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Monetary Policy and Volatility of Value and Growth Stocks (2009-2021)

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Abstract

Especially after the subprime international financial crisis, which began in 2007/2008, the role of central banks and the implementation of monetary policy gained ground and affected financial markets. In such a scenario, quantitative easing, a monetary stimulus program implemented by several central banks, significantly reduced interest rates, especially in developed countries. In this context, the objective of the research is to investigate whether there is a relationship between the monetary policy actions of the Federal Reserve (Fed) and the volatility of value and growth stocks in the USA in the period between 2009 and 2021 using a generalized heteroscedastic conditional autoregressive (Garch) model. The research hypothesizes that both value and growth stocks react with increased volatility to changes in monetary policy, with growth stocks showing superior sensitivity. Among the results found, there is evidence that the policies implemented by the Fed over the period led to volatility in the markets, with an emphasis on the intensity of volatility for value stocks to the detriment of growth stocks, which refuted, albeit partially, the initially formulated hypothesis.

Keywords: value stocks, growth stocks, volatility, monetary policy, Garch model

1. Introduction

The international financial crisis of 2007/2008, which began in the subprime credit market, had unprecedent impact on how central banks and monetary policy act. Specifically, in the United States, the epicenter of the crisis after a series of discretionary policies divided between the rescue of banks and the punishment of large financial institutions through the "permission" of bankruptcy, the option of what became known as quantitative easing was chosen. Quantitative easing was a monetary stimulus program based on purchasing public and private bonds to significantly reduce interest rates, expand liquidity, and stimulate the credit market, aiming to minimize the effects of a possible depression. Meanwhile, the post-subprime crisis period, especially the 2010s, was characterized by the high growth of technology companies, with very different characteristics from traditional companies. In this context, the absolute returns of growth and value stocks were considerable. However, growth stocks had proportionally higher returns than value stocks, contrary to the usual expectation in the financial literature in times of conventional monetary policy.

Considering both the unconventional monetary policy (quantitative easing) and the accelerated growth of technology companies, the objective of this research is to investigate, for the period between 2009 and 2021, whether there is a relationship between the Federal Reserve's (Fed's) monetary policy actions, measured primarily using the short-term interest rate, and asset balance and the volatility of US value and growth stocks through the use of a generalized heteroscedastic conditional autoregressive (Garch) model. With the analysis of four exchange-traded funds (ETFs) representative of the US stock market (two for value and two for growth), the application of the aforementioned econometric model allows the generation of the conditional standard deviation, which, in turn, shows the peak volatility of each of the ETFs over time. After that, periods of change, both in the short-term interest rate and in the Fed's asset balance, are evaluated to confirm whether there is a relationship between monetary policy actions and asset volatility. Quantitative easing resulted in a drop in the economy's interest rate, especially, according to Bernanke (2022), the long-term interest rate. In this context, the research hypothesis is that both value and growth stocks react with increased volatility to changes in monetary policy, with growth stocks showing greater sensitivity to value stocks in the face of more significant uncertainty regarding future cash flows to a monetary policy scenario such as quantitative easing. Two factors mainly justify

the research: the relevance of stock market analysis in periods of unconventional monetary policy and the strong growth of the technology sector and, consequently, that of growth stocks in the selected period.

Initially, it is helpful to introduce some general notions about ETFs. Exchange-traded funds (ETFs) are financial instruments that are very similar to mutual investment funds or, in the Brazilian case, investment funds in quotas, considered, according to the governing legislation (article 1.368-C of the Civil Code), as a species condominium of a unique nature, aimed at the allocation of the shareholders' resources in financial assets, goods, and rights of any nature. However, the particularity of ETFs is that, unlike traditional funds, which only allow direct redemption, their shares are freely traded on the stock exchange and can be bought and sold whenever their holders see fit.

In addition, ETFs make it possible to structure the most diverse purchases of assets, including indices, thematic groups of shares, single shares, bonds, commodities, currency pairs, and derivatives, among many other possibilities. This broad flexibility allows individual investors to access financial instruments and strategies previously restricted to institutional allocators. The management of ETFs can be active and passive, the first being carried out by a manager who chooses the securities and financial instruments that make up the fund and the second being only representative of an index replicated, a situation in which management fees are usually very modish.

The dissemination of ETFs indeed took place after the 2008 crisis, with the growth of managers such as BlackRock and Vanguard due to the great interest of individual investors in allocating ETFs that passively replicated the leading stock indices, allowing individuals to have a low rate of return management and returns in line with the market. This situation was unlike the one that had prevailed in the fund industry over the years, according to Bogle (2017), in which mutual funds charged high management fees and performed below the general indices most of the time.

The article is structured as follows to achieve the research objectives. The theoretical framework, presented in the next section, refers to the role of the Fed, the theoretical aspects of monetary policy, and an analysis of the characteristics of value and growth stocks. Next, the third section presents the research methodology, which uses a generalized heteroscedastic conditional autoregressive model (Garch), along with details of the data used in the research. Finally, the fourth section contains the research results and a discussion, followed by the references used in the research.

2. Literature Review

Studying the effects of monetary policy on the volatility of value and growth stocks depends on theoretical issues that concern not only monetary policy itself but also the actions of the Federal Reserve. Complementarily, the specific effects of monetary policy on the stock market should be addressed, in addition to the characteristics of value and growth stocks. In this sense, the theoretical framework is divided into three blocks. The first block relates to the Fed's performance and monetary policy. The second block involves a theoretical analysis of the monetary policy transmission channels, highlighting the effects on the stock market and vice versa. The third and last block contains the criteria for distinguishing between "growth" and "value," that is, the characteristics of growth stocks compared with those of value stocks.

2.1 Central Bank and Monetary Policy

Monetary policy in the United States is the responsibility of the Central Bank. Thus, the Federal Reserve, the central bank of the United States of America, established through the Federal Reserve Act of 1913, aims to provide the country with a stable monetary and financial system. As it is a body established by law, the competence to modify the regency legislation rests with Congress, which, over the decades, has amended the act several times to shape the performance of the monetary authority in line with the political guidelines and the social and economic goals outlined by parliamentarians. In this sense, the Federal Reserve is responsible for conducting monetary policy and promoting the financial system´s stability, the safety of financial institutions, the safety and efficiency of the payment and compensation system, and consumer protection and community development.

It is thus up to the Fed to outline the national monetary policy by making decisions regarding open market operations, which, therefore, interfere in the formation of the Federal Funds Rate (FFR), the posting of which is essential to define the rate at which the depository institutions lend to each other. The Federal Open Market Committee (FOMC), created by Congress in 1933, is the committee that sets the economy's interest rate, in addition to defining the composition of assets on the Fed's balance sheet and issuing periodic communications to the public to outline the future of monetary policy (forward guidance), among other tasks.

Complementarily, Section 2A of the Federal Reserve Act establishes as the objective of monetary policy the growth of monetary aggregates to achieve multiple aims, such as full employment, price stability, and moderate long-term interest rates. At this point, it is essential to note that, initially, the function of the Fed was only to ensure price stability, that is, to control inflation. Subsequently, however, with the addition of the objective of full employment, apparent contradictory purposes were attributed to the monetary authority since, according to Froyen (2013), the Philips curve shows that the unemployment and inflation variables would be inversely correlated. It should be noted, therefore, that, unlike other central banks, which have the achievement of price stability as their sole objective, the Fed faces the challenge of seeking stable inflation concomitantly with economic growth through monetary policy.

2.2 The Transmission Effects of Monetary Policy

Changes in interest rates entail a series of impacts on the economy, which are called "monetary policy transmission effects." The transmission effects of monetary policy generate significant repercussions for the capital market. They can be segmented as follows: effects on stock prices, on the value of the dollar, on credit spreads, on lending patterns, and on capital formation.

To provide more detail on each effect, as the Fed raises or lowers short-term interest rates (FFRs), financial market agents are expected to change their expectations and, consequently, sell or buy, depending on the movement. In this sense, a drop in interest rates, according to Bernanke and Kuttner (2005) and Rigobon and Sack (2002), causes an increase in stock indices in the short term, given the measures to stimulate demand, which tend to engender an increase in corporate net income. The opposite will also occur if there is an increase in interest rates so that stock indices tend to fall initially, with projections of economic deceleration. The same phenomenon occurs with bonds, with impacts varying according to the duration of the bonds.

Changes in the pricing of companies also produce a derivative effect, consisting of the wealth effect, since the allocation of bonds and shares of households and individual investors will be subject to changes arising from the monetary policy outlined. According to Case, Quigley, and Shiller (2005) and Ludvigson and Steindel (1999), with the reduction in equity due to the fall in the price of stocks and bonds, consumers are likely to spend less and be more restrained with their expenses, causing negative consequences for the economy as a whole, with a possible reduction in the GDP growth rate. Similarly, an increase in investors' equity leads to a stimulus to household consumption.

The second transmission effect to be explored concerns the dollar's strength against other currencies. In a scenario such as that of 2022, in which the FOMC clearly stated, through the minutes and statements of its members, that the direction of gradual interest rate increases is intended to contain inflation, agents quickly incorporated this contractionary monetary policy into their expectations, with the dollar strengthening against virtually all currencies in developed and emerging countries. This effect, in turn, has consequences for the GDP, either by making imports cheaper and exports more expensive in a situation where the dollar appreciates or by stimulating the economy where the currency is devalued against its peers (Bernanke, 2022).

The third, fourth, and fifth effects concern spreads, credit granting parameters, and capital formation, deserving joint treatment due to the inseparable relationship that the variables present. Suppose the monetary authority reduces short-term interest rates. In that case, investors tend to reassure themselves regarding companies' ability to honor their debts since monetary policy signals tend to favor revenue growth prospects. In this hypothesis, the spreads tend to be smaller since there is no risk of default in the medium-term and long-term scenarios. In a contractionary scenario, conversely, spreads tend to increase, given the risk of default by companies, causing creditors to demand a higher interest premium to lend to companies. These spreads affect the conditions for companies to issue debt, increasing or decreasing the cost of capital depending on whether the monetary policy signals an increase or a decrease in interest rates.

2.2.1 The Effects of Monetary Policy on the Stock Market and Vice Versa

After examining the transmission effects of monetary policy, it is necessary to revisit some studies that have carefully analyzed the main impacts of recent measures adopted by the monetary authority on stocks and, likewise, the repercussions that movements in stock prices may have for decisions concerning the conducting of monetary policy. In the analysis by Rigobon and Sack (2002), an attempt was made to identify the behavior of the effects of monetary policy on stocks and on the yield curve by analyzing the increase in variance detectable on days of FOMC meetings and the half-yearly testimony by the President of the Fed to Congress. The results obtained through the methodology applied were quite different from the assumptions adopted in the event study method, therefore emphasizing that an increase in short-term interest (FFR) implies a more expressive fall in stock prices and a less significant slope of the yield curve, which becomes progressively smaller when reaching

long maturities. The author´s chosen method allowed the news that reached the market to be linked predominantly to monetary policy, avoiding noise from other events that could affect stock prices. In the authors' opinion, the variance of monetary policy shocks on these dates is a sufficient causal factor to measure the consequences of monetary policy for stocks.

According to the results achieved by Rigobon and Sack (2002), the most significant effects are attributed to Nasdaq shares in such a way that a 25 basis point increase in three-month interest rates leads to falls of 1.90% in the S&P 500 and 2.50% in the index with a preponderance of technology companies. Likewise, this increase implies a slope in the North American yield curve between 18 and 22 basis points for maturities of up to five years, with more negligible growth in the more distant vertices. Rigobon and Sack (2003) also published a study analyzing the inverse relationship: the impact of stock prices on monetary policy, bearing in mind the macroeconomic consequences resulting from stock movements. The authors used an identification technique based on the heteroscedasticity of stock market returns to measure the reaction of monetary policy to fluctuations in stock prices, concluding that a 5% rise or fall in the S&P 500 would increase the probability by 50%, respectively, an increase or a cut of 25 basis points in short-term interest rates. In their conjectures aiming to explain this movement with positive correlation, the authors preliminarily admitted the difficulty in finding justification. However, they warned of the choice in the analysis carried out by measuring the monetary policy response in the face of an exogenous movement in the price of shares, therefore moved by the propensity of investors to assume risks. Furthermore, Rigobon and Sack (2003) considered that another fact in the movement of stocks may be systematically related to the prospects of the economy as a whole: the release over weeks of the primary economic data, which are concomitantly examined to trace the path of policy currency. Interestingly, by the researchers' argument, when analyzing the two works by Rigobon and Sack (2003) together, they verify that causality occurs in both directions since, on the one hand, the rise or fall in the prices of shares takes into account movements in the aggregate demand, while, on the other hand, the inverse relationship occurs, with decisions on monetary policy interfering with this macroeconomic variable, which is fundamental for the projection of companies' profits and dividends as well as future expected excess returns.

Another vital work detailing the relationship between the transmission effects of monetary policy on the stock market is the research by Ehrmann and Fratzscher (2004), which surveyed market participants to assess the shocks that monetary policy causes to expectations from the market. The authors' first observation concerns the specific effects that monetary policy can have in each industry, oscillating by the nature of the activity performed by the company. According to the authors, technology, communications, and cyclical consumer goods companies react to monetary policy two to three times more intensely than companies in less cyclical sectors. The second check focuses on the details of corporate finances, highlighting that companies with low cash flows, small market capitalization, a low credit rating, a low debt-to-equity ratio, a high price-earnings multiple, and a high "q" are much more sensitive to central bank decisions. In this case, it is interesting to note that companies in this group, based on the results found, are affected practically twice as much by monetary policy than companies with large cash flows and debts.

In any case, the authors highlighted the difficulties in establishing the causal relationship between monetary policy and stock prices, especially about identifying monetary policy in isolation as a causal factor since changes in interest rates made by the monetary authority can coincide with changes in the economic cycle as well as with changes in economic data. This difficulty has been reflected in many past surveys. The vital contribution of the authors, in fact, given the previous literature, concerns the clear identification of the heterogeneity of the effects on companies, depending on the particular financial circumstances and the market niche in which they operate. Bernanke and Kuttner (2005), in turn, when examining the reaction of the stock market to the monetary policy of the Federal Reserve, pointed out that a hypothetical unexpected cut of 25 basis points in the FFR would provide an increase of approximately 1% in stock indices due to the impact of the unanticipated measure on the excess returns expected by agents. The authors' finding reinforces the theory of rational expectations to the extent that only monetary policy actions not priced by agents—which, for example, can be seen in the derivatives market and, more specifically, in FFR futures contracts—could cause changes in the pricing of shares. Bernanke and Kuttner (2005), similarly to other studies, also found that the effects fluctuate according to sectors, with the subgroups of technology and telecommunications exhibiting a response approximately 50% more sensitive than that to the general indices. Conversely, sectors such as utilities (concessionaires) and energy seem to be little affected by the change in monetary policy, everything converging, therefore, to the predictions of the CAPM model.

However, an important caveat made by Bernanke and Kuttner (2005) concerns the problematic question of interpreting why stocks respond to monetary policy, as found in the research. To the authors, the reaction does

not result directly from the change in the real interest rate but mainly stems from the effects on expected future excess returns or expected future dividends. A contractionary monetary policy would imply lower prices for shares due to the increase in the expected equity risk premium, either due to the increase in interest costs and the weakening of the balance sheet of listed companies or due to the reduction in expected consumption levels, leaving open the possibility that monetary policy may also affect the level of precautionary savings of economic agents.

Campbell and Viceira (2001), conversely, carried out an analysis of the perspective of buying long-duration bonds in the composition of a portfolio, concluding that, in the composition of the portfolio of an investor without a determined life estimate, without considering the income from work and in the face of stochastic interest rates, there is room to allocate part of it to long-term bonds to protect against the risk of a drop in real interest rates. The most appropriate way to carry out this strategy would be through long-term inflation-indexed bonds. However, nominal bonds could also be considered, provided inflation risks were low. Indeed, exploring the rationale underlying this portfolio structure, as long-term bonds offer an interest premium, it makes sense from a risk perspective that is more prone to speculation to compose part of the portfolio with these bonds, even if there are fluctuations in the short term. As a practical consequence, they concluded that more risk-averse investors tend to opt for indexed securities in pension plans and annuities. In contrast, more aggressive investors may accept the risk of inflation or stock risk.

Gilchrist and Zakrajsek (2013) identified in their research that the large-scale asset purchase program reduced the cost of protecting against default risk, both for investment-grade bonds and speculatively rated bonds. However, even though the credit risk of the economy had fallen substantially, the financial intermediation sector would not have felt any similar benefit. Indeed, large-scale asset purchase (LSAP), a form of quantitative easing, was a program designed to reduce the interest rates at the extended vertices of the curve through the purchase of securities issued by government-sponsored housing entities (government-sponsored housing agencies), mortgage-backed securities, and securities issued by the US Treasury (treasury bonds). In 2011, the bond maturity extension program was carried out to put more significant pressure on the long peaks to stimulate economic activity. According to the analysis by Gilchrist and Zakrajsek (2013), quantitative easing, due to its various transmission effects, deserved a closer examination from the perspective of the default risk channel, so the authors aimed to quantify the effects of the announcements of the three purchases of assets due to the impact of risk-free asset rates on indicators that measure corporate credit risk, both in the economy in general and in the financial sector in particular. When assessing the effects of the credit default swap (CDS), the authors concluded that the asset purchase programs were fundamental for reducing the cost of this hedge, also corroborating the results of Hancock and Passmore (2011) regarding the significant reduction in interest on residential mortgages, with more relaxed financial conditions for both families and companies.

Alternatively, as they were unable to identify the same effect in the financial sector, Gilchrist and Zakrajsek (2013) conjectured that financial institutions probably remained with this perception of greater risk due to the projected lower profitability of banks and the potential attribution of losses by the government to large financial intermediaries, despite the elimination of the tail risk arising from a systemic financial crisis, suppressed by the adoption of quantitative easing. D'Amico and King (2010) obtained important results for this work when examining the consequences of asset purchase programs (quantitative easing) for reducing the North American yield curve's apexes. According to the research carried out, asset purchases by the Federal Reserve caused an average drop of 3.5 basis points on the days when they took place, and, in a longer time frame, the policy would have engendered a solid drop of 50 points in the yields of treasuries, mainly in the vertices between 10 and 15 years. At the same time, Joyce et al. (2011), members of the Bank of England, conducted research to analyze the effects of quantitative easing on asset prices in the United Kingdom. For the authors, it was consistent to state that, between 2009 and 2010, long-term government bonds were affected by approximately 100 basis points, with the central part of this impact being felt through the portfolio balancing effect since the change in the vertices of the yield curve induced new pricing of assets, which, therefore, led investors to recalibrate their portfolio according to the changes in the macroeconomic scenario. Another effect observed by the authors concerned the reduction of the illiquidity premium, in line with the work of Tobin (1958), regarding the maintenance of money by the Keynesian liquidity preference, mainly given of the adherence to investor expectations, which will remain in demand for money that is more sensitive to fluctuations in interest rates. In this sense, as the central bank positions itself as an essential player in purchasing assets, it becomes less costly for investors to sell assets. Regarding this topic, Bernanke (2017) was able to establish that the Federal Reserve's monetary policy exerts an impact on the liquidity premium in dollarized markets, affecting the availability and cost of credit in emerging markets, attesting, in this case, to the importance of US monetary authority on the

global stage, with cross-border transmission effects. It is interesting to note, while examining the results found by Joyce et al. (2011), the preparation of a table to demonstrate the short- and long-term effects on the assets, firstly through the window at the time of the announcement of the measures and, in the second demarcation, by an interregnum of approximately 15 months after the announcement. Interestingly, the short-term effects indicated a drop of 100 basis points in Gilts, 70 basis points in investment grade corporate bonds, 150 basis points in high-yield bonds (with greater intensity than the previous ones), 3% on the FTSE All-Share, and 4% on the British Pound Exchange Index. In the more extended cut, there was a 30 basis point increase in Gilts, a 400 basis point decrease in investment grade corporate bonds, a 2,000 basis point decrease in high-yield bonds, a 50% increase in the FTSE All-Share, and an increase of 1% in the pound sterling exchange rate.

Black (2002) sought to evaluate the effects of monetary policy on the return and volatility of value and growth stocks in a broad study involving several countries. Even though the classification of value and growth stocks at the time of the study was very different from the definitions used today, it was possible to identify that, in part of the countries analyzed, value stocks had a lower return than growth stocks in the face of a policy restrictive currency. Specifically concerning volatility, while the stock market of some countries demonstrated a reduction in volatility with restrictive monetary policies, other markets faced an increase in volatility in an environment of rising interest rates.

Bartram, Brown, and Stulz (2012) demonstrated that the shares of US companies are more volatile than the shares of similar companies in other countries due to factors such as the level of investor protection, the development of the stock market, and the innovation process. Major innovations associated with high growth potential would explain the increase in volatility. Even though the authors do not have differentiated value and growth stocks, growth stocks are related to companies with a high degree of innovation and, in this sense, tend to exhibit higher volatility. In other words, volatility is related to the ability of companies to take risks that could lead to more innovation and growth in the future, typical characteristics of growth companies.

2.3 Growth vs. Value: Criteria for the Distinction

The distinction between value actions (value) and growth actions (growth) has dominated the debate in the last decade, considering that the historical comparison favored the preponderance of value actions, according to the analysis by Fama and French (1996), which would have a return premium over comparable growth stocks. However, this favoritism of value stocks, to be demonstrated in the data subsection of the methodological section, was overcome between January 2009 and December 2021 so that growth companies established a considerable return advantage over companies of value. So far, however, only the two groups have been referred to, and the discrepancy in performance between the two groups has been highlighted, making it necessary, from now on, to address solid criteria to understand the dichotomy. Indeed, the classification criterion by itself presents problems because the idea of value can be referred to the work of Graham and Dodd (1934), whose lessons indicated the need to assess the intrinsic value of the asset under examination, forecasting the future generation of cash flows and discounting them for a fee to obtain the present value. In this way, through the path described, share´s intrinsic value would be reached, consequently confronting it with the market price traded on the stock exchange to determine whether there would be a safety margin for the asset´s purchase. According to Graham (2005), if there were such a difference, it would be up to the investor to buy the stock and wait indefinitely until the market converged to the intrinsic value.

In the light of this theoretical ideal of value investing, a stock with a forecast of significant growth in revenue and net profit could, in theory, have its intrinsic value above the trading price since the cash flow projections would assume this remarkable growth in advance, as pointed out by Fisher (2003). However, from the observations of Greenwald et al. (2001), it is apparent that the framework of value investing is very cautious about assumptions of significant growth as they bring significant risk to the valuation, which is why theorists and practitioners have agreed to categorize value stocks as a representative subgroup of companies with low projected growth of net income, as exposed by Penman and Reggiani (2018). Therefore, companies with low price/earnings multiples are treated as value stocks due to the conservatism of the value investor method, which avoids projecting large earnings growth ahead as a way of mitigating investment risk. That said, as a logical result, the first denotative criterion for the growth category became high price/earnings, as indicated by Vasconcelos and Martins (2019), along with the practice of structuring ETFs with passive management of these two subgroups. The second criterion to aid the classification is the multiple price/book value (price to book), as value companies would have a low ratio between market price and equity. In contrast, growth companies, mainly due to the projected high return on equity (ROE), would have very high multiples. Against this distinction, however, Penman and Reggiani (2018) proposed the thesis that the low price-to-book ratio could indicate a value trap so that the lower this multiple, the greater the risk projected by the market regarding the business's ability to

increase its net income in the coming years. Therefore, investors could buy an asset based on the premise that they had acquired a bargain when, in reality, they would fall into a trap by disregarding the opacity in the projection of future earnings. Think, for example, of European banks with low price multiples over book value, which have suffered severely in the last decade, to increase their net income and return on equity (ROE).

Furthermore, in addition to the argument raised by Penman and Reggiani (2018), after the subprime crisis, as highlighted by Haskel and Westlake (2018), many of the companies that flourished in the 2010s were companies that did not depend on a large amount of capital and a large physical structure, its competitive differential residing purely in information technology and intellectual property data, which, consequently, dispensed with the analysis of price over equity value since the mentioned multiple would be of negligible importance for drawing any relevant conclusion regarding the valuation of the company.

Thus, as described by Haskel and Westlake (2018), the rise of the intangible economy in the last decade is the economic model capable of explaining the success of companies such as Amazon, Facebook, Google, Microsoft, and Netflix, among many others that have achieved great success, with low capital employed and minimal physical structure available to the company, thanks to innovations such as cloud computing and artificial intelligence. In addition to this indicated problem of multiple prices over book value, there is a trend that began during the internet bubble, especially with Amazon, according to which internet companies would spend years suffering financial losses without showing net profits or positive generation of operating cash, to subsidize considerable future growth in the user base—and, logically, in revenue and profits—thus justifying the current cash burn. Given the success of Amazon, the model was replicated by venture capital and private equity funds in several companies that were still at an embryonic stage, and the North American market began to list, in the initial public offering of shares, companies that were absolutely innovative albeit, in this initial stage, lacking clarity about their ability to generate stable net profit for shareholders in the future, consequently harming their inclusion in the growth categorization, given the present losses presented, which would result in negative multiples. In this context, Tesla is a suitable case to exemplify the discussion in these last paragraphs. Cornell and Damodaran (2014) analyzed Tesla's market price in light of the proposed valuation and reached the conclusion that the price reflected irrationality in relation to the fundamentals, with pricing approximately 150% above the intrinsic value. Given these results, they stated, in line with Summers's (1986) proposition, that the irrationality of pricing in the face of value could last for a long time, but in the future, with the clarity of data and the cash flow generation, the two numbers would converge. However, contrary to what the authors considered and despite moments of great difficulty, as narrated by founder Elon Musk, when Tesla was trying to scale up the production of the Model S after some follow-on captures, the company not only survived an intense burning company cash flow but also, more recently, managed to become profitable. (Note 1). It is true, however, that the valuation is very different from the market price, considering that the company is worth more than all other automotive assemblers combined. The case is emblematic of the shift in this type of company´s fundamentals over the years, making it difficult to categorize it as achieving growth in times of intense financial losses due to negative multiples. For these reasons, it seems appropriate to insert the near future profit projection as an additional distinctive criterion in a more extended period, for example, the next three years, capable of capturing the operational change in the company´s life. The criticism, however, that could be leveled at this criterion is that it deals with mere expectations, which can be impregnated with substantial irrationality and optimism. Although this point does not fit into significant incursions into the valuation problems of these projections, it is essential to consider, against the grain of this exacerbated confidence, that the promises of a large addressable market (total addressable market), widely used for pricing technology companies in IPOs by coordinating banks, tends to carry exaggerated assumptions that will inevitably lead to a correction to the intrinsic value at an imprecise moment, as demonstrated by Cornell and Damodaran (2020). Indeed, one has the impression that earnings projections have already been incorporated into the selected databases since the responsible managers emphasize the multiple prices/earnings for the next twelve months, thus instilling analysts' expectations and the sell side in both value and growth groups. Finally, it is worth highlighting the research by Christian, Woltering, and Sebastian (2017), who identified greater sensitivity of value stocks than growth stocks about the short-term interest rate. Conversely, growth stocks showed higher sensitivity to long-term interest rates than value stocks.

3. Methodology

The methodology used to reach the research objectives consists of applying a generalized heteroscedastic conditional autoregressive (Garch) model. This section is divided into two parts, the first presenting the data used in the research and the second presenting the econometric model. Briefly, the intention is, initially, to estimate the conditional standard deviation of each of the value and growth ETFs and, subsequently, based on the behavior of the Federal Funds Rate and the total assets on the Fed's balance sheet, to determine whether there

were coincidences between movements in short-term interest rates and Fed assets with increased volatility in value and growth ETFs.

3.1 Data

The empirical survey of this research involves the initial selection of two passive ETFs of each type (value and growth), with daily data between the first day of January 2009 and the last day of December 2021. The Vanguard Value ETF (ticker: VTV) and the Invesco S&P 500 Pure Value ETF (ticker: RPV) are selected as value ETFs, and the Vanguard Growth ETF (ticker: VUG) and the iShares Russell 1000 Growth ETF (ticker: IWF) are chosen as growth ETFs. In addition to the ETF data, the study employs the evolution of the Federal Funds Rate between January 2009 and December 2021 monthly, and the total assets on the Fed's balance sheet, also monthly, over the same period. Briefly, after estimating the conditional standard deviation of each ETFs, the research will investigate whether changes in short-term interest rates and the Fed's balance sheet coincide with the ETF´s volatility peaks. In addition, it will ascertain whether there are differences in the volatility of ETFs (value × growth) in the face of the changes mentioned above.

Table 1. Top 10 ETF positions—IWF, VUG, RPV, and VTV

Company	%ETF IWF	Company	% ETF VUG	Company	%ETF RPV	Company	% ETF VTV
Apple Inc.	12,94%	Apple Inc	12,60%	Berkshire Hathaway Inc	2,331%	Berskhire Hathaway Inc. Class B	3,38%
Microsoft Corp	11,04%	Microsoft Corp.	10,98%	Mosaic Co	2,105%	UnitedHealth Group Inc.	2,63%
Amazon Com Inc	5,52%	Amazon.com Inc	6,48%	Archer-Daniels-Midland Co	2,047%	Johnson & Johnson (JNJ)	2,55%
Tesla Inc	4,00%	Alphabet Inc	3,98%	Prudential Financial Inc	2,011%	J.P. Morgan Chase & Co.	2,20%
Alphabet Inc Class A	3,20%	Alphabet Inc	3,57%	Cigna Corp	1,967%	Procter & Gamble Co.	2,01%
Alphabet Inc Class C	2,95%	Tesla Inc	3,43%	Allstate Corp	1,834%	Exxon Mobil Corp.	1,91%
Meta Platforms Inc Class A	2,60%	Nvidia Corp	2,84%	MetLife Inc	1,808%	Chevron Corp.	1,74%
Nvidia Corp	2,46%	Meta Platforms	2,45%	Marathon Petroleum Corp.	1,805%	Pfizer Inc.	1,59%
Visa Inc Class A	1,80%	Visa Inc	1,71%	Paramount Global	1,800%	AbbVie Inc.	1,57%
Home Depot Inc	1,66%	Home Depot Inc	1,61%	Westrock Co	1,779%	Bank of America Corp.	1,55%

Source: *iShares, Vanguard, and Invesco.*

Thus, detailing the selected ETFs, the ETF Vanguard Value has as a strategy investment through indexing, monitoring the performance of the CRSP US Large Cap Value Index, composed, in turn, of value companies, predominantly large caps. In this way, VTV establishes the same weights for the stocks in the index and presents, on average, a price/earnings ratio of 15.8, a price/book value of 2.6, a return on equity (ROE) of 14.5%, and average growth in net income over the past five years of 12.2% per year. The most recent composition of each ETF can be seen in Table 1, with the top ten assets in each portfolio.

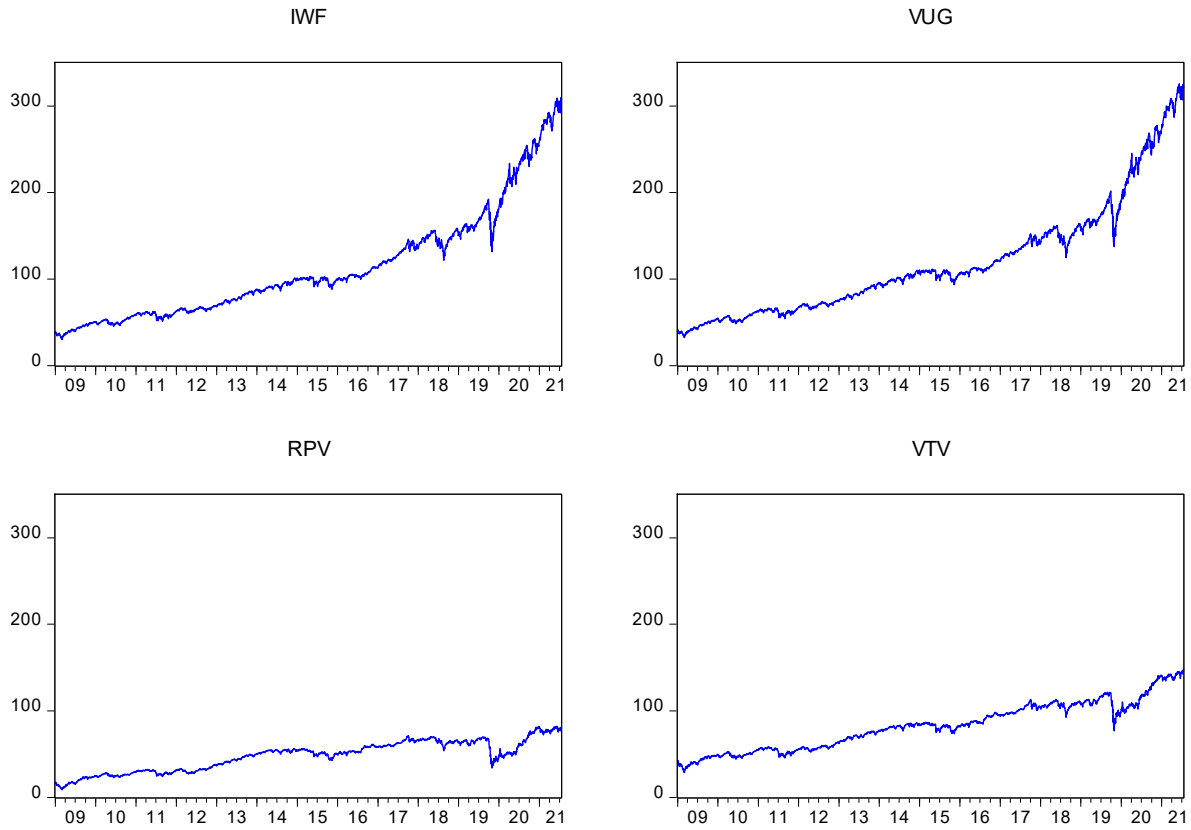

Figure 1. Prices of growth and value ETFs (2009–2021)

Source: *Yahoo Finance*.

Concerning the behavior of the selected value and growth ETFs, Figure 1 presents their prices over the 2009–2021 period. The movements of the IWF and VUG growth ETFs are pretty similar. The same applies to value, RPV, and VTV ETFs. In general terms, the four ETFs showed an upward movement in the period, but the growth ETFs had a more expressive increase than the value ETFs. It is also noticeable that, in October 2019, all the ETFs experienced a sharp drop, with subsequent recovery.

3.2 Heteroscedastic Generalized Conditional Autoregressive (Garch) Model

Conditional heteroscedasticity autoregressive (Arch) models are designed to model and predict conditional variances. The variance of the dependent variable is modeled as a function of past values of the dependent variable and the exogenous or independent variables. Engle (1982) was the first to develop the Arch models, later generalized by Bollerslev (1986) and Taylor (1986), with wide use for the analysis of financial time series. The interest in modeling or predicting volatility may relate to the need to analyze the carrying risk of an asset or the value of an option or to obtain more accurate intervals by modeling the variance of errors or even by estimating more efficiently from an adequate analysis of the heteroscedasticity of the errors.

The simplest Garch model (Garch (1,1)) can have different specifications: one for the conditional mean equation, another for the conditional variance, and a third for the conditional error distribution. The simplest form has the following specification:

$$Y_t = X_t'\theta + \epsilon_t \quad (1)$$

$$\sigma_t^2 = \omega + \alpha\epsilon_{t-1}^2 + \beta\sigma_{t-1}^2 \quad (2)$$

In equation (1), the mean equation is written in the form of a function of exogenous variables with an error term. The variable σ_t^2 is the prediction of variance one period ahead, based on past information, and is called conditional variance. The conditional variance equation, written in (2), is a function of the constant term ω of news about the volatility of the previous period, measured by the differences in the residual squares of the mean equation ϵ_{t-1}^2 (Arch term) and, finally, the forecast variance of the last period, consisting of σ_{t-1}^2 (Garch term). By mentioning the (1,1) in the Garch (1,1), one is referring to the presence of a first-order autoregressive

Garch term and then a first-order moving average of the Arch term. An ordinary Arch model would be a result of the Garch specification in which there are no differences in predicted variances in the conditional variance equation (Garch 0.1). There are also higher-order Garch models, expressed by Garch (q, p), which can be estimated using q or p greater than 1, where q is the order of autoregressive Garch terms and p is the order of the moving average of the Arch terms. The representation of the variance of the Garch (q, p) can be expressed by:

$$\sigma_t^2 = \omega + \sum_{j=1}^{q} \beta_j \sigma_{t-j}^2 + \sum_{i=1}^{p} \alpha_i \in_{t-i}^2 \quad (3)$$

Furthermore, from equation (2), it is possible to represent exogenous or predetermined variables that are included in the mean equation. By introducing the conditional variance or the standard deviation of the mean equation, we arrive at the Garch-M model, according to Engle, Lilien, and Robins (1987):

$$Y_t = X_t'\theta + \lambda\sigma_t^2 + \epsilon_t \quad (4)$$

The Arch-M model can be used in financial modeling in which the expected return of the asset is linked to its expected risk so that the estimated coefficient of expected risk is a measure of the risk–return tradeoff. Two variants of the Arch-M specification use the conditional standard deviation or the conditional log variance in place of the variance in the previous equation:

$$Y_t = X_t'\theta + \lambda\sigma_t + \epsilon_t \quad (5)$$

$$Y_t = X_t'\theta + \lambda\log(\sigma_t^2) + \epsilon_t \quad (6)$$

In the Garch model, the individual volatility of each ETF presented below will be evaluated to establish whether the increase in volatility, measured using the conditional standard deviation, coincides with oscillation in the interest rate or a change in the total assets of the Federal Reserve. The ETFs to be analyzed are presented in detail in the next section.

4. Results and Discussion

To estimate a Garch model, the returns of the four selected ETFs between January 2009 and December 2021 are initially presented, with a sizeable absolute performance advantage for growth funds, as previously mentioned (see Figure 2). Next, the descriptive statistics of daily returns are presented, referring to the four selected ETFs used in the Garch model (see Table 2).

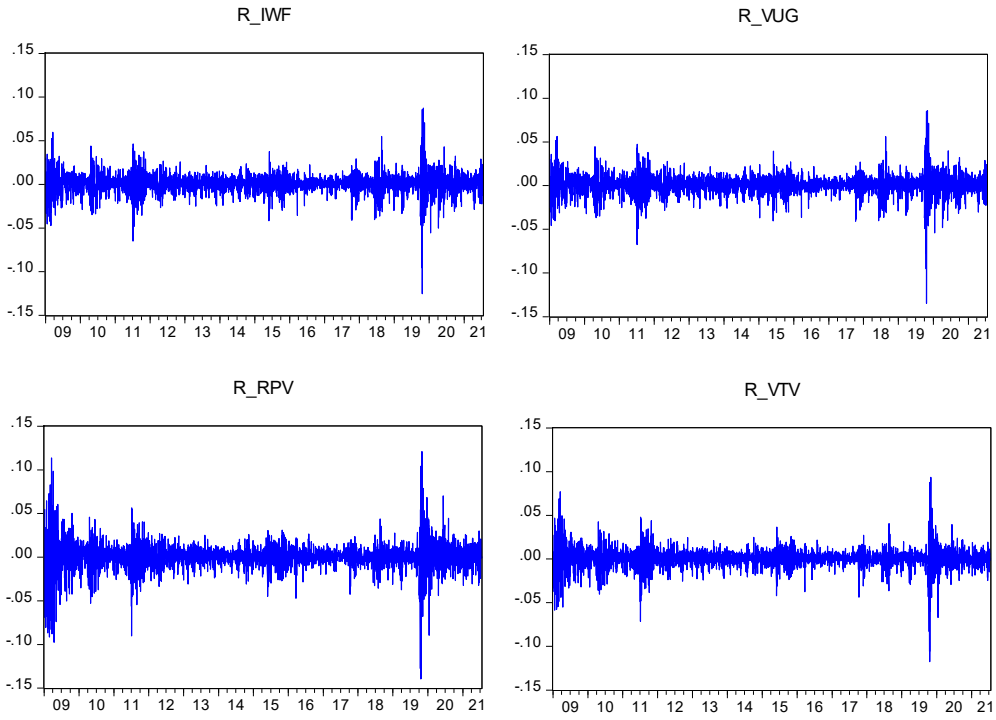

Figure 2. Returns of the four ETFs (2009–2021)

Source: Own elaboration from *Yahoo Finance*.

In Table 2, it is possible to perceive typical characteristics of financial series with a leptokurtic distribution. Even though the RPV value ETF had the highest standard deviation among the four analyzed ETFs, it is noteworthy that the growth ETFs, IWF and VUG, had a lower coefficient of variation than the value ETFs, which suggests, in relative terms, lower volatility of growth ETFs than of value ETFs over the period under analysis. From the returns of the four ETFs, Garch models (1,1) were estimated for each of the ETFs, to obtain the conditional standard deviation of each ETF.

Table 2. Descriptive statistics of daily returns from January 1, 2009 to December 31, 2021.

	R_IWF	R_VUG	R_RPV	R_VTV
Average	0,000645	0,000640	0,000498	0,000389
Median	0,001016	0,000980	0,000903	0,000722
Maximum	0,087385	0,085659	0,120728	0,093342
Minimum	-0,125432	-0,134850	-0,139525	-0,117415
Standard deviation	0,011682	0,011810	0,016046	0,011745
Asymetry	-0,627695	-0,732094	-0,668339	-0,595213
Kurtosis	1370826	1443636	1476382	1535044
Coefficient of variation	1149,80	1205,10	1776,97	1626,73
Observations	3273	3273	3273	3273

Source: *Yahoo Finance.*

The estimated results have been suppressed due to a need for more space. The estimated conditional standard deviations are shown in Figure 3, in which volatility peaks can be noticed at important moments of the adoption of monetary policy measures by the Federal Reserve. Accordingly, there are volatility peaks in the four ETFs in April 2010, July 2011, June 2015, October 2017, August 2018, and October 2019, drawing attention to the fact that the RPV ETF has higher sensitivity than the other three. Another point worth mentioning is the similarity in periods of peak volatility, albeit more intense in the value ETFs (VTV and RPV) than in the growth ETFs (VUG and IWF).

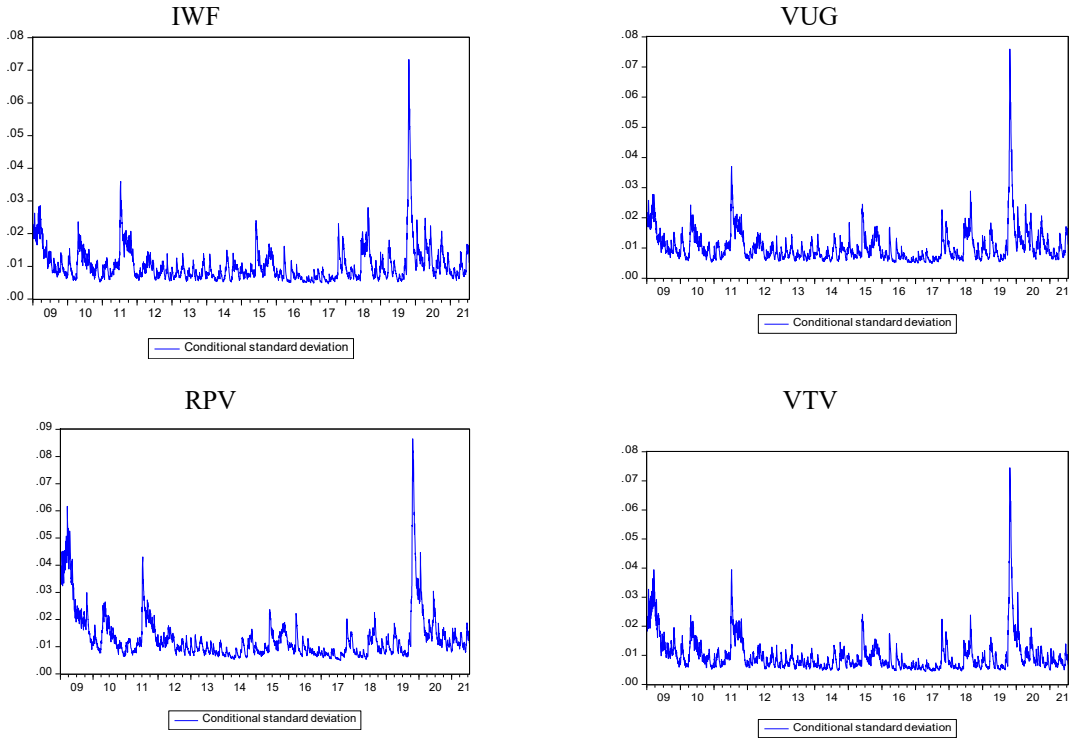

Figure 3. Estimated conditional standard deviation of IWF, VUG, RPV, and VTV - Garch (1.1)

Source: Own elaboration from Yahoo Finance.

Given of the behavior of the conditional standard deviation estimated with the Garch model for each of the ETFs, based on the behavior of the total assets on the Fed balance sheet and the Federal Funds Rate, shown in Figure 4, we seek to verify whether there are relationships between the changes in interest rates and Fed assets and the volatility of ETFs as well as the intensity of these relationships.

According to Figure 4, in April 2010, the Fed paralyzed the purchase of assets, keeping the total assets on the balance sheet relatively constant, around US$2.3 trillion, until December of the same year. In July 2011, there was a new purchase interruption, maintaining the amount at US$2.8 trillion. As of July 2014, the total assets remained stable between US$4.4 and 4.45 trillion until February 2018. The peak of volatility, however, occurring in June 2015, seems to be linked to the market's anticipation that the Fed would start raising the FFR, which effectively started in February 2016. This signal and the continuous upward movement in the short-term interest rate seem to have caused the peak of volatility in October 2017, reflecting the decrease in total assets on the Fed's balance sheet as of March 2018, justifying the new volatility peak in August 2018. Vartanian and Lima (2015) discussed in detail the evolution of monetary policy after the subprime crisis in the US economy.

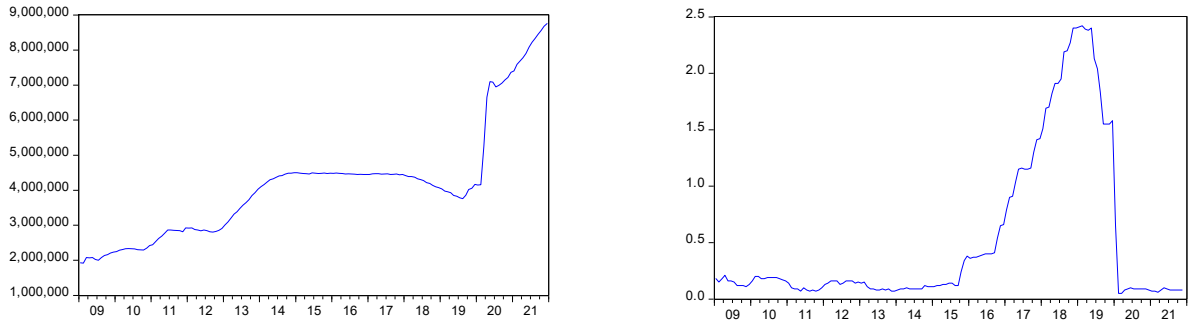

Figure 4. Total assets in millions of US$ on the Federal Reserve balance sheet and Federal Funds Rate (January 2009–December 2021)

Source: FRED Economic Data. St. Louis Fed.

In October 2019, the highest volatility peak in the series occurred; it is linked to the interruption to the decrease in total assets, with a turnaround by the monetary authority between September and October 2019, which started to repurchase assets to stimulate the US economy, simultaneously with the start of reductions in the FFR, as shown in Figure 4. On September 20, 2019, the Fed announced that it would inject up to US$75 billion per day until the 10th of the following month, which could result in injections of up to $1.5 trillion in a four weeks. In the following year, with the effects of the COVID-19 pandemic, there was a jump in the Fed's balance sheet, which quickly surpassed the figure of US$7 trillion; this also generated volatility peaks, although they were much less intense than those in the last quarter of 2019. As such, there is a view that the main monetary policy decisions of the period justify the increases in volatility in fundamental moments of increase, decrease, or stabilization of the assets held on the Fed balance sheet as well as of constriction interest rates from 2016 until August 2019. These observations are confirmed by the research by Bernanke and Kuttner (2005) and Rigobon and Sack (2002, 2003), which demonstrated that there is an impact of the increase (or decrease) of interest on stock market pricing in the short term, as well as the considerations by Ehrmann and Fratzscher (2004) on the different impacts of monetary policy according to each sector of activity and the company's capital structure. In comparative terms, Figure 3 showed that, although the volatility movements of the value ETFs are very similar to those of the growth ETFs, the volatility of the value ETFs was relatively more intense in the analyzed period. The means of the Garch model deserve to be highlighted since the volatility peaks measured by the conditional standard deviations of each ETF coincide with the moments of change in monetary policy, whether regarding the purchase of assets or the posting of the short-term interest rate. Nevertheless, in comparative terms, the value ETFs, on average, showed greater volatility than the growth ETFs, measured by conditional standard deviation, with emphasis on RPV. It is possible, therefore, to relate the research findings with the analysis by Bartram, Brown, and Stulz (2012) since value stocks are characterized by companies and sectors that present a high degree of innovation and superior growth in the future, which justifies the superior volatility compared to growth stocks.

5. Final Considerations

In response to the international financial crisis of 2007/2008, the central banks of developed countries, particularly the Fed, acted with asset purchase programs and liquidity injection into the economy. The injection of liquidity into the economy promoted numerous effects, among which are prominent impacts on the stock market. In this context, this research aimed to evaluate how monetary policy actions, measured through the Fed's asset balance and the short-term interest rate, affecting the volatility of value and growth actions between 2009 and 2021. For this purpose, a Garch model was applied to four ETFs representing value and growth stocks. The comparison of the effects of monetary policy between the value and the growth stocks was justified by the importance and growth of growth stocks, especially in the 2010s, with the emergence and development of several new businesses in the digital age.

The analysis of the conditional standard deviations of each of the ETFs, possible after estimating the Garch model, enabled the researchers to determine whether the volatility peaks observed in the four ETFs during the cut period can be explained by the effective monetary policy measures taken by the US Central Bank, such as changes in the Fed's balance sheet or the interest rate. The results suggest that it is indeed possible to attribute the volatility peaks observed in the conditional standard deviations to monetary policy decisions. However, it is certainly not possible to state that this is the only causal factor throughout the period capable of influencing the volatility of asset pricing. Although the research results were partially opposite to what was expected according to the formulated hypothesis, given the initial expectation of greater volatility in growth stocks, the relevance of the research was apparent when identifying the effects of the policy currency on the stock market. Although the four ETFs showed an upward trend over the analyzed period, there was an increase in volatility in the periods concomitant with changes in the Fed's balance sheet and the short-term interest rates; that is, there is evidence that the policies implemented by the Fed over the period led to volatility in the markets, with emphasis on the intensity of volatility for value stocks.

Considering that other factors that were not addressed in this research may have contributed to the volatility peaks, it is recommended that further research increases the number of variables to identify them and complement the present study. Another less important issue is exploring the differences in behavior identified between value and growth stocks in greater depth. A possible explanation that lacks investigation is that growth ETFs are formed especially by companies such as Apple, Amazon, Tesla, and Google, which stood out and consolidated in the business environment and the economy in the research analysis period, especially in the 2010s. Thus, given the results found in the present study, such issues are included as relevant on the agenda for future research.

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Informed consent

Obtained.

Ethics approval

The Publication Ethics Committee of the Canadian Center of Science and Education.

The journal and publisher adhere to the Core Practices established by the Committee on Publication Ethics (COPE).

Provenance and peer review

Not commissioned; externally double-blind peer reviewed.

Data availability statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Data sharing statement

No additional data are available.

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Note

Note 1. In 2015, Tesla had a negative free cash flow of approximately $2,158.00. In 2021, the company closed with a positive free cash flow of US$3,483.00.