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Research Article / *Araştırma Makalesi*

NVIDIA'S VOLATILITY SPILLOVERS TO EMERGING MARKETS: SHORT- AND LONG-TERM EFFECTS

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ABSTRACT

In recent years, the increasing market influence of technology companies and the potential for speculative bubbles in their stock prices to lead to financial instability, especially in emerging markets, has become a major concern. The vulnerability of emerging markets to such volatility spillovers in global markets is the main driver of this research. Using daily stock data, this study analyzes potential volatility spillovers from Nvidia (NVDA) to several emerging markets, including Brazil, Indonesia, Taiwan, Chile, and India. The results, obtained using the GSADF test and Diebold and Yılmaz's (2012) volatility spillover methodology, show that Nvidia's speculative bubble has minimal short-term effects on these emerging markets. However, in the long run, Nvidia transmits significant volatility to these markets, especially Brazil, Indonesia, Taiwan, and Chile. Specifically, Nvidia transmits 17.03% of its volatility to Brazil, 16.16% to Indonesia, 13.63% to Taiwan, and 12.2% to Chile. These results suggest that the bursting of Nvidia's speculative bubble could have a significant long-term impact on the financial stability of these emerging markets, highlighting the growing interdependence between global technology companies and emerging markets.

Keywords: *Emerging Markets, Financial Stability, Nvidia Stock Price, Speculative Bubbles, Volatility Spillover*

JEL Classification: *C58, G12, G15*

NVIDIA'NIN VOLATİLİTESİNİN GELİŞMEKTE OLAN PAZARLARA YAYILMASI: KISA VE UZUN VADELİ ETKİLER

ÖZET

Son yıllarda, teknoloji şirketlerinin artan piyasa etkisi ve hisse senedi fiyatlarındaki spekülatif balonların özellikle gelişmekte olan piyasalarda finansal istikrarsızlığa yol açma potansiyeli önemli bir endişe kaynağı haline gelmiştir. Gelişmekte olan piyasaların küresel piyasalardaki bu tür oynaklık yayılmalarına karşı kırılganlığı, bu araştırmanın ana itici gücüdür. Bu çalışma,Nvidia'nın (NVDA) günlük hisse senedi verilerini kullanarak Brezilya, Endonezya, Tayvan, Şili ve Hindistan gibi çeşitli gelişmekte olan piyasalara potansiyel volatilite yayılımlarını analiz etmektedir. GSADF testi ve Diebold ve Yılmaz'ın (2012) volatilite yayılma metodolojisi kullanılarak elde edilen sonuçlar, Nvidia'nın spekülatif balonunun bu gelişmekte olan piyasalar üzerinde minimum kısa vadeli etkilere sahip olduğunu göstermektedir. Ancak, uzun vadede, Nvidia bu piyasalara, özellikle Brezilya, Endonezya, Tayvan ve Şili'ye önemli ölçüde volatilite aktarmaktadır. Spesifik olarak, Nvidia oynaklığının %17,03'ünü Brezilya'ya, %16,16'sını Endonezya'ya, %13,63'ünü Tayvan'a ve %12,2'sini Şili'ye aktarmaktadır. Bu sonuçlar, Nvidia'nın

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spekülatif balonunun patlamasının bu gelişmekte olan piyasaların finansal istikrarı üzerinde uzun vadede önemli bir etkisi olabileceğini göstermekte ve küresel teknoloji şirketleri ile gelişmekte olan piyasalar arasında artan karşılıklı bağımlılığın altını çizmektedir.

Anahtar Kelimeler: *Gelişmekte Olan Piyasalar, Finansal İstikrar, Nvidia Hisse Senedi Fiyatı, Spekülatif Balonlar, Volatilite Yayılımı*

JEL Sınıflandırması: *C58, G12, G15*

1. Introduction

Technological innovation in artificial intelligence (AI) has caused significant volatility in global financial markets in recent years. AI has transformed the technology sector and profoundly impacted various industries, from data centers to autonomous systems, healthcare, and gaming. This has rapidly increased the growth potential of companies while increasing investor interest in these companies. Technology giants such as Nvidia (NVDA) have been at the forefront of these developments, creating speculative bubbles in the markets whose effects have become increasingly visible in the global financial system.

As in the dot-com bubble of the early 2000s, the rapid and uncontrolled rise in the stock prices of technology companies created great excitement among investors (Bhattacharya et al., 2009). At the time, the rapid growth of Internet companies raised expectations of large profits, but these profits also carried great risks (Allen & Gale, 2000). When the dot-com bubble burst, many investors suffered severe financial losses and global markets plunged into deep uncertainty (Brunnermeier & Oehmke, 2013). Today, we see a similar situation again in speculative movements observed in AI pioneer technology companies such as NVDA stocks. Although the intense interest in NVDA's AI technologies has led to a rapid increase in its stock prices, the sustainability and potential risks of this increase are questionable (Babina et al., 2024). In particular, it should be taken into account that such speculative movements can lead to serious volatility spillovers not only in developed markets (Bekiros et al., 2017) but also in emerging markets.

At this point, the stock markets of emerging markets such as Brazil, Indonesia, and Taiwan are the markets that may feel the effects of speculative bubbles in global technology companies the most. The share of technology stocks in Brazil's Bovespa index is about 12% (Rocha Filho & Rocha, 2020) and fluctuations in this sector directly affect the market's overall performance. In Indonesia's Jakarta Stock Exchange, the share of indices linked to the technology sector is 15% (Suriani et al., 2024). In Taiwan, the technology sector, especially through semiconductor and hardware manufacturers, accounts for 25% of the total market (Huang et al., 2024). Given Taiwan's critical role in the global technology supply chain, the risks of such speculative moves are amplified. Given the concentration of foreign investors in these markets and their sensitivity to global market movements, speculative bubbles in the stocks of technology giants such as NVDA could pose serious risks to the financial stability of these countries.

As a result, investor profiles in emerging markets can be directly affected by speculative bubbles that may develop in these markets. While domestic investors pursue strategies focused on short-term gains, foreign investors tend to have longer-term and more diversified portfolios.

However, both groups can be vulnerable to volatility in global technology companies. Therefore, the volatility spillovers from companies such as NVDA can create long-term financial vulnerabilities in emerging markets. This study examines the volatility spillovers of speculative bubbles in NVDA stock in such markets.

This paper examines the short- and long-term effects of speculative bubbles in NVDA's stocks on emerging markets (e.g., Brazil, Indonesia, Chile and Taiwan). The study asks whether these speculative bubbles in NVDA's share prices have led to volatility spillovers to emerging markets and how they have affected the financial stability of these markets. It also investigates which markets in emerging markets are more susceptible to these volatility spillovers and which countries are more vulnerable to these effects. In addition, the study also investigates how NVDA's equity volatility affects investor behavior in emerging markets and how these markets can become more resilient to volatility spillovers.

In light of these research questions, the study is motivated to examine the potential impact of speculative bubbles in a global technology giant such as NVDA on emerging markets. In recent years, the increasing market influence of technology companies and the potential for speculative bubbles in their stock prices to lead to financial instability, especially in emerging markets, has become a major concern. The vulnerability of emerging markets to such volatility spillovers in global markets is the main driver of this research. The study aims to understand these risks and guide policymakers by examining short- and long-term volatility dynamics.

After providing information about the subject of the study, the following sections review the relevant literature. The second section presents the theoretical framework. The third section presents the data, the fourth section explains the methodology, and the fifth section presents the empirical findings. The sixth section discusses the findings, and the seventh section presents recommendations. The conclusion includes the findings and the study with recommendations for future studies.

1.1. Related Literature

Irrational investment is an economic phenomenon that occurs when asset prices in financial markets become inflated and diverge from their real value, followed by a sudden price decline. Such bubbles can potentially cause financial instability in both developed and emerging markets. Price fluctuations, especially those led by technology companies, can cause cross-market volatility spillovers. There is a large body of research on detecting speculative bubbles and analyzing their impact on markets. This section reviews studies examining how speculative bubbles arise in both emerging markets and the technology sector.

Several studies have shown that speculative bubbles precede financial crises in emerging markets, emphasizing that the GSADF test can be an important tool in detecting these bubbles and ensuring economic stability (Shaikh et al., 2023). Studies analyzing markets in Asia, Africa, South America, and Eastern Europe from the early 1990s to 2006 found that speculative bubbles were detected only in Mexico, Sri Lanka, and Taiwan (Ahmed et al., 2010). Other studies using the GSADF unit root test have shown that speculative bubbles occur before crises and that the GSADF method can be used as an early warning system for financial crises (Zeren & Yilanci, 2019). Furthermore, tests on the São Paulo Stock Exchange Index in Brazil revealed

the presence of speculative bubbles in twenty out of twenty-seven stocks, and these results provide important information for investors and financial institutions (Costa et al., 2017). An analysis of the Pakistan Stock Exchange using the GSADF test revealed the presence of multiple bubbles in different sectors, with only the investment, chemical, and textile yarn sectors showing no bubbles (Liaqat et al., 2019). A study on the start and end dates of speculative bubbles in ten emerging market indices reported that the WIG20 index could not resist this bubble formation (Koy, 2018). Studies in South Asian capital markets revealed the existence of rational bubbles in the stock markets of Pakistan, Bombay, Dhaka, and Colombo (Nazir et al., 2020).

Research on technology stocks shows that large companies are essential in forming speculative bubbles. The increases in NVDA stock prices between 2020 and 2024 show the tendency of technology companies to create speculative bubbles. These bubbles were influenced by technological developments such as artificial intelligence, data centers, and autonomous systems (Potrykus, 2024). The volatility of large technology stocks such as FAANG and Microsoft during the pandemic period was analyzed, and it was emphasized that these stocks increased the risk of speculative bubbles (Özdurak & Karataş, 2021). Studies on the investment behavior of young investment managers in technology stocks have found that these managers follow trends and that this behavior increases speculative bubbles in the technology sector (Greenwood & Nagel, 2009). Another study on technology bubbles in 2020 found that the positive feedback trading model, which causes stock valuations to rise above fundamentals, supports speculative bubbles (Tokic, 2020).

The literature reviewed above shows that speculative bubbles significantly impact emerging markets and technology companies. Using methods such as GSADF and volatility propagation models, studies have extensively examined the detection of bubbles and their potential to create financial instability. The long-term effects of speculative bubbles on emerging markets, especially in the technology sector, have received considerable attention. However, the existing literature shows that the dynamics of these bubbles in different periods and their impact on the vulnerability of emerging markets are not fully understood. Moreover, empirical evidence on how speculative bubbles driven by technology firms generate more profound and widespread volatility in specific markets remains inconclusive.

The importance of this paper lies in its detailed analysis of how emerging markets, which are increasingly integrated into global markets, are exposed to volatility shocks from technology companies. In particular, the study highlights the long-term economic risks for emerging markets when technology bubbles burst. Examining the impact of NVDA volatility on emerging markets highlights the importance of financial stability policies in these countries. In addition, it provides important information for policymakers and investors in such markets to develop more resilient strategies for possible future market shocks. Therefore, this paper aims to fill this gap in the literature by providing an in-depth analysis of the long-term volatility effects of speculative bubbles in the stocks of technology firms in emerging markets.

2. Theoretical Framework

This paper is based on a solid theoretical foundation built around the concepts of speculative bubbles and volatility spillovers. Speculative bubbles refer to the inflation of asset prices through speculative movements that deviate significantly from economic fundamentals, often leading to market imbalances. Minsky's (1986) financial instability hypothesis argues that speculative bubbles are inevitable, and their bursting can trigger financial crises. Speculative bubbles are particularly prevalent in high-growth areas such as technology, and the bursting of these bubbles can cause tremendous market volatility.

Speculative bubbles observed in the share prices of technology giants such as NVDA can lead to significant volatility spillovers in emerging markets. The volatility spillover theory examines the effects of price fluctuations in one market on other markets (Diebold & Yılmaz, 2012). In this theory, shocks or uncertainties in one market can spread to other markets in the short and long run. With deepening global market integration, emerging markets, in particular, are becoming more vulnerable to volatility movements in global technology companies. In this context, the bursting of speculative bubbles created by large technology companies such as NVDA can potentially create long-term volatility spillovers and financial instability in emerging markets (Brunnermeier & Oehmke, 2013).

The theory of global market integration (Kearney & Lucey, 2004) argues that financial markets are increasingly integrated and that this integration can increase volatility, especially in emerging markets. Emerging markets may be more vulnerable to volatility shocks from large players in global markets. Market movements by tech giants such as NVDA can have wider economic consequences by affecting capital flows into these markets, exchange rates, and interest rates. For example, in countries such as Brazil and Indonesia, technology sector-driven volatility can create long-term vulnerabilities in their financial systems.

Moreover, financial stability theory (Crockett, 1997) emphasizes the importance of macroprudential policies to limit the impact of market volatility shocks. Financial regulators in emerging markets need to take proactive measures against sudden changes in global markets. These policies imply the use of instruments to limit volatility and build more resilient market structures.

3. Data

The data used in this study consists of emerging market indices and NVDA stock prices. For emerging markets, the Brazil Index 50 (Brazil), Jakarta LQ45 (Indonesia), Nifty 50 (India), S&P CLX IPSA (Chile), and TSEC Taiwan 50 (Taiwan) are selected. Nvidia (NVDA) stock prices are used to represent the AI sector. The study period includes daily closing prices from January 3, 2011, to July 31, 2024. This period represents an appropriate timeframe to examine the rapid rise of NVDA in the technology sector and the impact of speculative bubbles on emerging markets.

Table 1: Descriptive Statistics

	BRA	CHILE	IDN	IND	TWN	NVDA
Mean	13206.82	4619.201	870.7923	10936.17	8574.831	11.44651
Median	12048.97	4450.95	895.38	9827.15	7653.3	3.82
Maximum	22217.05	6781.88	1132.19	24951.15	20190.72	135.58
Minimum	6386.63	2876.03	566.83	4544.2	4664.33	0.28
Std. Dev.	4675.49	744.776	116.8806	4960.535	3154.784	20.82898
Skewness	0.34900	0.685139	-0.42481	0.799796	0.96286	3.279681
Kurtosis	1.565099	2.802825	2.202819	2.622989	3.039452	15.20793
Jarque-Bera	362.5089	272.8674	193.2522	384.5305	528.2049	27344.36
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

According to Table 1, NVDA exhibits high volatility and large price movements compared to other indices. Although its mean (11.45) is lower than other indices, its maximum (135.58) and high standard deviation (20.83) indicate that NVDA is more susceptible to speculative movements. In addition, the skewness (3.28) and kurtosis (15.21) values show that NVDA prices often exhibit extremes and that this market deviates significantly from a normal distribution. Among emerging market indices, India (IND) and Brazil (BRA) exhibit relatively higher volatility and right-skewed distributions, suggesting that these markets may experience large positive price movements from time to time. The results of the Jarque-Bera test confirm that all markets deviate from a normal distribution and that volatility is higher than expected. These results suggest that the volatility of large technology companies such as NVDA may create more risk in emerging markets over the long term.

4. Method

4.1. GSADF (Generalized Supremum Augmented Dickey-Fuller) Test

The GSADF test is a method for detecting asset price bubbles. Compared to the traditional Augmented Dickey-Fuller (ADF) test, the GSADF test detects speculative bubbles over time more flexibly and comprehensively by considering different starting and ending points. The extended ADF model proposed by Phillips et al. (2015):

$$y_t = \alpha + \beta t + \delta y_{t-1} + \sum_{i=1}^{k} \phi_i \Delta y_{t-i} + \varepsilon_t \quad (1)$$

Where y_t is the time series under test, t is the time trend, α is the constant term, β is the coefficient on the time trend, δ indicates the presence of bubbles,$\Delta\, y^{t-i}$ is the difference in the series, and ε_t is the error term. The GSADF test uses rolling window and expanding window methods to observe the time-varying structure of the bubble using test statistics at different start and end periods. In this way, the test can detect multiple bubbles (Phillips et al., 2015). Accordingly, the hypotheses are,

H_0: There is no bubble in the time series (δ=0)

H_1: There is a bubble in the time series (δ>1)

It is constructed as follows. In the GSADF test, the test statistic takes the supremum value of the ADF test across windows. It is calculated as follows:

$$GSADF = \sup_{r_1 \in [r_0, r_T]} \sup_{r_2 \in [r_1, r_T]} ADF_{r_1, r_2} \quad (2)$$

where r_1 and r_2 are the boundaries of the recyclical window, r_T is the last date and $ADF_{r1,r2}$ is the ADF test statistic. This statistic is used to understand whether there is a bubble formation in a given time interval.

4.2. Diebold & Yılmaz (2012) Volatility Spillover

This model is used to analyze the volatility spillover between markets. Diebold & Yilmaz's model measures how much volatility is transferred from one market to another and the magnitude of this spillover. The Diebold & Yilmaz (2012) volatility spillover model is based on generalized variance decomposition and analyzes the propagation of shocks across markets. The model is based on a VAR(p) model:

$$X_t = \sum_{i=1}^{p} A_i X_{t-i} + \varepsilon_t \quad (3)$$

X_t is the -dimensional time series vector (e.g., indices across markets), is the parameter matrix (the effect of past shocks), and is the error term. This method is based on the variance decomposition method. It shows how sensitive a given market is to shocks from other markets. We calculate the spillovers from each market to the other using generalized variance decomposition. Accordingly, the spillover matrix (Diebold & Yilmaz, 2012):

$$\theta_{ij} = \frac{\sigma_{ij}^2}{\sum_{j=1}^{N} \sigma_{ij}^2} \quad (4)$$

where θ_{ij} is the volatility dispersion rate from the *i*-th market to the *j*-th market, σ_{ij}^2 is the variance component from the *i*-th market to the *j*-th market. From this matrix, the To (sending the spread) and From (receiving the spread) values of each market are calculated:

To: Shows how much volatility one market is sending to other markets.

From: Shows how much volatility a market receives from other markets.

As a result, this model helps to understand how and to what extent volatility shocks propagate by examining the dependence and propagation relationships between markets.

5. Empirical Findings

Initially, the study was to include the stocks of the technology giants known as the "Magnificent Seven" (Apple, Microsoft, Alphabet, Amazon, Meta, Tesla and Nvidia). However, since the GSADF test results did not show an ongoing speculative bubble in the stocks of these companies, only NVDA stock was included in the analysis. NVDA has exhibited persistent bubbles due to its leading position in AI and semiconductor technologies and is considered the most appropriate example of emerging market volatility spillovers.

The impact of speculative bubbles in NVDA stock prices on emerging markets is analyzed using the GSADF test and the Diebold & Yilmaz (2012) volatility propagation model. While the GSADF test identifies the bubble periods in NVDA stocks and the duration of these bubbles, the Diebold and Yilmaz model analyzes the volatility spillovers of these bubbles on emerging markets from short- and long-term perspectives. The results show that the impact of NVDA bubbles on markets varies over different periods.

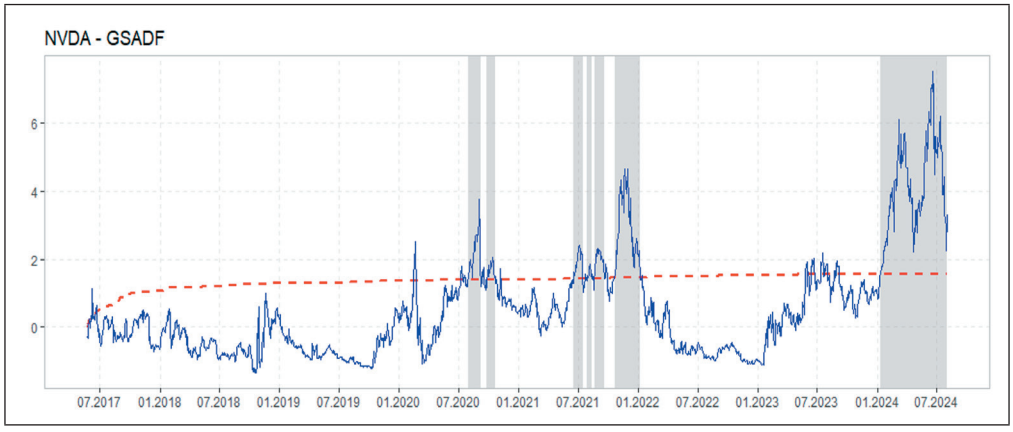
Table 2: NVDA Bubble Dates and Durations

Start	Peak	End	Duration	Ongoing
2020-07-30	2020-09-02	2020-09-08	27	FALSE
2020-09-25	2020-10-13	2020-10-22	19	FALSE
2021-06-17	2021-07-06	2021-07-16	20	FALSE
2021-07-28	2021-08-05	2021-08-11	10	FALSE
2021-08-20	2021-08-30	2021-09-20	20	FALSE
2021-10-21	2021-11-19	2022-01-07	54	FALSE
2024-01-10	2024-06-18	2024-07-31	140	**TRUE**

Note: GSADF test statistic: 7.53; 0.90 critical value: 2.23, 0.95 critical value: 2.45, 0.99 critical value: 2.93; critical values obtained by Monte Carlo simulation with 5000 replications.

Table 2 shows six different speculative bubbles formed in NVDA stock between 2020 and 2024, ranging from 10 to 54 days. Each bubble ended after a short period of upside, but the last bubble, which began in 2024, is still ongoing and stands out as the longest-lasting bubble at 140 days. NVDA shows that speculative bubbles in stocks are significant, and price movements are not random. In particular, the persistence of the most recent bubble suggests that speculative movements in market conditions are ongoing.

Figure 1: NVDA Bubble Periods



Resource: Prepared by the author (RStudio)

Figure 1 shows that the speculative bubbles in NVDA's stock price between 2020 and 2024 are closely linked to the company's structural changes and innovations. The bubble between July 2020 and September 2020 occurred when NVDA announced its new Ampere architecture, revolutionizing data centers, AI computing, and gaming. During this period, news that NVDA planned to acquire ARM Holdings also caused a stir in the markets and boosted share prices. However, the deal later ran into regulatory hurdles. Between September 2020 and October 2020, demand for NVDA's GPUs grew, particularly in gaming and cryptocurrency mining, and solid financial results supported the stock. However, uncertainty over earnings visibility and the ARM acquisition soon led to a correction.

Between June 2021 and July 2021, NVDA benefited from the global chip shortage, which sent the company's stock price soaring. In addition, the launch of new products, such as the RTX 30 series, and advances in AI technologies have boosted investor confidence. The wide range of applications for NVDA's chip technology, from data centers to automobiles, has attracted speculative investors. The July 2021-September 2021 bubble emerged due to NVDA's 4-for-1 stock split in July. The stock split attracted much interest from retail investors as the stock became more accessible, and prices rose rapidly. In addition, increasing demand for GPUs for AI and machine learning applications supported speculative trading during this period.

Between October 2021 and January 2022, NVDA became the 7th most valuable company in the U.S. and attracted much investor attention thanks to its leadership in the AI, gaming, and data center markets. However, concerns about supply chain disruptions and inflationary pressures led to a correction in share prices during this period. Finally, the bubble between January 2024 and July 2024 can be explained by new developments that solidified NVDA's leadership in the AI hardware market. In particular, AI chips developed for large-scale machine learning models and using this technology in autonomous systems, data centers, and AI services pushed NVDA stock prices to speculative levels. The company's collaborations with major technology companies and its expansion into new AI-enabled sectors have led to the continuation of this bubble.

Table 2 focuses on volatility spillovers between NVDA and the stock markets of several emerging markets, including Chile, India, Indonesia, Brazil, and Taiwan, over two time horizons: short-term (1 to 6 days) and long-term (6 days to infinity). The primary objective is to understand whether the ongoing speculative bubble in Nvidia could potentially trigger volatility spillovers in these markets when it bursts.

Table 3: Diebold & Yılmaz (2012) Volatility Spillover

	CHILE	IND	IDN	BRA	TWN	NVDA	FROM
			Roughly corresponds to 1 days to 6 days				
CHILE	2.56	0.39	0.56	0.82	0.45	0.29	8.99
IND	0.58	3.15	0.60	0.45	0.44	0.15	8.04
IDN	0.85	0.50	2.86	1.00	0.36	0.30	10.84
BRA	0.90	0.46	0.24	1.56	0.40	0.29	8.30
TWN	0.43	0.29	0.57	0.32	1.97	0.17	6.43
NVDA	0.30	0.17	0.27	0.30	0.34	2.42	4.99
TO	11.03	6.53	8.09	10.42	7.17	4.36	**47.6**
			Roughly corresponds to 6 days to Inf days.				
CHILE	45.88	4.04	7.63	26.62	9.04	1.74	8.57
IND	14.61	28.47	9.46	25.79	14.58	1.72	11.56
IDN	15.51	3.66	42.45	10.55	19.04	2.92	9.03
BRA	13.71	7.31	15.05	37.32	19.58	3.17	10.28
TWN	22.73	7.54	17.89	23.00	19.29	5.80	13.45
NVDA	3.27	1.43	42.48	11.48	15.78	21.76	13.01
TO	12.2	4.19	16.16	17.03	13.63	2.68	**65.90**

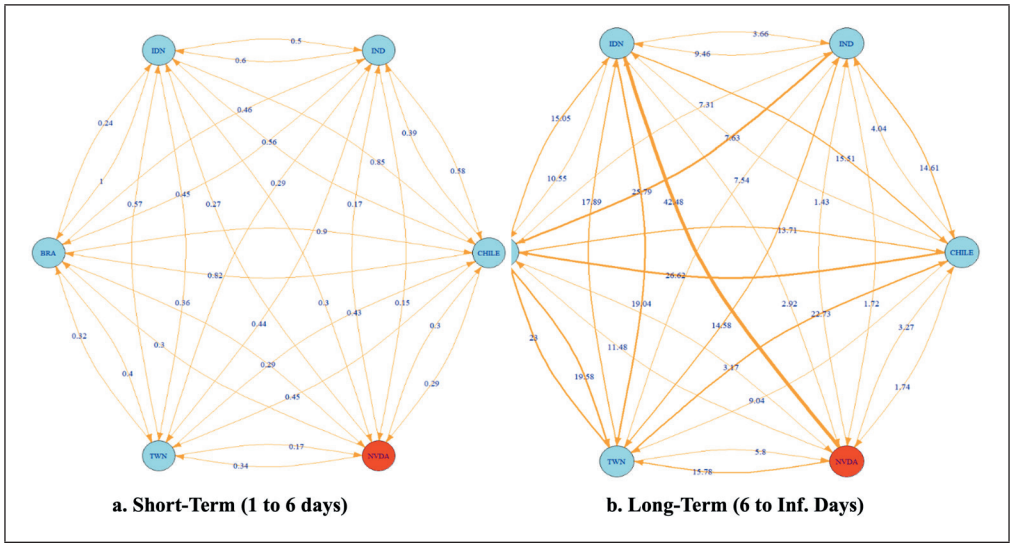
Notes: Numbers in bold indicate total effects. The numbers in each row show how the volatility of that row is affected by other variables. The numbers in each column show how that column's volatility is affected by other variables. The numbers in the "From" column indicate how much volatility a market receives from other markets, and the numbers in the "To" row indicate how much volatility a market sends to other markets. We use a window length of 300, based on the framework proposed by Diebold & Yilmaz (2012).

In the short-term horizon (1 to 6 days), Nvidia plays a relatively minor role as a transmitter of volatility. The "To" column for NVDA shows that it contributes only 4.36% to the system's volatility, indicating that its impact on these emerging markets is limited in the short term. This suggests that the immediate impact of sharp movements in Nvidia's stock price may not be significant within the first few days of a market event. However, NVDA still transmits volatility to markets such as Taiwan and India, reflecting its partial integration into global markets. On the receiving end, NVDA is more influenced by external markets, particularly Indonesia (0.85%) and Brazil (0.90%), showing a dependence on global market conditions even in the short term.

In the long-term horizon (6 days to infinity), Nvidia emerges as an important transmitter of volatility. The "To" column shows that Nvidia transmits 16.16% of its volatility to Indonesia and 17.03% to Brazil. This suggests that Nvidia plays a significant role in transmitting volatility to emerging markets over the long term. In addition, NVDA's total "To" value is 65.90%, indicating that Nvidia's influence is significant, especially in the long term.

Notably, the volatility spillovers to emerging markets are more pronounced in the long run. Chile, India and Indonesia show more significant spillovers throughout the system, meaning that if Nvidia's stock bubble bursts, it could have a cascading effect on these emerging markets, especially in the long run.

Figure 2: Diebold & Yilmaz (2012) Volatility Spillover Network Structure



5.1. Evaluation of Findings

The analysis provides important insights into the development and collapse of speculative bubbles in NVDA stocks over time. In particular, the results reveal different dynamics regarding short- and long-term volatility spillovers. In the short run (between 1-6 days), the impact of NVDA on global markets is limited, while in the long run (6 days and beyond), NVDA is more volatile than emerging markets. It spreads significant volatility, especially to Indonesia (16.16%) and Brazil (17.03%).

In the short term, NVDA's volatility transmission to other markets is limited, although it has been found to impact some markets, such as India and Taiwan. However, this effect is generally minimal, and its impact on global markets is limited in the short term.

In the longer term (6 days and beyond), NVDA's volatility has spilled significantly into emerging markets, particularly Brazil and Indonesia. NVDA imparts volatility of 17.03% to Brazil, 16.16% to Indonesia, 13.63% to Taiwan, 12.2% to Chile, and 4.19% to India. These results suggest that Nvidia has a significant volatility spillover to emerging markets in the long run and that these markets are vulnerable to Nvidia's volatility.

The results suggest that speculative bubbles in NVDA stock have a limited spillover effect in the short run. Still, in the long run, when these bubbles burst, they can lead to severe volatility spillovers in emerging markets. In particular, countries such as Indonesia and Brazil are among the most affected markets. These findings underscore that the impact of technology giants such as NVDA on emerging markets may increase in the long run, and investors in these markets should be more cautious about global market developments.

In conclusion, the results suggest that NVDA's stock price fluctuations may have significant volatility spillover effects on global markets in the long run. Future financial risks should

be carefully assessed, as emerging markets, in particular, can be heavily influenced by the performance of such global technology giants.

6. Discussion

This study examined the volatility spillover effects of speculative bubbles in NVDA stocks in emerging markets (such as Brazil, Indonesia, Taiwan, India, and Chile). Using the volatility spillover model of Diebold & Yılmaz (2012), the analysis revealed significant differences between short-term and long-term volatility dynamics.

i. Short-Term Volatility Spillover

In the short term (1-6 days), the impact of NVDA on these markets has been quite limited. It was found that when NVDA's speculative bubbles burst, the short-term market effects were minimal and did not cause significant spillovers to emerging markets. This finding suggests that the immediate spillover of stock price movements of large technology companies such as NVDA to global markets is lower than expected. In the context of the theory of speculative bubbles, this situation suggests that the shocks generated by bubbles at the moment of bursting are initially too weak to affect market stability.

ii. Long-Term Volatility Spillover

In the long term (6 days and beyond), NVDA is found to give significant volatility to emerging markets, especially Indonesia (16.16%) and Brazil (17.03%). These results show that NVDA creates significant volatility spillover to emerging markets in the long term and NVDA gives significant volatility to Indonesia (16.16%) and Brazil (17.03%) in the long term.

iii. The Fragility of Emerging Markets

The study results show that emerging markets are more susceptible to speculative bubbles in global technology giants in the long run. In particular, it was found that Indonesia experienced the highest volatility from NVDA and that this vulnerability could pose serious risks in the long run. From the perspective of financial stability and risk management, these findings suggest that emerging markets should be more resilient to risks in global markets.

iv. Economic Effects of Speculative Bubbles

If NVDA's speculative bubbles burst, the economic impact will be greater in emerging markets. The risk of financial instability in these markets increases, forcing investors to be more cautious. While Minsky's financial instability hypothesis argues that the bursting of speculative bubbles can have long-term effects on markets, the results of this study support this hypothesis. The bursting of bubbles in technology giants such as NVDA can significantly impact the financial system, especially in developing countries.

v. Interdependence of Global Markets

It is important to highlight how NVDA's volatility not only affects emerging markets, but also interacts with global economic trends. As a major player in the semiconductor market, Nvidia plays an important role in technology manufacturing. Fluctuations in NVDA's stock could lead to production disruptions in industries such as electronics, automotive, and healthcare. This could affect economic activity not only in emerging markets but also in developed

economies that depend on these sectors. In addition, the speculative bubble in NVDA has been observed to coincide with global investment trends in technology stocks. As investors become more dependent on technology stocks, the volatility of such companies will become more closely linked between developed and emerging markets. This could increase the impact of NVDA's stock movements on global financial markets and cause volatility in markets around the world.

vi. Macroeconomic Risks

The speculative bubble in NVDA has the potential to create macroeconomic risks in both emerging and developed markets. In particular, volatility in NVDA's stock could affect capital flows in emerging markets. Capital outflows could cause exchange rate volatility and inflationary pressures, which could increase the cost of borrowing in these countries. It would also be useful to compare NVDA's impact on global financial stability to past global crises, particularly the 2008 financial crisis and the dot-com bubble. In both cases, volatility in the technology sector triggered major crises in global markets, and emerging markets were severely affected by these shocks. A similar systemic risk could arise if the NVDA speculative bubble bursts.

vii. Global Policy Considerations

The financial risks posed by speculative bubbles in large technology companies such as NVDA should be addressed as part of a broader policy debate. The potential for speculative movements in the stock prices of technology giants to spill over into emerging markets raises the need for a better global regulatory framework. International financial regulations need to be strengthened to limit the impact of the volatility that such companies can cause, especially given NVDA's market value. In addition, the volatility created by NVDA in global markets increases the need for cross-border financial cooperation. International cooperation and information-sharing mechanisms should be put in place to make developing countries more resilient to such risks. In this context, greater coordination between international regulators and local authorities should be ensured to minimize the impact of potential shocks that large technology companies such as NVDA can cause in emerging markets.

viii. Geopolitical Tensions

NVDA's role in the global technology sector is also vulnerable to the effects of geopolitical tensions. Uncertainties in global trade policy, particularly the U.S.-China trade war, can impact both NVDA's production and investor confidence. Such geopolitical risks may increase NVDA's stock volatility and exacerbate economic instability in both emerging and developed markets. As emerging markets are more vulnerable to such trade wars and global uncertainties, NVDA-driven volatility could have a greater impact on these markets.

7. Recommendations

In light of these findings, it is clear that emerging markets need to become more resilient to the long-term volatility spillovers from global technology giants such as NVDA. In particular, countries such as Indonesia and Brazil should strengthen their market risk management strategies. The results show that speculative bubbles in NVDA stocks have a limited impact in the short run, but in the long run, when these bubbles burst, they can cause serious volatility in

emerging markets. Therefore, financial regulators in such markets need to take more proactive measures against sudden changes in global markets. This may include the effective use of financial instruments and the development of volatility hedging strategies.

The potential for volatility in NVDA stock to spill over into emerging markets also suggests that investments in the technology sector should be carefully diversified. Investors in these markets should avoid over-reliance on technology stocks and balance their portfolios with more stable sectors such as energy, infrastructure and agriculture. As the findings suggest that NVDA volatility may spill over into other markets, especially over the long term, such diversification strategies will help investors minimize the risks of market shocks.8

In addition, increased international cooperation is also important in light of these findings. While fluctuations in the stock prices of global technology giants such as NVDA have the potential to spill over into other markets, these interactions need to be closely monitored and managed. Emerging markets should integrate into international financial networks to better monitor the global impact of large technology companies and manage potential risks to these markets. In this context, the development of information-sharing and cooperation mechanisms among market regulators will help to better prepare for potential market shocks.

Finally, given the long-term impact of technology bubbles on emerging markets, these countries should strengthen their financial stability policies. As the evidence suggests that speculative bubbles in NVDA can lead to long-term market volatility, financial regulators should develop macroprudential policies to mitigate the effects of market bubbles. Such policies could include measures such as expanding stress testing in markets and implementing early warning systems to protect against overvaluation in the technology sector.

8. Conclusion

In this study, the volatility spillover of speculative bubbles formed in NVDA stocks to emerging markets (Brazil, Indonesia, India, Chile and Taiwan) was analyzed using the GSADF test and the volatility spillover model of Diebold & Yılmaz (2012). The GSADF test revealed that six different bubbles formed in NVDA stocks between 2020 and 2024, and the last bubble is still ongoing. The Diebold & Yilmaz model assessed the short- and long-term impact of these bubbles on emerging markets.8

The results show that speculative bubbles in NVDA's stock have a limited impact in the short term, but in the long term they have caused significant volatility in Brazil (17.03%), Indonesia (16.16%), Taiwan (13.63%), and Chile (12.2%). These results suggest that global technology companies have the potential to create long-term financial risks in emerging markets.

Recommendations for Future Research

Sector-based studies: Future studies could examine volatility spillovers not only to the technology sector, but also to other sectors (e.g., energy, finance) in emerging markets. This would allow for a broader perspective to assess the impact of technology giants such as NVDA.

Impact of macroeconomic shocks: The volatility spillover in the markets has been analyzed in the study; however, the role of global macroeconomic shocks (e.g., pandemic, geopolitical risks) on this spillover can be further explored in the future.

Comparison with Alternative Methods: Besides the Diebold & Yilmaz model, various volatility propagation models (such as BEKK-GARCH) can be used to evaluate the consistency of results and model sensitivity.

Other tech giants: The impact of other major tech companies (e.g., Apple, Microsoft) on emerging markets can be analyzed using similar methods. It is important to highlight the unique characteristics of NVDA in terms of its volatility spillover.

This study showed that NVDA's speculative bubbles pose significant volatility risks in emerging markets and provided important clues for policymakers on how to guard against such risks.

Conflict of Interest

The author declares that there is no conflict of interest.

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