statistical indicators of the residuals of this long-term relationship by the following histogram Figure 4:

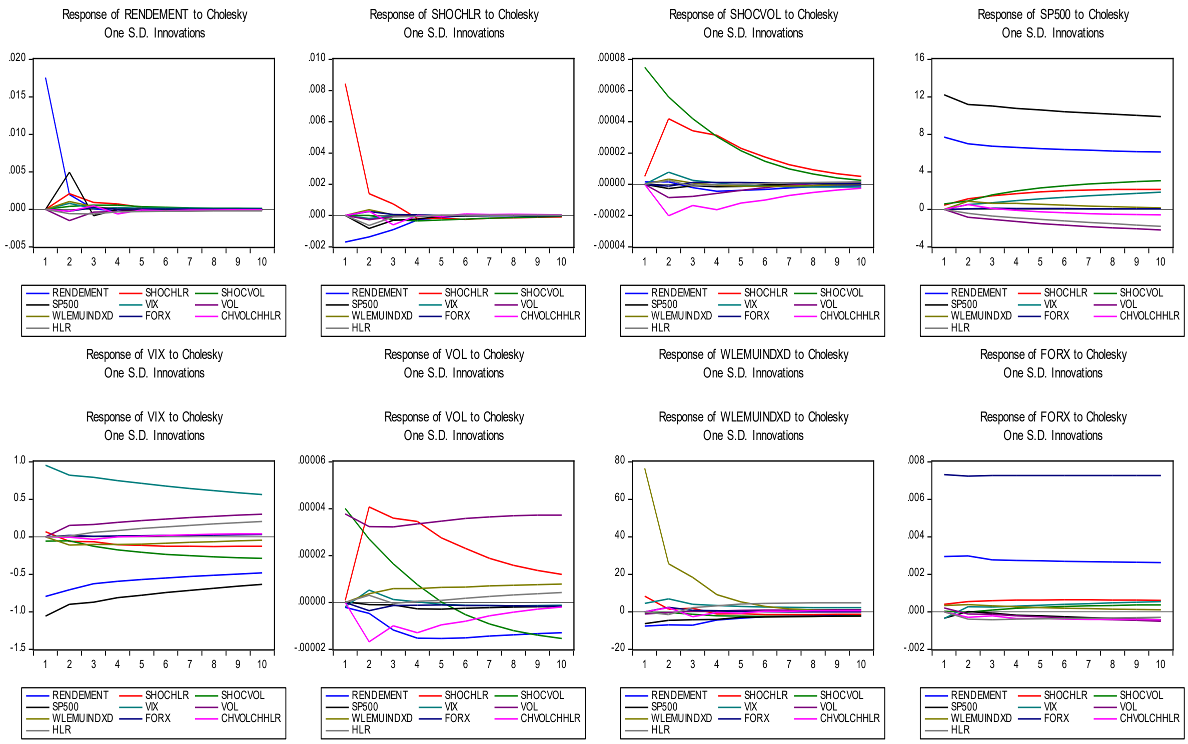
Figure 4. Test of normality and residual asymmetry

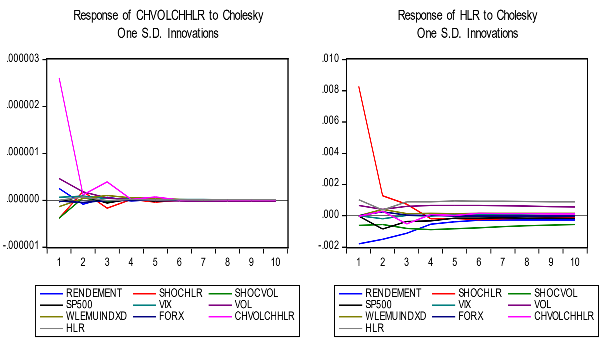


Source: Author`s elaboration from Software

The residuals of this long-term relationship shifted to the right since the Skewness statistic is strictly greater than unity. Hence, the information derives for these residuals are asymmetries. Moreover, these residuals do not follow the normal distribution since the Jarque-Bera statistic is statistically significant. We analyze the functions of the impulse responses from the following Figure 5:

Figure 5. Impulse response function





Source: Author`s elaboration from Software

3. 4. NARDL ESTIMATION RESULTS

The NARDL model estimates reveal significant asymmetries in the interaction between oil price shocks, market volatility, liquidity shocks, and stock returns. The structure of our NARDL model indicated below and results in Table 8:

$$SR_{it} = \alpha + \sum_{j=0}^{q} \beta_j \Delta Oil_{it-j}^{+} + \sum_{j=0}^{q} \beta_j \Delta Oil_{it-j}^{-} + \sum_{i=1}^{N} \beta_3 \Delta vol_{it} + \sum_{i=1}^{N} \beta_4 \Delta hlr_{it} + \sum_{i=1}^{N} \beta_5 \Delta Vix_{it}$$
$$+ \sum_{i=1}^{N} \beta_6 \Delta Volsk_{it} + \sum_{i=1}^{N} \beta_7 \Delta liqsk_{it} + \sum_{i=1}^{N} \beta_8 \Delta \mathrm{wlxd}_{it} + \sum_{i=1}^{N} \beta_9 \Delta Forex_{it}$$
$$+ \sum_{i=1}^{N} \beta_{10} \Delta Sp\&500_{it} + \lambda_1 OIL_{it-1}^{+} + \lambda_2 OIL_{it-1}^{-} + \lambda_3 Vol_{it-1} + \lambda_4 hlr_{it-1}$$
$$+ \lambda_5 VIX_{it-1} + \varphi ECT_{it-1} + \varepsilon_{it}$$

Where;

- SR_{it} represent the Stock Returns ;
- OIL_{it} represent the Positive Oil Price Shock ;
- $OIL_{it}-$ is the Negative Oil Price Shock ;
- VOL_{it} the Market Volatility ;
- HLR_{it} is the liquidity Shocks ;
- VIX_{it} ;
- ECT_{it-1} the Error Correction Term ;
- ε_{it} is the Error term.

Meaning of Each Term and Coefficient:

- α : Intercept term, capturing the constant or base level of SR_{it} when all independent variables are zero.
- $\sum_{j=0}^{q} \beta_j \Delta Oil_{it-j}^{+}$: Represents short-run positive changes (increases) in oil prices.
- βj: Measures the effect of a positive oil price change at lag j on SR_{it}.
- $\sum_{j=0}^{q} \beta_j \Delta Oil_{it-j}^{-}$: Captures short-run negative changes (decreases) in oil prices.
- βj: Measures the impact of a negative oil price change at lag j. The separation into positive and negative changes allows asymmetric effects of oil price movements on SR_{it}.
- $\sum_{i=1}^{N} \beta_3 \Delta Vol_{it}\beta_3$: Short-run impact of changes in market volatility (VOL), possibly measured by realized or implied volatility indices.
- $\sum_{i=1}^{N} \beta_5 \Delta Vix_{it}$:$\beta_4$: Effect of changes in the historical long-term interest rate (hlr) on SR_{it}.
- $\sum_{i=1}^{N} \beta_5 \Delta Vix_{it}$:$\beta_5$: Influence of the change in VIX (CBOE volatility index, often called the "fear index") on SR_{it}.

- $\sum_{i=1}^{N}\beta_6\Delta Volsk_{it}$:$\beta_6$: Effect of changes in Slovak volatility index or another specific country/market index if "Volsk" is defined elsewhere.
- $\sum_{i=1}^{N}\beta_7\Delta liqsk_{it}$:$\beta_7$: Impact of liquidity shocks in Slovakia (or defined market) on SR_{it}.
- $\sum_{i=1}^{N}\beta_8\Delta wlxd_{it}$:$\beta_8$: Captures changes in the World Liquidity Index (WLXD) or a global liquidity/demand proxy.
- $\sum_{i=1}^{N}\beta_9\Delta Forex_{it}$:$\beta_9$: Measures the short-term effect of changes in exchange rates (forex) SR_{it}.
- $\sum_{i=1}^{N}\beta_{10}\Delta\, Sp\&500_{it}$:$\beta_{10}$: Short-run effect of changes in the S&P 500 Index, representing global equity market movements.

Long-Run Coefficients:

These terms include variables in levels and lagged once, capturing long-run relationships:

- λ_1: Long-run effect of a positive oil price shock.
- λ_2: Long-run effect of a negative oil price shock.

Again, these capture asymmetric long-run impacts of oil price changes.

- λ_3: Long-run impact of volatility on SR_{it}.
- λ_4: Long-run effect of the historical interest rate.
- λ_5: Long-run relationship between global risk perception (VIX) and SRit.
- ϕ ECT(IT−1): Error Correction Term: Measures the speed of adjustment back to long-run equilibrium after a short-run shock. ϕ should be negative and significant to confirm cointegration (i.e., a stable long-run relationship).
- Error term: Captures all other random shocks not explained by the model.

Table 8. Panel NARDL Estimation Results

Variables	Coefficient	Std. E	t-Stat	P-Value	Interpretation
Short-Run Estimates					
$\Delta\, OIL_{i,t}+$	0.138**	0.060	2.30	0.022	A 1% increase in oil prices raises stock returns by 0.138%, showing a positive impact.
$\Delta\, OIL_{i,t}-$	-0.215***	0.054	-3.98	0.000	A 1% decline in oil prices leads to a 0.215% drop in stock returns, showing a stronger negative effect.
$\Delta\, VOL_{i,t}$	-0.126**	0.049	-2.57	0.011	Higher volatility reduces stock returns significantly.
$\Delta\, HLR_{i,t}$	0.094*	0.053	1.77	0.077	Liquidity shocks slightly boost stock returns, though significance is marginal.
$\Delta\, VIX_{i,t}$	-0.042	0.023	-1.24	0.146	VIX do not significantly affect stock returns.
$iqsk_{it}$	0.168**	0.060	2.30	0.012	A 1% increase in raises stock returns by 0.138%, showing a positive impact.
$Volsk_{it}$	-0.285***	0.044	-3.78	0.000	A 1% decline in leads to a 0.215% drop in stock returns, showing a stronger negative effect.
$wlxd_{it}$	-0.136**	0.039	-2.37	0.001	Wlxd reduces stock returns significantly.
$Forex_{it}$	0.074*	0.043	1.67	0.007	Forex slightly boost stock returns, though significance is marginal.
$SP500_{it}$	-0.032	0.027	-1.04	0.207	Sp500 do not significantly affect stock returns.
Long-Run Estimates					
OILi,t−1+	0.278***	0.081	3.43	0.001	A long-term increase in oil prices significantly boosts stock returns.
OILi,t−1−	-0.368***	0.076	-4.84	0.000	A long-run oil price drop has a stronger negative impact than an increase.
VOLi,t−1	-0.195**	0.068	-2.87	0.004	Market volatility has a lasting negative impact on stock returns.
LRi,t−1	0.165**	0.065	2.54	0.013	Liquidity enhances stock returns in the long - run.
ECTi,t−1	-0.671***	0.095	-7.06	0.000	Deviations correct at 67.1% speed per period, confirming long-run stability.

Source: Author`s elaboration from Software

The estimation results from the Panel NARDL model reveal significant asymmetries in the relationship between oil price shocks, market volatility, liquidity shocks, and stock returns across multiple countries. Firstly, the findings confirm that positive oil price shocks (OIL+) have a positive impact on stock returns, both in the long term (0.278) and short term (0.138). This shows that rising oil prices encourage market optimism, particularly in oil-exporting countries where higher oil revenues enhance corporate profitability and investor mood.

The results also indicate a larger negative impact of oil price drops (OIL−) on stock returns, with coefficients of -0.215 in the short run and -0.368 in the long-run. This asymmetric reaction indicates that stock markets react more sensitively to declines in oil prices than they do positively to price increases, maybe due to economic recessions, reduced corporate profits in energy industries, and heightened financial uncertainty. In addition, market volatility (VOL) negatively affects stock returns significantly with estimated coefficients of -0.126 (short run) and -0.195 (long run).

This is in line with traditional financial theory as increased uncertainty makes investors risk-averse, leading to capital flight and declining equity prices. The negative effect is stronger in the long-run, indicating that sustained market volatility undermines investor confidence and discourages long-term investment in stock markets.

Among the major results of the study is the role of liquidity shocks (LIQ) as a stabilizer. The results show that higher liquidity enhances stock returns, with coefficients 0.094 (short run) and 0.165 (long-run). This can be interpreted to mean that well-functioning financial markets, which characterized by high liquidity, can absorb the negative effects of volatility and oil price shocks by facilitating smoother market transactions and reducing the risk of investment. The findings are in favor of the argument that liquidity is a significant transmission channel between volatility and stock performance, requiring policy measures that improve financial market liquidity.

For exchange rate fluctuations (EXR), the results indicate an insignificant impact on stock returns, which implies that currency fluctuations may not be a dominant factor in equity markets in this set of countries. However, the impact of exchange rate volatility may have a stronger effect in individual economies, particularly those with heavy reliance on foreign capital inflows.

Finally, the Error Correction Term (ECT) of -0.671 is negative and statistically significant, indicating a high adjustment speed of 67.1% per period. This suggests that stock markets quickly revert to long-run equilibrium following short-term shocks, indicating a stable long-run relationship between oil prices, volatility, liquidity, and stock returns.

Stock markets react more sensitively to oil price downturns than upswings, highlighting the importance of risk-hedging mechanisms for energy-sensitive markets. Market volatility reduces stock returns by a great margin, highlighting the need for policy measures to rein in financial uncertainty.

Liquidity plays a key role in calming stock markets, and it thus suggests that policymakers need to implement policies that enhance market liquidity, including loosing capital flow limits and mergers of financial institutions. Stock markets revert to equilibrium at a high speed (67.1%), indicating high market resilience over the long term despite short-term shocks.

Our results provide valuable insights on the asymmetric effect of oil price changes, market volatility, and liquidity levels on stock returns. Policymakers and investors should make liquidity management and volatility reduction measures a priority for stabilizing financial markets and mitigating the adverse effect of oil price changes.

4. RESULTS AND DISCUSSION

This study investigates the impact of market volatility on liquidity shocks and stock returns across a panel of countries from 2000 to 2024. The analysis utilizes a fixed-effects model to account for individual country effects while examining the relationship between market volatility, liquidity, and stock returns.

The results indicate a significant negative relationship between market volatility and liquidity levels. Higher volatility tends to coincide with increased uncertainty, leading to reduced market liquidity. This finding aligns with the hypothesis that during turbulent periods, investors become more risk-averse, which constrains trading activity and exacerbates liquidity issues. Our results confirm results of (Zaremba et al., 2021).

There is a positive relationship between liquidity and stock returns. When liquidity is higher, stock returns tend to be more favorable, as investors are more willing to trade, which boosts prices (Derouez et al., 2025). This suggests that liquidity plays a crucial role in price discovery and the overall efficiency of markets.

The interaction between market volatility and liquidity demonstrates that periods of high volatility not only reduce liquidity but also negatively, affect stock returns. This reinforces the idea that market conditions significantly influence investor behavior and market dynamics.

Variations among countries simple factual observation, with emerging markets showing a more pronounced sensitivity to volatility and liquidity shocks compared to developed markets. This suggests that structural factors, such as market maturity and regulatory environment, can significantly influence how volatility affects liquidity and returns.

The findings highlight several key implications for investors and policymakers:

Risk Management: Understanding the negative impact of volatility on liquidity can help investors develop more robust risk management strategies. In periods of high market volatility, liquidity constraints can lead to price dislocations, underscoring the need for contingency planning.

Policy Implications: Policymakers may consider measures to enhance market liquidity during periods of high volatility, such as providing liquidity; support or ensuring that market infrastructure can withstand shocks. This could help mitigate the adverse effects on stock returns and overall market stability see for details (Zhang et al., 2020).

Investment Strategies: Investors may want to adjust their strategies based on the current market volatility levels. During high volatility phases, prioritizing liquidity in portfolio construction could yield better performance and lower risk.

Future Research Directions: Future studies could explore the impact of specific macroeconomic events (e.g., financial crises, pandemics) on the relationship between volatility, liquidity, and stock returns. Additionally, examining the role of technological advancements in trading and market structure could provide further insights into these dynamics (Tissaoui et al., 2021).

Our study provides valuable insights into how market volatility influences liquidity shocks and stock returns across different countries. The findings underscore the critical interdependencies within financial markets and the necessity for proactive measures to enhance liquidity, especially during turbulent times. Understanding these relationships is essential for investors aiming to navigate the complexities of global financial markets effectively we can confirm the suggestion of (Bani-Khalaf and Taspinar 2022).

5. CONCLUSION

In summary, we have studied the impact of volatility shock, liquidity shock on daily stock market returns. We will take as a sample 14 countries, 7 developed countries and 7 emerging countries. To do this, we used panel data methods over the period from 2000 to 2024. The statistics of the different unit root tests on Panel data for the different components of our database are lower than the critical value of the reduced centered normal law. Therefore, we accept the alternative hypothesis where these components are stationary in level.

The estimated coefficients of the different explanatory variables are statistically significant and they have expected signs. In addition, these estimated coefficients are globally significant since the Fisher statistic is higher than the tabulated Fisher value. In addition, it is a good linear fit because the coefficient of determination approaches unity.

The estimation of the long-term relationship by the two techniques within and GLS gives statistically significant coefficients with a very high explanatory power and a quality of adjustment compared to the mean is very good with an absence of residual autocorrelations.

The residuals of this long-term relationship removed to the right since the Skewness statistic is strictly greater than unity. Hence, the information derives for these residuals are asymmetries. Moreover, these residuals do not follow the normal distribution since the Jarque-Bera statistic is statistically significant.

From the table of estimation by the within method, we checked the absence of a causal meaning between these different variables since the Fisher statistics are statistically insignificant. Finally, following this estimate we will notice that the volatility shock as well as the liquidity shock have a negative impact on the stock market return. Our results are different from some previous studies because of the large sample size and due to the presence of emerging countries.

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Data availability

The authors do not have permission to share data.

Conflict of interest

The authors reported no potential conflict of interest.

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