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Abstract

This paper maps the US presidential terms with price dynamics in US stock markets by focusing on the S&P500 index. Fractional integration techniques, which are more general than other standard methods, are used and the results obtained produce interesting findings. It was found that during the second presidential terms, S&P500 stock market is less efficient and present higher degrees of persistence in its volatility. This is observed independently of the political affiliations of the president in power. The volatility, in general, reflects the spillover of economic excesses at the end of the first presidential term when seeking re-election into the second term in office. Expansionary monetary and fiscal policies at the end of the first term may create disequilibria in the economy which are amplified in the second term through a transmission mechanism resulting in contractionary interventionist policies in a situation where no incentive for re-election exists by the incumbent.

Key words: Democratic party; Fractional integration; Republican party; Stocks; US Presidential terms

JEL Classification: C22; H54.

1. Introduction

It is of interest to observe and map fluctuations in stock prices to presidential terms since such fluctuations, causing cycles in businesses, are natural processes of changing consumer expectations. Many of such cycles, as documented in Hurst (1970) exist. The stock market is known to be the most sensitive indicator of the business cycles, and serves as the most influential variable in the government's index of leading economic indicators (Bernstein, 1991; Sensier et al., 2004; Wong and McAleer, 2009).[1] The Theory of the Presidential Election Cycle,[2] which attempts to explain the relationship existing between presidential elections and stock prices, has led to several studies with interesting findings that have important policy implications. This is basically because of the belief that businesses tend to be more profitable in low tax regimes and under stable government policies. These features are often characterized by the ideologies of the government in power, which are likely to change every four years in election processes. According to the stock market hypothesis, upon election, a president may often try to introduce unpopular economic measures, which often involve cutting down on fiscal spending and/or contractionary monetary policy, thus inducing a deflationary phase in the business cycle. However, as the next election approaches, the incumbent president applies expansionary fiscal and monetary policy. The argument is that, a strong economy in the first half of a president's term serves no political role, owing to the short-term memories of voters. On the other hand, stimulating the economy prior to the presidential elections enhances the

[1] Wong and McAleer (2009) documents six cyclical patterns that are likely to affect general pricing behaviours of commodities: the 28-day Trading Cycle also known as the Lunar Cycle, the 10.5-month Commodity Futures Cycle, the January Effect, the 4-year Cycle also known as the Kitchin Cycle/Presidential Election Cycle), the 9.2-year Cycle also known as the Juglar Cycle and the 54-year Cycle also known as the Kondratieff Cycle. These cycles' analysis is explained in Financial astrology which believes that Jupiter-Saturn cycle is being used in trading activities since Sun shifts periodically based on the positions and gravitational pulls of these heavy planets, which on the long run, causes change in weather and as well affect commodity prices.

[2] This presidential 4-year cycle is originally known as the Kitchen Wave cycle (Kitchin, 1923). The Proponent of the theory (Kitchin) noted a 40-month cycle existing in some financial variables in Great Britain and the USA between 1890 and 1922, particularly that US Presidential terms caused cyclical patterns in US stock prices from 1868 to 1945. In practice, this 4-year cycle varies in length from 40 to 53 months (see Stovall, 1992).

chances of the incumbent party's victory. A weak economy works strongly against an incumbent's re-election. Consequently, the stock market, which is a leading indicator of economic activities is, therefore, expected to fall during the first two years after a presidential election and rise strongly during the two years prior to the next presidential election (Hoey, 1978).

Early empirical literature (for example, Niederhoffer *et al*. (1970) and Riley and Luksetich (1980)) find that increases in US stock market prices are associated with the election of Republican presidents, while decreases in the prices are often associated with the election of Democrats. The conclusion, however, is not supported by empirical evidence. Huang and Schlarbaum (1982), for example, found increase in stock market returns when Democrats were in power. Between the years 1928 and 2002, the US stock index had negative returns in just three election years, while returns were positive for the remaining election years (see Nickles, 2004). Other studies have also tried to find macroeconomic explanations for the apparent relationships between stock market returns and politics. For instance, Stangl and Jacobsen (2007), basing their findings on individual company stocks, could not find stocks with higher market returns during Democratic rule than those observed during Republican rule. They, therefore, suggested that the explanation for their existence must be found at the macroeconomic level. Wong and McAleer (2009) found that US stock prices followed the four-year presidential election cycle, in which prices of stock fell during the first half of a presidency, and rose to reach a peak at the end of the first four-year term. These authors reported that the pattern was maintained from as far back as the term of President Lyndon Johnson to the administration of President George W. Bush. Wong and McAleer (2009) have further shown that the stock market prospers in the election year, given that policy makers tend to tread softly with respect to taxation issues, but thereafter, falls given the regime changes and plausible adoption of unpopular policies. Therefore, the pattern of stock price movement within and across each four-year cycle (usually found to vary between 40 and 53 months) for a sitting US president is an important feature to be investigated. Although, factors that influence stock prices are complex to model, several more recent studies have shown some levels of dependencies of the US stocks (S&P500) on US presidential terms and election year, since 1928. For example, Wang and Wong (2015) studied US stocks from 1927 to 2012 and found within that period, the existence of rational speculative bubbles under Republican presidents, whereas these are lacking under Democratic rulings. Colón-De-Armas et. al. (2017) examined shifts in investor's sentiment in seven US presidential elections from 1988 to 2012, by means of closed-end funds discounts strategy. The results indicated that investor sentiment diminished within the two weeks to election period and persisted until a week after the election.

In several studies of the four-year terms of US presidents, stock prices have generally been observed to fall, reaching a trough in the first half of a presidency, and reaching a peak in the third and fourth years (see Allivine and O'Neill, 1980; Huang, 1985; Stovall, 1992; Gartner and Wellershoff, 1995; Hensel and Ziemba, 1995; Booth and Booth, 2003; Nickles, 2004; Wong and McAleer, 2009; Egan, Yellin and Houp, 2019). Hinging on the observed pattern, stock market players are advised to invest during October of the second year of a presidential term and sell off the stocks in December of the fourth year. Generally, the US Presidential administrations have influenced performance of stocks, while Presidents Reagan, Clinton and Obama coincided S&P500 price index to increase by 118, 210 and 181 percent, respectively, in their two-term reigns (8 years), the stock index during the one 4 year term of President George H.W. Bush rose by 51 percent. However, in the case of President George W. Bush, the stock index fell by 37 percent within his eight-year period in office, and this fall started in the third year of his second four-year term (see Egan, Yellin and Houp, 2019). These presidents, who belong to different political parties have distinctive ideologies with respect to governance. Therefore, the persistence of US presidential terms/election cycle, alternating between the two main political parties – the Democrats and the Republicans (see Huang, 1985), is however, more pronounced in the former than in the latter, and might have constituted some anomaly in the US stock market over the years. This, therefore, informs the need to investigate the extant relationship and/or pattern, which will be of immense interest the US government, portfolio managers and individuals. On the contrary, some studies (Santa-Clara and Valkanov, 2003) not only found that the difference in returns were inexplicable by expected returns related to business cycle variables, but also, that these returns did not cluster around election dates. However, the debate on the possible influence of presidential elections or presidential cycles on stock markets remains a researchable area (see Goodell and Vahamaa, 2013; Shaikh, 2017; Shen et al., 2017 and Pham et al., 2018 among others). Scholars such as Bohl and Gottschalk (2006), however, argue that the Democratic premium and the four-year election cycle are not pervasive around the world and are, at best, limited to the U.S. and only a few other countries. The size and influence of the US in the global economy, however, makes it important to understand its economic performance.

By way of adopting more general techniques of fractional integration, in this present paper, the performance of stocks in the US was investigated, using time series analysis over several US presidential terms over a forty year period, incorporating aspects of stock market efficiency and volatility persistence with some degree of success. Using S&P500 as the main stock index representing the capital market of the US, fractional integration is applied to investigate the time property of the stock index over time (from January 1977 to March 2019), corresponding to the presidential terms of President Jimmy Carter up to President Donald Trump. An important contribution of the analysis in this paper is to map stock price dynamics with US presidential terms, and determine whether there is a difference in the first and the second periods in power, in terms of market inefficiency and the persistence of volatility, and the extent to which these aspects, if at all, are affected by the president being a Republican or a Democrat. Fractional integration techniques are very flexible in the analysis of time series data, and provide important insights relating to the degree of persistence inherent in the data. Moreover, market efficiency requires an order of integration equal to 1 for the stock market prices and departures from this assumption produces inefficiencies in the stock markets. No study so far has examined the issues of US presidential terms and their impact on the S&P500 index using fractional integration techniques.

The rest of the paper is structured as follows: Section 2 is devoted to discuss the statistical methods used in the paper. Section 3 presents the empirical results, while Section 4 focuses on the interpretation of the results. Section 5 concludes the paper.

2. Statistical Methods

The methodology used in the paper is based on fractional integration or $I(d)$ techniques. However, before introducing this concept, there is a need to describe the integration of order 0, or $I(0)$ process. A process $\{u_t,\ t = 0, \pm 1, \ldots\}$ is said to be integrated of order 0, and denoted as $u_t \approx I(0)$ if it is a covariance stationary process with a spectral density function that is positive and bounded at all frequencies. This is usually considered as a minimal requirement to make statistical inference and includes the white noise model but also the classical stationary and invertible ARMA (AutoRegressive Moving Average) class of models.

On the other hand, many processes are nonstationary and require a number of differences (usually 1) to render them stationary $I(0)$. If the number of differencing is one, the series is said to be $I(1)$ or integrated of order 1, including here the random walk process and the $ARIMA(p,1,q)$ type of models. On some rare occasions, the series might be integrated of order two, that is, $I(2)$.[2] The order of integration can also be fractional, which is the idea behind the fractional integration technique.

A time series $\{x_t,\ t = 0, \pm 1, \ldots\}$ is said to be integrated of order d, and denoted as $x_t \approx I(d)$ if it can be represented as:

$$(1 - L)^d x_t = u_t, \qquad t = 1, 2, ..., \tag{1}$$

where L is the lag operator (i.e., $Lx_t = x_{t-1}$) and u_t is $I(0)$. Then, the polynomial on the left hand side in equation (1) can be expressed in terms of its binomial expansion, such that, for all real d,

$$(1 - L)^d = \sum_{j=0}^{\infty} \psi_j L^j = \sum_{j=0}^{\infty} \binom{d}{j} (-1)^j L^j = 1 - d\,L + \frac{d(d-1)}{2} L^2 - \frac{d(d-1)(d-2)}{6} L^3 + ...$$

and thus equation (1) can be expressed as

$$x_t = d\,x_{t-1} - \frac{d(d-1)}{2} x_{t-2} + \frac{d(d-2)(d-3)}{6} x_{t-3} \quad ... \quad + u_t, .$$

Thus, if d is a real value, x_t depends on all its past history, playing also a crucial role as an indicator of the degree of dependence of the series: the higher the value of d, the higher the level of association between the observations. Moreover, d also plays a crucial role in the determination of the nature of the shocks, noting that if d is smaller than 1, shocks will have a transitory nature contrary to what happens if $d \geq 1$, where shocks will be permanent.

This type of process was proposed in the 80s by Granger (1980, 1981), Granger and Joyeux (1980) and Hosking (1981). Though, it was not until the 90s that they appeared, for the first time, in the analysis of aggregate data (see Sowell, 1992; Baillie, 1996; Gil-Alana and Robinson, 1997; etc.). Since then, they have become very popular in economics and finance (see Michelacci and Zaffaroni, 2000; Mayoral, 2006; Christensen et al., 2010; Martins and

[2] See, e.g., Haldrup (1998), Juselius (2006), Juselius and Johansen (2006), etc.

Rodrigues, 2012; Gil-Alana and Moreno, 2012; Hassler et al., 2014; Cavaliere et al., 2015; Abbritti et al., 2016; Gil-Alana and Huijbens, 2018, among many others).

The differencing parameter d is estimated in this paper by using the Whittle function in the frequency domain (Dahlhaus, 1989). In particular, a testing approach developed by Robinson (1994) which is very convenient, especially, in the context of nonstationary data is used. Robinson (1994) proposed a very general statistical method that tests for fractional orders of integration in time series. His set up is given in equation (2) below as

$$y_t \;=\; \beta' z_t \;+\; x_t \;, \qquad (2)$$

where y_t represents the observed time series; z_t is a $(k \times 1)$ set of exogenous regressors or deterministic terms that might include, for example, an intercept, and/or an intercept with a time trend, β is a $(k \times 1)$ vector of unknown parameters, and the regressions errors (x_t) are given by a general expression, that for the purpose of this work, is simplified and assumed to follow equation (1). Then, he proposed a test statistic of the null hypothesis:

$$H_o\!: \; d \;=\; d_0, \qquad (3)$$

in the model given by (1) and (2) for any real value d_0. In the context of efficiency of stock markets this hypothesis entails that prices always fully reflect the information available and no profit can be made from information based trading (Lo and MacKinley, 1999).

This method, whose specific form can be found in any of the numerous empirical applications (Gil-Alana and Robinson, 1997; Gil-Alana and Henry, 2003; etc.), has several advantages with respect to other methods. First, the fact that d_0 can be any real value, allows us to test nonstationary hypotheses (i.e., $d \geq 0.5$), with no need of preliminary differencing, as is the case with other methods.[3] Also, the limit distribution is standard normal, with no need

[3] Lobato and Velasco (2007) proposed a Wald test with the same asymptotic distribution as in Robinson (1994); however, it requires a consistent estimate of d and thus, it is constrained to the stationary region (d < 0.5).

for the calculation of numerical values, as is the case in other unit root approaches. Moreover, this method is the most efficient one in the Pitman sense against local departures from the null.

3. Data and Empirical Results

The data used in this paper are the daily closing values of Standard & Poors (S&P500) index of the United States, spanning between January 20, 1977 and March 1, 2019, covering the terms for seven presidents in which four of them spent two terms each. Table 1 summarizes the periods of ruling of these presidents, together with their political affiliations, either a Democrat or a Republican. Within the sampled period, the first president who ruled between 1977 and 1981 was President Jimmy Carter (JC), while the current president is Donald Trump (DT), who has spent about 2 years out of his first 4-year term. Presidents Ronald Reagan (RR), Bill Clinton (BC), George W. Bush (GWB) and Barack Obama (BO), each spent two terms in office, and during the time of government, S&P500 market performed well, with positive returns in these administrations. For these four presidents, at the end of their 4-year term (either 1st or 2nd), stocks performed relatively better than during their first 2 years in the 4-year term, and this is independent of whether the president was a Republican or a Democrat. The 8-year period of President George W. Bush (GWB), a Republican, coincided with the 2008/09 global crisis, which emanated from the US and spread through integrated financial markets. Also, the government public policy strategy of this Republican president contributed to the overall negative returns in S&P500 index, in both the 1st and 2nd terms of his 4-year terms.

[Insert Table 1 about here]

Here, the results in terms of the estimated values of d are presented for the S&P500 index, for each of the presidential periods. In all cases, the model given by the equations (2) and (1) is considered, with z_t in (2) equal to $(1, t)'$ for t ≥ 1, (0, 0)' otherwise. Thus, the tested model under (3) is:

$$y_t = \beta_0 + \beta_1 t + x_t, \qquad (1-L)^{d_o} x_t = u_t, \qquad t = 1, 2, ..., \qquad (4)$$

for any range of values of d_0 from 0, …(0.01) to 2. Both original and log-transformed data are used, and started with the assumption that the error term, u_t in (4) is a white noise process. Table 2 displays the results for the original data, while Table 3 refers to the results for log-transformed values. The tables illustrate the estimated values of d (along with the 95% confidence bands of the non-rejection values of d using Robinson's (1994) tests), under the three standard cases: i) no deterministic terms (i.e., $\beta_0 = \beta_1 = 0$ in (4)), ii) an intercept ($\beta_1 = 0$ in (4)), and iii) an intercept with a linear time trend (β_0 and β_1 unknown). The selected model for each series, based on the t-values of the estimated coefficients on the d-differenced series presented in the tables were marked in bold.

Starting with the original data (in Table 2), it is observed that the model with a time trend would be required in a number of cases (BC and BO during the two terms). However, for the rest of the periods, the model with intercept only seems to be sufficient to describe the deterministic terms. Focussing on the values of d, it is observed that most are around 1, implying efficiency in the market in the sense of Fama (1970)[4] though, evidence of mean reversion (i.e., values of d statistically smaller than 1) are obtained in a number of cases: BC during the second term; GWB during the second term; and BO in both 4-year terms. This evidence of mean reversion indicates that the null of $d = 1$ is rejected in favour of $d < 1$, implying inefficiencies in the markets as the random walk hypothesis is rejected by the data.

[4] According to the Efficient Market Hypothesis (EMH), stock market prices should follow a random walk, implying an order of integration of 1 in the log price series. Following this theory, its weak form states that it is not possible to trade profitably on the basis of historical stock market prices and/or return information (see Fama, 1970).

[Insert Tables 2 and 3 about here]

Looking at the results for the log-transformed data (Table 3), the values are very similar, finding evidence of market inefficiencies in the same 4-year terms of BC, GWB and BO as before, along with RR again during the second 4-year term in power.

Next, the autocorrelated errors, u_t are accommodated. However, instead of using here a parametric ARMA model, which might produce multiple results, depending on the specification of the AR and MA orders, a non-parametric approach proposed by Bloomfield (1973) is selected. This method is called semi-parametric in the sense that it is not explicitly formulated but implicitly, in terms of its spectral density function, which is given by:

$$f(\lambda;\, \tau) \;=\; \frac{\sigma^2}{2\pi} \exp\left(2 \sum_{r=1}^{m} \tau_r \cos(\lambda\, r) \right), \qquad (5)$$

where m indicates the number of short run components (which ranges from $r = 1$ to a particular value m), that is, the size of the truncated Fourier function, π = 3.142, τ_r are coefficients in the function, and u_t is an $I(0)$ process with variance σ^2, while λ gives the frequency in the truncated function. Bloomfield (1973) showed that this specification approximates, fairly well, the spectrum of highly parameterized ARMA models, thus producing autocorrelations that decay exponentially fast to zero. Moreover, this model is stationary across all values of τ unlike what happens in the ARMA case, and it accommodates extremely well, for autocorrelation in the context of fractional integration. (See Gil-Alana, 2004). The results in terms of the values of d, using Bloomfield (1973) for the error term are presented in Tables 4 and 5.

[Insert Tables 4 and 5 about here]

Starting again with the original data (Table 4), the time trend is now required in the majority of the cases and mean reversion $(d < 1)$ seems to occur in the following presidential periods (terms): RR, BC, GWB and BO, and in all cases, surprisingly, during the second term in power. For the logged series (Table 5), this evidence is obtained precisely in the same presidential terms. Thus, it seems that markets become inefficient during the second presidential terms, and this happened in the case of both Democrat and Republican governments. This issue will be further elaborated in the next section.

Now, we move to the volatility of the series, and we proxy this feature by using two measures: absolute and squared returns, obtained as the absolute and squared values of the first differenced log-S&P500 index.[5] As with the levels, we start with the case of no autocorrelation (white noise) errors, and the results are presented in Tables 6 and 7, respectively, for the absolute and squared returns. It is observed that across these two tables, all the estimated values of d are positive and significant, implying long memory patterns. These values range between 0.05 (BC, 1st term) and 0.22 (RR, 2nd term, and DT) for the absolute values, and are slightly higher for the squared returns, ranging now between 0.12 (BC, 1st term) and 0.40 (GWB, 2nd term).

[Insert Tables 6 - 9 about here]

Allowing for autocorrelation, the results presented in Tables 8 and 9 are similar to the previous case. All the values are significantly positive (long memory) and range between 0.05 and 0.24 with respect to the absolute returns, and between 0.07 and 0.42, for the squared returns. Generally, the periods of President George W. Bush (GWB) (2nd term) reported the highest volatility due to the global financial crisis that occurred during his second term, while the lowest volatility was reported, generally, in the period of President Ronald Reagan (1st term). The overall volatility result is not surprising, since this was something that was observed in most financial markets a long time ago (Ding, Granger and Engle, 1993). However, taking a critical look at the results, another interesting feature is observed; noting that the estimated

[5] Absolute returns have been employed as proxy for the volatility in Ding et al. (1993), Granger and Ding (1996), Bollerslev and Wright (2000), Gil-Alana (2005), Sibbertsen (2004), Cotter (2005) and Yang and Perron (2010), among many others. On the other hand, squared returns are used in Lobato and Savin (1998), Blair et al. (2001), Cotter (2005), Patton (2011), Jondeau (2015), etc.

values of d are generally greater during the second periods in power for each government. Thus, in the same way that we observe inefficiencies in the second terms, we also observe a higher degree of persistence in the volatility processes. These two features are critically investigated in the next section.

4. Summary and Discussion

The results presented in Table 10 and Table 11 are the summary of the results reported in Section 3, for the level and volatility series. Starting with the level series, in Table 10, the selected estimates of d are presented for each period of government, in the results obtained across Tables 2 through 5. It is observed that in all the periods, where the incumbent president has been re-elected to office for a second time, there is a substantial reduction in the degree of integration during the second term, moving from potential efficiencies $(d = 1)$ to inefficiencies and mean reversion $(d < 1)$. This happens in all the cases considered, although, during the administration of BO, the mean reversion is also observed in the first term, at least for the case of uncorrelated (white noise) errors.

[Insert Tables 10 and 11 about here]

Focusing on the volatilities, Table 11 summarized the results reported across Tables 6 through 9. The results are also interesting here, noting an increase in the degree of persistence in all except one case (BO with squared returns and autocorrelated errors). In all the other cases, the values of d are higher during the second terms.

A vital hypothesis explaining increasing market inefficiency in the second term is that the interventionist expansionary policies aimed at achieving re-election at the end of the first term have now been transmitted more fully into the economy by the second term creating market inefficiencies. The adverse effects of these policies were not fully felt in the economy at the end of the first presidential term as their transmission takes time but these excesses now adversely affect market efficiency and other aspects of economic performance more fully in the second term. In some cases, contractionary monetary and fiscal policies are employed in an attempt to put the economy back on track in the second term and these further deepen the economic challenges to be faced and contribute to higher volatility persistence in the second presidential term. The lack of concern with re-election in the second term may reduce the attempts to address the fundamental causes of the problem leading to quick-fix solutions that further exacerbate the economic challenges worsening market inefficiency and increasing volatility persistence.

5. Conclusions

The results obtained in this paper demonstrate that during the second legislature, the markets are more inefficient, in the sense that the differencing parameter, *d,* is found to be large but smaller than 1 in most of the cases during the second period in power but not during the first. This happens in both parties. Also, the persistence is higher in the volatilities in all cases during the second legislatures. Thus, markets are efficient at first, but after four years, of the same government in power, markets become inefficient and the persistence in the volatility increases. This implies that during the first term, prices are more reflective of all information and neither technical nor fundamental analysis can produce risk-adjusted excess returns. Stocks trade at their fair value in stock exchanges making it more difficult for investors to purchase undervalued stocks or sell stocks for inflated prices. It is therefore difficult to outperform the overall market through expert stock selection or market timing and the only way an investor can obtain higher returns is by purchasing riskier investments. An explanation for this is that first term economic performance is likely to be more robust especially towards the end because of the focus on re-election. The focus on re-election at the end of the first term, however, creates fundamental market distortions through interventionist policies based on expansionary fiscal and monetary policies to boost the economy. The negative economic effects of these interventionist policies through a larger fiscal deficit and higher inflation, for example, carry over into the second presidential term. Additional policy interventions may be undertaken during the second term to deal with emerging problems from the original interventions that arose at the end of the first term. This trend magnifies and the distortions in the economy become more deeply embedded in the second term with less care about the adverse economic consequences as incumbents are not seeking re-election. Market efficiency is, therefore, eroded during the second term with technical or fundamental analysis and able to produce risk-adjusted excess returns. During the second term, stocks are more likely to be under or overvalued. This has important policy implications for investors and portfolio managers who can capitalise on buying undervalued stocks and selling overvalued stocks to beat the market in the second term. Attempts to beat the market are therefore more likely to succeed during the second term than during the first term when the market is more efficient. Volatility persistence also increases during the second term as the adverse consequences of economic excesses at the end of the first presidential term are now amplified. Attempts to deal with these problems through contractionary monetary and fiscal policies may contribute to an economic downturn with greater volatility as the second term proceeds.

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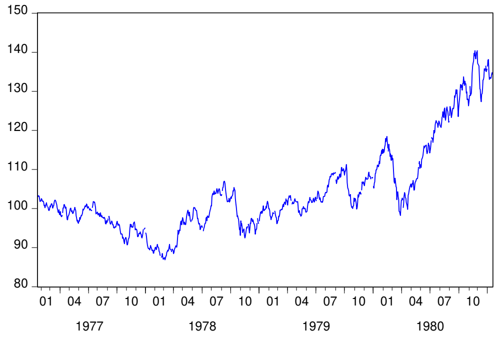
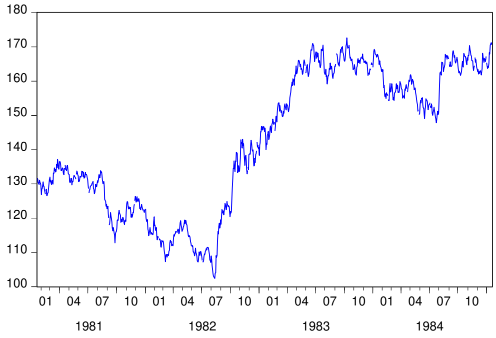
Table 1: US Presidential terms

Period	Name	Party	Term	First 2-year S&P500 Performance (%)	Full term S&P500 Performance (%)
20/01/1977-19/01/1981	Jimmy Carter (JC)	Democratic	1st	-3.2	30.5
20/01/1981-19/01/1985	Ronald Reagan (RR)	Republican	1st	11.1	30.1
20/01/1985-19/01/1989	Ronald Reagan (RR)	Republican	2nd	53.5	63.7
20/01/1989-19/01/1993	George HW Bush (GHWB)	Republican	1st	15.9	51.8
20/01/1993-19/01/1997	Bill Clinton (BC)	Democratic	1st	7.2	79.1
20/01/1997-19/01/2001	Bill Clinton (BC)	Democratic	2nd	61.8	72.9
20/01/2001-19/01/2005	George W Bush (GWB)	Republican	1st	-33.9	-11.8
20/01/2005-19/01/2009	George W Bush (GWB)	Republican	2nd	21.7	-27.7
20/01/2009-19/01/2013	Barack Obama (BO)	Democratic	1st	61.2	84.5
20/01/2013-19/01/2017	Barack Obama (BO)	Democratic	2nd	35.5	51.7
20/01/2017-1/03/2019	Donald Trump (DT)	Republican	1st	17.6	----

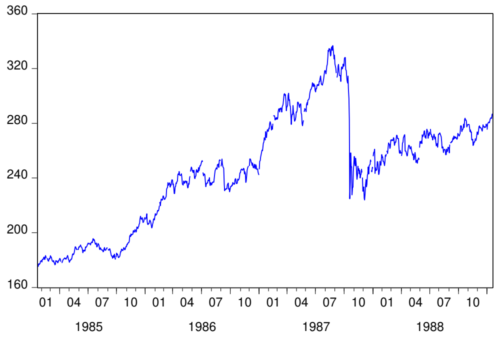
JC 77 - 81



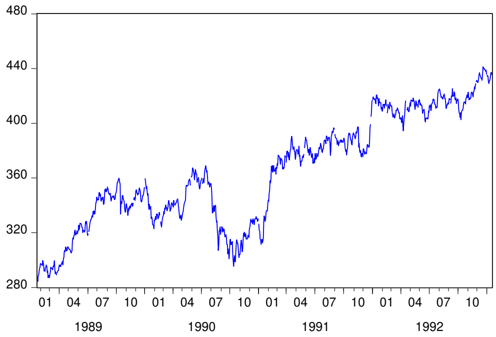
R.R. 81 - 85



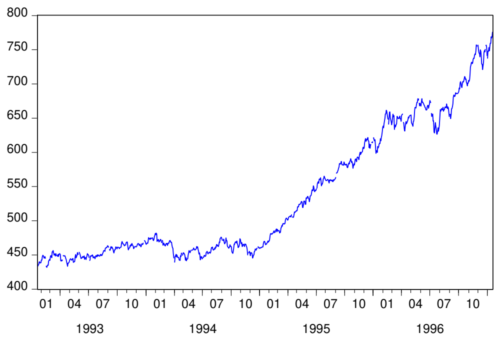
R.R 85 - 89



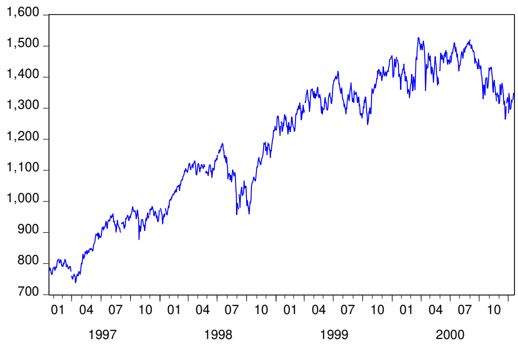
GHWB 89 - 93



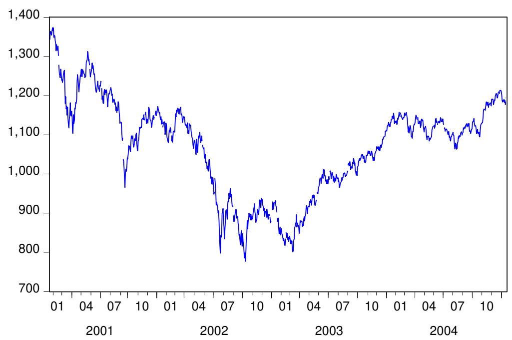
BC 93 - 97



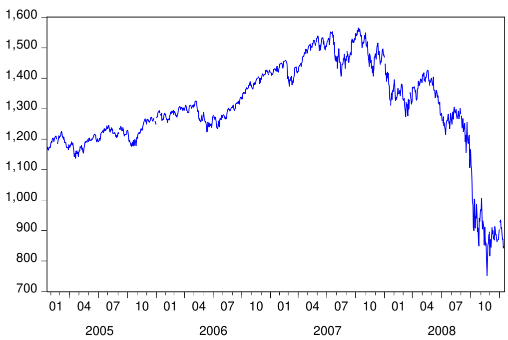
BC 97 - 01



GWB 01 - 05



GWB 05 - 09



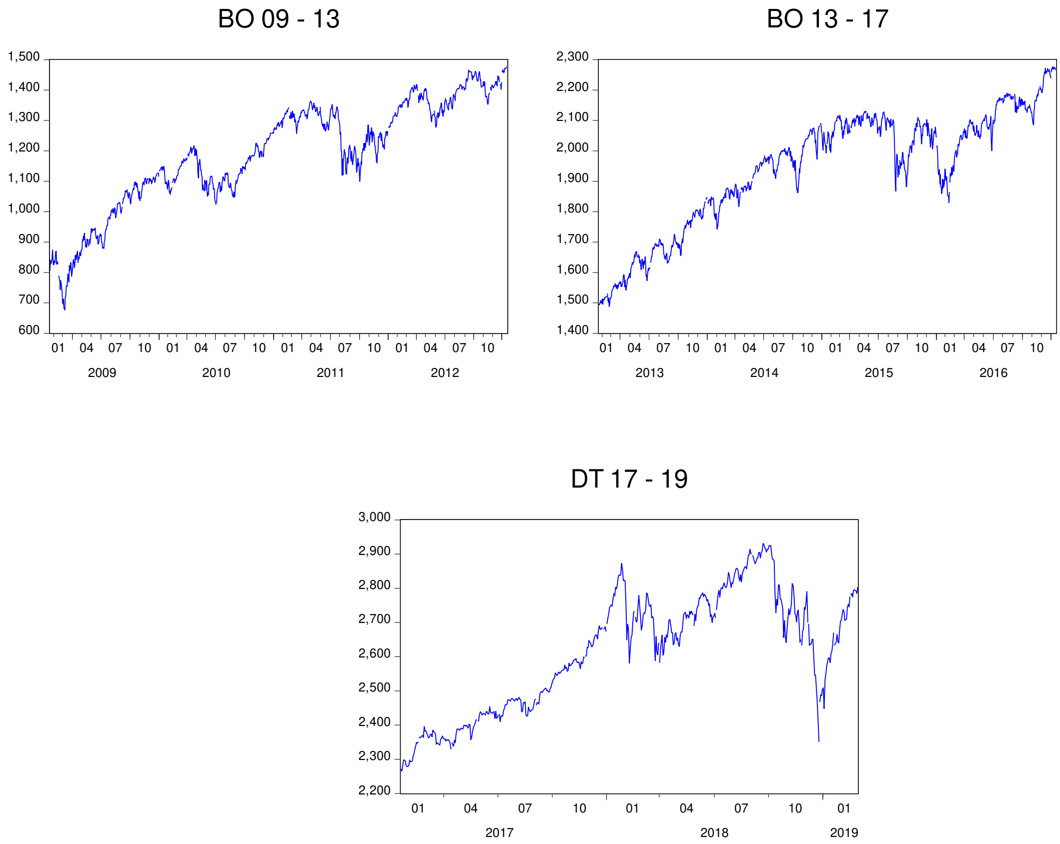


Figure 1: Plots of S&P Stocks by US Presidential terms

Table 2: Estimates of d for each series under no autocorrelation (Original series)

Presidential term	**Party**	No terms	An intercept	A linear time trend
Jimmy Carter (JC) --- 1st term	Democratic	1.00 (0.96, 1.06)	**1.09 (1.06, 1.15)**	1.10 (1.06, 1.15)
Ronald Reagan (RR) --- 1st term	Republican	1.00 (0.96, 1.05)	**1.04 (1.00, 1.10)**	1.04 (1.00, 1.10)
Ronald Reagan (RR) --- 2nd term	Republican	1.01 (0.96, 1.05)	**1.00 (0.95, 1.05)**	1.00 (0.95, 1.05)
George HW Bush (GHWB) --- 1st term	Republican	1.00 (0.96, 1.04)	**1.00 (0.95, 1.05)**	1.00 (0.95, 1.05)
Bill Clinton (BC) --- 1st term	Democratic	1.02 (0.97, 1.06)	1.04 (0.99, 1.08)	**1.04 (0.99, 1.08)**
Bill Clinton (BC) --- 2nd term	Democratic	0.97 (0.94, 1.03)	0.93 (0.88, 0.99)	**0.93* (0.88, 0.99)**
George W Bush (GWB) --- 1st term	Republican	1.00 (0.96, 1.05)	**0.98 (0.94, 1.03)**	0.98 (0.94, 1.03)
George W Bush (GWB) --- 2nd term	Republican	0.97 (0.93, 1.02)	**0.89*(0.86, 0.93)**	0.89 (0.86, 0.93)
Barack Obama (BO) --- 1st term	Democratic	1.01 (0.96, 1.06)	0.93 (0.89, 0.98)	**0.93* (0.89, 0.98)**
Barack Obama (BO) --- 2nd term	Democratic	0.99 (0.95, 1.04)	0.92 (0.90, 0.99)	**0.92* (0.90, 0.99)**
Donald Trump (DT) --- 1st term	Republican	1.00 (0.94, 1.06)	**0.97 (0.91, 1.03)**	0.97 (0.91, 1.03)

*: Evidence of mean reversion at the 95% level.

Table 3: Estimates of d for each series under no autocorrelation (in logs)

Presidential term	**Party**	No terms	An intercept	A linear time trend
Jimmy Carter (JC) --- 1st term	Democratic	1.00 (0.96, 1.05)	**1.09 (1.04, 1.13)**	1.09 (1.04, 1.13)
Ronald Reagan (RR) --- 1st term	Republican	1.00 (0.96, 1.04)	**1.05 (1.01, 1.09)**	1.05 (1.01, 1.09)
Ronald Reagan (RR) --- 2nd term	Republican	1.00 (0.96, 1.05)	**0.96*(0.94, 0.99)**	0.98 (0.94, 1.03)
George HW Bush (GHWB) -- 1st term	Republican	1.00 (0.96, 1.04)	**1.00 (0.96, 1.06)**	1.00 (0.96, 1.06)
Bill Clinton (BC) --- 1st term	Democratic	1.00 (0.96, 1.05)	1.02 (0.97, 1.07)	**1.02 (0.97, 1.07)**
Bill Clinton (BC) --- 2nd term	Democratic	1.00 (0.96, 1.04)	0.93 (0.89, 0.99)	**0.93* (0.89, 0.99)**
George W Bush (GWB) --- 1st term	Republican	1.00 (0.96, 1.04)	**0.98 (0.93, 1.02)**	0.98 (0.93, 1.02)
George W Bush (GWB) --- 2nd term	Republican	0.99 (0.96, 1.04)	**0.88*(0.85, 0.92)**	0.88 (0.85, 0.92)
Barack Obama (BO) --- 1st term	Democratic	1.00 (0.96, 1.05)	0.93 (0.89, 0.98)	**0.93* (0.89, 0.98)**
Barack Obama (BO) --- 2nd term	Democratic	1.00 (0.95, 1.04)	0.93 (0.90, 0.99)	**0.93* (0.90, 0.99)**
Donald Trump (DT) --- 1st term	Republican	0.99 (0.94, 1.06)	**0.96 (0.90, 1.03)**	0.96 (0.90, 1.03)

*: Evidence of mean reversion at the 95% level.

Table 4: Estimates of d for each series under (Bloomfield) autocorrelation (Original series)

Presidential term	**Party**	No terms	An intercept	A linear time trend
Jimmy Carter (JC) --- 1st term	Democratic	0.98 (0.92, 1.07)	0.98 (0.92, 1.07)	0.98 (0.92, 1.07)
Ronald Reagan (RR) --- 1st term	Republican	0.98 (0.92, 1.06)	0.99 (0.92, 1.06)	**0.99 (0.92, 1.06)**
Ronald Reagan (RR) --- 2nd term	Republican	0.99 (0.92, 1.06)	0.91 (0.85, 0.97)	**0.91* (0.85, 0.97)**
George HW Bush (GHWB) -- 1st term	Republican	1.01 (0.94, 1.08)	0.94 (0.87, 1.03)	**0.94 (0.87, 1.03)**
Bill Clinton (BC) --- 1st term	Democratic	1.01 (0.94, 1.08)	0.95 (0.89, 1.03)	**0.95 (0.89, 1.03)**
Bill Clinton (BC) --- 2nd term	Democratic	0.97 (0.90, 1.04)	0.86 (0.79, 0.92)	**0.86* (0.80, 0.92)**
George W Bush (GWB) --- 1st term	Republican	0.99 (0.93, 1.07)	**0.97 (0.91, 1.04)**	0.97 (0.91, 1.04)
George W Bush (GWB) --- 2nd term	Republican	0.97 (0.93, 1.02)	**0.95*(0.91, 0.99)**	0.95 (0.91, 0.99)
Barack Obama (BO) --- 1st term	Democratic	1.01 (0.96, 1.06)	0.94 (0.86, 1.02)	**0.94 (0.87, 1.02)**
Barack Obama (BO) --- 2nd term	Democratic	0.99 (0.95, 1.04)	0.88 (0.77, 0.98)	**0.88* (0.78, 0.98)**
Donald Trump (DT) --- 1st term	Republican	1.00 (0.94, 1.06)	**0.94 (0.84, 1.06)**	0.94 (0.84, 1.06)

*: Evidence of mean reversion at the 95% level.

Table 5: Estimates of d for each series under (Bloomfield) autocorrelation (in logs)

Presidential term	**Party**	No terms	An intercept	A linear time trend
Jimmy Carter (JC) --- 1st term	Democratic	0.99 (0.93, 1.07)	**1.00 (0.94, 1.07)**	1.00 (0.94, 1.07)
Ronald Reagan (RR) --- 1st term	Republican	0.99 (0.93, 1.07)	**1.00 (0.94, 1.08)**	1.00 (0.94, 1.08)
Ronald Reagan (RR) --- 2nd term	Republican	0.99 (0.93, 1.07)	0.89 (0.81, 0.95)	**0.89* (0.81, 0.95)**
George HW Bush (GHWB) -- 1st term	Republican	0.99 (0.93, 1.06)	0.95 (0.88, 1.02)	**0.95 (0.88, 1.02)**
Bill Clinton (BC) --- 1st term	Democratic	0.99 (0.93, 1.07)	0.93 (0.88, 1.02)	**0.93 (0.88, 1.02)**
Bill Clinton (BC) --- 2nd term	Democratic	0.99 (0.93, 1.07)	0.87 (0.79, 0.95)	**0.87* (0.79, 0.95)**
George W Bush (GWB) --- 1st term	Republican	0.99 (0.93, 1.07)	**0.97 (0.92, 1.05)**	0.97 (0.92, 1.05)
George W Bush (GWB) --- 2nd term	Republican	0.98 (0.92, 1.06)	**0.93*(0.88, 0.98)**	0.93 (0.88, 0.98)
Barack Obama (BO) --- 1st term	Democratic	0.98 (0.92, 1.06)	0.96 (0.88, 1.04)	**0.96 (0.88, 1.04)**
Barack Obama (BO) --- 2nd term	Democratic	0.99 (0.93, 1.07)	0.89 (0.79, 0.97)	**0.90* (0.79, 0.97)**
Donald Trump (DT) --- 1st term	Republican	0.98 (0.90, 1.06)	**0.94 (0.84, 1.06)**	0.94 (0.84, 1.06)

*: Evidence of mean reversion at the 95% level.

Table 6: Estimates of d for each absolute returns series under no autocorrelation

Presidential term	**Party**	No terms	An intercept	A linear time trend
Jimmy Carter (JC) --- 1st term	Democratic	0.10 (0.07, 0.13)	0.12 (0.09, 0.15)	**0.07 (0.04, 0.12)**
Ronald Reagan (RR) --- 1st term	Republican	0.08 (0.05, 0.12)	**0.07 (0.05, 0.11)**	0.07 (0.04, 0.10)
Ronald Reagan (RR) --- 2nd term	Republican	0.22 (0.18, 0.26)	**0.22 (0.19, 0.26)**	0.22 (0.18, 0.26)
George HW Bush (GHWB) -- 1st term	Republican	0.11 (0.08, 0.15)	0.10 (0.07, 0.14)	**0.09 (0.06, 0.13)**
Bill Clinton (BC) --- 1st term	Democratic	0.06 (0.03, 0.10)	0.06 (0.03, 0.10)	**0.05 (0.02, 0.09)**
Bill Clinton (BC) --- 2nd term	Democratic	0.10 (0.07, 0.15)	0.11 (0.08, 0.15)	**0.10 (0.07, 0.14)**
George W Bush (GWB) --- 1st term	Republican	0.19 (0.17, 0.22)	0.17 (0.14, 0.20)	**0.14 (0.12, 0.18)**
George W Bush (GWB) --- 2nd term	Republican	0.23 (0.21, 0.25)	0.24 (0.22, 0.27)	**0.21 (0.18, 0.23)**
Barack Obama (BO) --- 1st term	Democratic	0.19 (0.16, 0.21)	0.16 (0.13, 0.18)	**0.15 (0.12, 0.18)**
Barack Obama (BO) --- 2nd term	Democratic	0.21 (0.18, 0.26)	**0.21 (0.17, 0.25)**	0.21 (0.17, 0.25)
Donald Trump (DT) --- 1st term	Republican	0.23 (0.18, 0.28)	0.24 (0.20, 0.29)	**0.22 (0.17, 0.27)**

In bold indicates the selected model as in equation (2)

Table 7: Estimates of d for each absolute returns series under autocorrelation (Bloomfield)

Presidential term	**Party**	No terms	An intercept	A linear time trend
Jimmy Carter (JC) --- 1st term	Democratic	0.13 (0.09, 0.18)	0.17 (0.12, 0.21)	**0.10 (0.06, 0.16)**
Ronald Reagan (RR) --- 1st term	Republican	0.18 (0.13, 0.23)	**0.15 (0.10, 0.20)**	0.14 (0.09, 0.19)
Ronald Reagan (RR) --- 2nd term	Republican	0.32 (0.26, 0.40)	**0.33 (0.27, 0.40)**	0.32 (0.26, 0.40)
George HW Bush (GHWB) -- 1st term	Republican	0.18 (0.13, 0.25)	0.16 (0.11, 0.21)	**0.15 (0.09, 0.21)**
Bill Clinton (BC) --- 1st term	Democratic	0.16 (0.10, 0.23)	0.14 (0.10, 0.20)	**0.12 (0.06, 0.19)**
Bill Clinton (BC) --- 2nd term	Democratic	0.17 (0.11, 0.24)	**0.18 (0.11, 0.23)**	0.17 (0.11, 0.23)
George W Bush (GWB) --- 1st term	Republican	0.40 (0.34, 0.46)	**0.35 (0.29, 0.40)**	0.32 (0.26, 0.38)
George W Bush (GWB) --- 2nd term	Republican	0.42 (0.38, 0.46)	0.43 (0.39, 0.47)	**0.40 (0.36, 0.45)**
Barack Obama (BO) --- 1st term	Democratic	0.42 (0.37, 0.49)	0.36 (0.31, 0.42)	**0.37 (0.31, 0.43)**
Barack Obama (BO) --- 2nd term	Democratic	0.33 (0.24, 0.39)	**0.30 (0.24, 0.39)**	0.30 (0.24, 0.39)
Donald Trump (DT) --- 1st term	Republican	0.28 (0.22, 0.37)	0.31 (0.25, 0.40)	**0.27 (0.20, 0.37)**

In bold indicates the selected model as in equation (2)

Table 8: Estimates of d for each squared returns series under no autocorrelation

Presidential term	**Party**	No terms	An intercept	A linear time trend
Jimmy Carter (JC) --- 1st term	Democratic	0.10 (0.07, 0.14)	0.11 (0.08, 0.15)	**0.07 (0.04, 0.12)**
Ronald Reagan (RR) --- 1st term	Republican	0.10 (0.07, 0.13)	**0.10 (0.07, 0.13)**	0.09 (0.06, 0.13)
Ronald Reagan (RR) --- 2nd term	Republican	0.12 (0.08, 0.16)	**0.12 (0.08, 0.16)**	0.12 (0.08, 0.16)
George HW Bush (GHWB) -- 1st term	Republican	0.10 (0.06, 0.14)	**0.10 (0.06, 0.14)**	0.09 (0.05, 0.14)
Bill Clinton (BC) --- 1st term	Democratic	0.05 (0.02, 0.09)	0.06 (0.02, 0.09)	**0.05 (0.01, 0.09)**
Bill Clinton (BC) --- 2nd term	Democratic	0.15 (0.11, 0.20)	**0.15 (0.11, 0.20)**	0.15 (0.11, 0.20)
George W Bush (GWB) --- 1st term	Republican	0.18 (0.15, 0.21)	0.17 (0.15, 0.20)	**0.16 (0.13, 0.19)**
George W Bush (GWB) --- 2nd term	Republican	0.20 (0.18, 0.23)	0.20 (0.18, 0.24)	**0.18 (0.16, 0.21)**
Barack Obama (BO) --- 1st term	Democratic	0.17 (0.14, 0.20)	0.16 (0.13, 0.19)	**0.16 (0.13, 0.18)**
Barack Obama (BO) --- 2nd term	Democratic	0.24 (0.21, 0.29)	**0.24 (0.21, 0.29)**	0.24 (0.21, 0.29)
Donald Trump (DT) --- 1st term	Republican	0.21 (0.16, 0.27)	0.22 (0.17, 0.27)	**0.20 (0.15, 0.26)**

In bold indicates the selected model as in equation (2)

Table 9: Estimates of d for each squared returns series under autocorrelation (Bloomfield)

Presidential term	**Party**	No terms	An intercept	A linear time trend
Jimmy Carter (JC) --- 1st term	Democratic	0.11 (0.08, 0.16)	0.14 (0.09, 0.18)	**0.07 (0.02, 0.13)**
Ronald Reagan (RR) --- 1st term	Republican	0.18 (0.14, 0.24)	**0.18 (0.14, 0.23)**	0.18 (0.13, 0.23)
Ronald Reagan (RR) --- 2nd term	Republican	0.19 (0.11, 0.26)	**0.19 (0.11, 0.26)**	0.19 (0.11, 0.25)
George HW Bush (GHWB) -- 1st term	Republican	0.10 (0.04, 0.16)	**0.10 (0.04, 0.16)**	0.09 (0.04, 0.16)
Bill Clinton (BC) --- 1st term	Democratic	0.12 (0.07, 0.19)	**0.12 (0.07, 0.19)**	0.11 (0.06, 0.18)
Bill Clinton (BC) --- 2nd term	Democratic	0.12 (0.06, 0.20)	**0.15 (0.07, 0.23)**	0.15 (0.06, 0.24)
George W Bush (GWB) --- 1st term	Republican	0.41 (0.35, 0.48)	**0.39 (0.33, 0.47)**	0.38 (0.31, 0.45)
George W Bush (GWB) --- 2nd term	Republican	0.41 (0.37, 0.45)	**0.43 (0.36, 0.46)**	0.43 (0.35, 0.47)
Barack Obama (BO) --- 1st term	Democratic	0.37 (0.32, 0.44)	0.34 (0.29, 0.40)	**0.35 (0.29, 0.43)**
Barack Obama (BO) --- 2nd term	Democratic	0.32 (0.25, 0.42)	**0.36 (0.27, 0.44)**	0.36 (0.27, 0.44)
Donald Trump (DT) --- 1st term	Republican	0.22 (0.15, 0.31)	0.24 (0.16, 0.33)	**0.20 (0.12, 0.30)**

In bold indicates the selected model as in equation (2)

Table 10: Estimated values of d on the levels depending on the party

Period	President	White noise errors		Autocorrelated errors	
Democrats					
Period	**President**	Original	Log values	Original	Log values
1977 – 1981	Jimmy Carter	1.09	1.09	0.98	1.00
1993 – 1997	Bill Clinton	1.04	1.02	0.95	0.93
1997 – 2001		0.93*	0.93*	0.86*	0.87*
2009 – 2013	Barack Obama	0.93*	0.93*	0.94	0.96
2013 – 2017		0.91*	0.95*	0.88*	0.90*
Republicans					
Period	**President**	Original	Log values	Original	Log values
1981 – 1985	Ronald Reagan	1.04	1.05	0.99	1.00
1985 – 1989		1.00	0.96*	0.91*	0.89*
1989 – 1993	GHW Bush	1.00	1,00	0.94	0.95
2001 – 2005	GW Bush	0.98	0.98	0.97	0.97
2005 – 2009		0.89*	0.88*	0.95*	0.93*
2017 – 2019	D. Trump	0.97	0.96	0.94	0.94

*: Evidence of mean reversion $(d < 1)$ at the 5% level.

Table 11: Estimated values of d on the volatility depending on the party

Democrats					
Period	**President**	White noise errors		Autocorrelated errors	
		Abs. returns	Sqr. returns	Abs. returns	Sqr. returns
1977 – 1981	Jimmy Carter	0.07	0.07	0.10	0.07
1993 – 1997	Bill Clinton	**0.05**	**0.05**	**0.12**	**0.12**
1997 – 2001		**0.10**	**0.15**	**0.18**	**0.15**
2009 – 2013	Barack Obama	**0.15**	**0.16**	**0.35**	0.35
2013 – 2017		**0.21**	**0.24**	**0.36**	0.33
Republicans					
Period	**President**	White noise errors		Autocorrelated errors	
		Abs. returns	Sqr. returns	Abs. returns	Sqr. returns
1981 – 1985	Ronald Reagan	**0.07**	**0.10**	**0.15**	**0.18**
1985 – 1989		**0.22**	**0.12**	**0.33**	**0.19**
1989 – 1993	GHW Bush	0.09	0.10	0.15	0.10
2001 – 2005	GW Bush	**0.14**	**0.16**	**0.35**	**0.39**
2005 – 2009		**0.21**	**0.18**	**0.40**	**0.43**
2017 – 2019	D. Trump	0.22	0.20	0.27	0.20

In bold, evidence of an increase in the persistence of the volatility during the second legislature.