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The Efficiency of the GIPS Sovereign Debt Markets during Crisis

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ABSTRACT

The efficient market hypothesis has been around since 1962, the theory based on a simple rule that states the price of any asset must fully reflect all available information. Yet there is empirical evidence suggesting that markets are too volatile to be efficient. In essence, this evidence seems to suggest that the reaction of the market participants to the information or events is the crucial factor, rather than the actual information. This highlights the need to include the behavioural finance theory in the pricing of assets. Essentially, the research aims to analyse the efficiency of the GIPS (i.e. Greek, Italian, Portuguese and Spanish) sovereign debt markets during the crises, in essence the recent global financial and sovereign debt crises. We use a GARCH-based variance bound test to test the null hypothesis of the market being too volatile to be efficient. In general, our EMH tests resulted in mixed results, pointing at the acceptance of the null hypothesis of the market being too volatile to be efficient. However, interestingly a number of observations are pointing at the rejection of the null hypothesis of the market being too volatile to be efficient.

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I. INTRODUCTION

The efficient market hypothesis has been the cornerstone of asset pricing since the early to mid-1960s, developed through prominence articles such as Malkiel (1962) and Fama (1965, 1970). However as suggested by Fakhry and Richter (2015), the efficient market hypothesis relies on some untestable assumptions and models like perfectly competitive markets and rational risk averse profit maximising market participants. Hence as suggested by Ball (2009), there have been many criticisms from policy makers and academics, especially in the aftermath of the financial crisis. Conversely, the momentum in the 1990s of behavioural finance also highlighted the issues surrounding the efficient market hypothesis. Essentially the efficient market hypothesis is difficult to test, however as Fakhry and Richter (2015) suggest it is possible to test the efficiency of the market through the use of the Shiller volatility test as derived by Shiller (1981a)

The GIPS (in essence the Greek, Italian, Portuguese and Spanish) markets have deep-rooted structural and imbalance issues in their economies as highlighted by Landesmann (2013) and Gros (2012) among others. Conversely, the GIPS markets are also at the centre of the Eurozone sovereign debt crisis. For these reasons, it would be interesting to test the impact of the crises on the efficiency of the GIPS sovereign debt markets.

As we are testing the efficient market hypothesis, we start this paper with a short review of the tests and empirical evidence of market efficiency. The next section gives methodology of the empirical test. Section III presents the data and empirical results and Section IV concludes.

II. REVIEW OF THE TESTS OF THE EFFICIENT MARKET HYPOTHESIS

In testing the efficient market hypothesis, we need to test whether markets follow the random walk model and prices incorporate information immediately. The variance ratio tests of Lo and MacKinlay (1988) allow the testing of the random walk model, the influencing assumption in the weak form efficient market hypothesis. However, a key factor is as stated by Fama (1970); any test of the efficient market hypothesis involves a joint hypothesis of the equilibrium expected rates of returns and market rationality. Thus, there is a need to review the variance bound test of Shiller (1979) and LeRoy and Porter (1981) which states any excess volatility in the price of any asset is the result of inefficient markets as argued by Shiller (1992). This would mean that in a rational market, fundamental information is not the driving force of the price and inefficiency in the market drives the price away from the long-term equilibrium.

As stated by Bollerslev and Hodrick (1992) past empirical evidence suggests that there is a difference between short and long horizons with short horizons displaying only minor violations of the efficient market hypothesis while with long horizons, large proportions are more predictable based on the price variance being largely explainable by past prices alone. Of course, this does not mean that markets are inefficient. A possible explanation is that the price variations could be due to time varying risk premium. However, as Poterba and Summers (1988) argue the magnitude of the variability is too large, to be explained by the rational pricing theory. The evidence from the long horizon tests seem to point at an overlapping issue suggesting the statistics are better estimated with an alternative asymptotic distribution as derived by Richardson and Stock (1989),

although, as Bollerslev and Hodrick (1992) state this problem could also be overcome by using the vector auto-regression method.

The concept of the volatility tests is a comparison of the variability of prices with the variability of the future cash flows. The basic argument is that in an ideal world, future cash flows should determine the behaviour of prices today; therefore, as Shiller (1992) argues, any excess volatility is evidence of inefficient markets. As emphasized by LeRoy (1989), the underlining factor of the volatility or variance bound tests is that market efficiency dictates that asset price volatility should be relatively low in comparison with returns volatility. Another key factor, highlighted by LeRoy (1989), is there exists a negative relationship between the variances of the asset price and returns given the amount of information market participants have. Empirical evidence from Shiller (1979, 1981b) and LeRoy and Porter (1981) suggests asset prices are more volatile than is consistent with the efficient market hypothesis.

And while the evidence is mostly geared towards the stock market with both LeRoy and Porter (1981) and Shiller (1981b) suggesting that the price seems to be more volatile than the returns in the stock market, suggests that the efficient market hypothesis is rejected due to information not being uniformed across all market participants. The empirical evidence provided by Shiller (1979) illustrates that the tests reject the expectation model; in essence, these results seem to be suggesting a negative relationship. This points at the long-term interest being too volatile and therefore rejecting the efficient market hypothesis.

As emphasized by Shiller (1981a), there are a number of different interpretations for the simple pricing model depending on the underlying market and market variables used. For example in LeRoy and Porter (1981), they used earnings instead of the dividends used in Shiller (1981b) on the stock market and in Shiller (1979), he uses the long-term yields with the expectation model to analyse the bond market.

As Shiller (1979) emphasizes, an argument often made against rational expectation models of the term structure is long term interest rates are too volatile. The expectation model of the term structure dictates long averages of expected short-term interest rates plus a liquidity premium could dictate long-term interests. Additionally, in a conditional mean rational expectation model any shock to the trend should only occur on the arrival of important new information, which does not happen too often. Past empirical evidence on long-term interest rates suggests that they follow the efficient market or random walk. Hence, the evidence of long-term interest rates being too volatile contradicts the past empirical evidence.

As stated by Shiller (1981a) the simple pricing model dictates that the price of any asset (i.e., stock or bond) is fundamentally the present value of rationally expected or optimal forecastable earnings (i.e. dividends or coupons) divided by a discount factor. The efficient market hypothesis states that information regarding fundamentals is priced immediately. This would suggest that the change in the price depends on information about the dividends or coupons. Thus, any deviation from the long run equilibrium is therefore the result of information about the dividends or coupon rate. In essence, the basis of the present value is the long weighted moving average, thus suggesting that the equilibrium long run expected prices are smooth. However, a major issue is that occasionally asset prices are too volatile for the information to explain away. This means that the changes in asset prices seem to be too large in association with the sequence of events influencing the information.

The basis of the volatility test of LeRoy and Porter (1981) are the three theorems about the relationship between the variance of the dependent and independent variable processes. The theorems are the basis for tests of validity of the present value relation in asset pricing. The efficient market hypothesis implies the present value relationship between the asset price and earning. This means that the theorems are validity by the efficient market hypothesis and thus the variance bound test can test the efficient market hypothesis.

As Shiller (1981a) states, the inequalities suggest that using the volatility or variance bound tests of the efficient market hypothesis have certain advantages over the conventional tests such as simplicity and understandability. However, the key benefit is greater power of robustness to data errors such as misalignment.

As suggested by Bollerslev and Hodrick (1992), a key factor in the financial market is many financial asset returns are characterised by periods of asset booms followed by periods of asset busts. Since the basis of most pricing models is around the mean-variance trade-off, thus the time variations of the conditional second moments of returns and the underlying process are important in the testing of market efficiency.

As suggested by Shiller (1981a), a possible test of the model is to use a conventional regression technique and the F-test on the resulting coefficients. However, based on the assumptions made earlier, conventional regression techniques no longer suggest the likelihood test and the volatility test have more power under certain parameters. Nevertheless, as pointed by Bollerslev and Hodrick (1992) the use of ARCH/GARCH models in the estimation process can overcome seasonality in fundamentals and volatility clustering issues.

As suggested by Cochrane (1991), there is a misinterpretation in the hypothesis underlining the volatility test as purposed by Shiller (1979, 1981b) and LeRoy and Porter (1981). Many seem to be suggesting that the hypothesis points to a rejection of the efficient market hypothesis when the test shows that prices are too volatile. In essence, the tests are equivalent to the Euler-equation based tests of the discount rate models; hence, the hypothesis is that markets are forecastable due to the current discount rate models leaving a residual. In fact as suggested by Bollerslev and Hodrick (1992), the volatility tests are a joint hypothesis of the return generating process and first order condition for economic agents similar to the Euler-equation based tests.

As suggested by Cochrane (1991), opponents of the efficient market hypothesis do not argue that changes in prices are predictable; the basis of their argument is why prices move so much in the absence of any relevant news on the fundamental factors e.g. dividends. In addition, tests of the coefficients in a return-forecasting regression or the variance bounds do not show the true and enormous size of the error term or the unpredictable part of the price changes.

The evidence from the first generation of volatility tests as originally derived by Shiller (1979, 1981b) and LeRoy and Porter (1981) pointed to a clear rejection of the efficient market hypothesis with actual prices displaying excessive volatility in comparison to implied prices. As suggested by Shiller (1981a) a possible explanation was the existence of speculative bubbles and/or fads in the actual prices. As stated by Shiller (1981a), there are a number of alternative hypotheses such as rational bubbles, fads and unsuspected “disaster” or Knightian Uncertainty events. However, as suggested by Cochrane (1991), since the alternatives such as fads and bubbles are not testable hypothesis in a time varying model of asset pricing, i.e. there are no rejectable models;

the empirical evidence is not convincing. Moreover, Hayek (1945) presents a possible explanation for the market prices behaviour, market participants need not know all the information about the fundamental elements; hence, they only need to know their own piece of information and market prices.

Efficient market hypothesis tests were always conditioned on the model of equilibrium expected returns. Simply put the basis of the tests is the assumptions of normal price behaviour under the efficient market. However, as mentioned in Schwert (1991), there are a number of issues regarding the assumptions in the volatility tests. As suggested by Schwert (1991) the empirical evidence provided by Shiller (1992) is the existence of sampling errors and bias. This seems to be pointing at excess volatility not causing the bound violation present in the empirical evidence. However, as Shiller (1979) argues conventional tests of the efficient market hypothesis may be weak.

As stated by Schwert (1991), in fact past empirical evidence points towards expected earnings being time varying rather than constant. Hence, the excess volatility shown by some of the volatility tests could be due to time varying expected returns. As highlighted by Bollerslev and Hodrick (1992) relaxing the assumption of a constant discounts rate results in a mixed picture of excess volatility and market inefficiency. Another problem with the earlier models as stated by Bollerslev and Hodrick (1992) is that they did not take account of non-stationary prices and fundamentals in calculating and interpreting the test statistics results.

In general, there is a large body of empirical literatures on the efficiency of the financial market. A large percentage of these are based on the stock market, the recent evidence on the efficiency of the stock market is mixed. Some found the stock market to be inefficient; an example is Cajueiro et al. (2009) who found the liberalization of the Greek stock market made it significantly less efficient. However, the evidence from Cuthbertson and Hyde (2002) seem to suggest the acceptance of the EMH for the French stock market and slightly less so for the German.

In comparison, the body of empirical literatures on the efficiency of the sovereign debt market is limited despite the first model of international efficient market being based on the French sovereign debt market as stated by Zunino et al. (2012). As Zunino et al. (2012) suggest the main reasons are the size of trading on the stock market and the type of trading for the sovereign debt market, mainly traded "over-the-counter". Like the stock market, the recent empirical evidence on efficiency in the sovereign debt market is mixed. Zunino et al. (2012) using sovereign debt indices found that developed markets tend to be more efficient than emerging markets.

Fakhry and Richter (2015) studying the impact of the recent financial and sovereign debt crises on the US and German sovereign debt markets found in general both markets were too volatile to be efficient. Although the US datasets do suggest the market is efficient, is efficient, yet the subsamples suggest a mixed results pointing to both crises having an impact on the efficiency of the US and German markets. This leads to a possible explanation of the efficiency of the US datasets using the behavioural finance theory. Since market participants were overreacting/underreacting to information during different periods, one possible conclusion is that the overreaction/underreaction cancel each other out leading to a stable state in the datasets giving the impression of market efficiency.

III. METHODOLOGY

The main aim of this paper is to extend the test for the efficient market hypothesis (EMH) in the US and German sovereign debt markets used in Fakhry and Richter (2015) to the GIPS markets. We follows Fakhry and Richter (2015) in using a GARCH variant of the variance bound test proposed by Shiller (1979, 1981a). We use the 5% critical value F-statistics to test the efficient market hypothesis. Although Shiller does advocate the use of such methodology, yet he does not specify a specific econometric model. There are a number of pre-requisite steps in the model specification of the test:

As illustrated by Shiller (1981a), the key factor underlying any variance bound test is the variance calculation. We model the datasets in our test as a time varying lagged variance of the price using Equation (1). We used the 20 lagged system advocated by Fakhry and Richter (2015).

$$\lim_{t \to T} \operatorname{var}(\text{Price}_t) = \frac{\sum_{q=1}^{Q} (\text{Price} - \mu)^2}{Q} \tag{1}$$

The first order autoregressive model estimates the residuals in the econometric model underpinning the test as illustrated by Equation (2).

$$\begin{gathered} \operatorname{var}(\text{Price}_t) = a + b_1 \operatorname{var}(\text{Price}_{t-1}) + u_t \\ u_t = pu_{t-s} + \in_t \end{gathered} \tag{2}$$

We set u_t to be equal to the residuals of the autoregressive model. Hence, the econometric model underpinning the test is estimated using Equation (3).

$$\operatorname{var}(\text{Price}_x) = a + b_1 \operatorname{var}(\text{Price}_{t-1}) + u_t \tag{3}$$

We opt to use the GARCH models in our tests. In common with all our GARCH models, generally we use the t-student distribution. Hence, we estimate a t GARCH (1, 1) using the variance Equation (4):

$$h_t = \omega + \alpha_1 k_{t-1} + \beta_1 h_{t-1} \tag{4}$$

As noted by Alexander (2008, p. 137) and Engle and Patton (2001), there is a story within any member of the GARCH family of volatility models influenced by the coefficients in the variance equation. This means the reaction and mean reversion of the market shocks to volatility can be naturally interpreted by the two key coefficients in Equation 4. However, due to the use of the variance of the price as the independent variable in the mean equation, we cannot use the true definition. This means the use of the price variance had the impact of hiking the α coefficient leading to a massive increase in the volatility's sensitivity to market shocks. In contrast, the β coefficient decreased significantly leading to massive downgrade in the persistence of the volatility in the aftermath of a crisis in the market. The coefficients of the GARCH model of volatility are also key to our variance bound test. As mentioned earlier in this section, we derive our EMH test by using the f-statistics; for our observed samples, the f-statistics at the 5%

level is 1.96. Thus we reject the null hypothesis for the EMH if the condition in Equation 5 is true but accept the null hypothesis of the market being too volatile to be efficient for anything else. We calculate our test statistics using Equation (5):

$$\text{EMH Test} = \frac{(\alpha+\beta)-1}{\text{standard deviation}\left(\text{var}(x)\right)} \leq \text{F statistics} \tag{5}$$

IV. EMPIRICAL EVIDENCE

This section aims to provide empirical evidence of the impact of the crises on the efficiency of the financial market. The section will analyse the GIPS sovereign debts markets over a 10-year notes observed from July 1, 2007 to December31, 2011. In order to analyse the efficiency of the sovereign debt market under different global market conditions, we subdivide our observed markets into the following periods: financial crisis of the late 2000s and sovereign debt crisis of the 2010s. As illustrated by, we use the daily 10-year sovereign debt, maturing in 2012, end of day bid prices for Greece, Italy, Portugal and Spain obtained from Bloomberg. We follow the norm by defining our week as Monday to Friday. In order to make the observed data uniformed across all observed datasets, we substitute all missing observations with the last known price.

Table 1
The 10-Year sovereign debt prices data with maturity in 2012

	ISIN	Download Date	Issue Date	Maturity Date
Greece	GR0124018525	17/12/2012	17/01/2002	18/05/2012
Italy	IT0003190912	16/07/2012	01/08/2001	01/02/2012
Portugal	PTOTEKOE0003	16/07/2012	12/06/2002	15/06/2012
Spain	ES0000012791	17/12/2012	14/05/2002	30/07/2012

Since the influencing assumption of the efficient market hypothesis is that prices must reflect the relevant information efficiently, thus excess volatility points at inefficient markets as suggested by Fama (1970) and Bollerslev and Hodrick (1992). Therefore, in testing for the efficient market hypothesis, we derive a test based on the variance bound test of Shiller (1979, 1981). As illustrated by the methodology, Shiller does not dictate which model to use as the basis of the variance bound test.

Table 2 is associated with the financial crisis of the late 2000s. Although the first hint of the end of the bubble came long before the financial crisis. Yet the financial markets continued riding the bubble until mid-2007 when a number of international banks (e.g., Bear Stearns and BNP Paribas) recorded losses on their off-balance sheet activities associated with the MBS or CDO, which resulted in flights to liquidity and quality. In essence, this meant an increase in market activities in the observed markets as market participants sought the safety of the sovereign debt market.

Table 2
GARCH EMH test statistics of the 2012 bond (02/07/2007–30/10/2009)

	Greek	Italian	Portuguese	Spanish
ω	1.49E-05	4.52E-06	1.50E-05	4.33E-06
	(2.93E-06)	(9.01E-07)	(2.52E-06)	(1.10E-06)
α	1.540484	1.787047	1.416167	2.169304
	(0.199140)	(0.256983)	(0.202024)	(1.10E-06)
β	0.089209	0.060629	0.073715	0.096187
	(0.026096)	(0.023431)	(0.023395)	(0.027979)
Standard Deviation	0.189977	0.116066	0.157186	0.141228
EMH Test Statistics	3.314575	7.303396	3.116575	8.960624
Efficiency	Reject	Reject	Reject	Reject

As the α coefficients suggest, the onslaught of the financial crisis led to an increase in the sensitivity levels to market shocks. Especially in the Spanish market where the impact from the financial crisis was felt most among the observed markets. However, with the possible exception of the Italian market, the sensitivity levels of the remaining markets did not increase significantly. As explained previously, the Greek and Portuguese markets are not as liquid as the other observed markets.

The β coefficients seem to be pointing at a high level of persistence in all the GIPS markets have a low level of persistence. This is to be expected since during the financial crisis, the financial market experienced a constant flight to safety and the US and German markets are regarded as the safe havens. In contrast the GIPS nations were not only perceived to be of a lower quality or liquid but also due to the German market being the key market in the Eurozone, this meant many Eurozone market participants were likely to go to the German market.

The standard deviation does reflect a significant decrease in the volatile market during the financial crisis in comparison with the pre-crisis period. This seems to be stating that the observed markets were not highly volatile during a period of highly volatile global financial markets. In essence, this is not surprising since the prices of these assets were generally following an upwards trend due to the global financial crisis and this does not make them volatile but this does make them predictable.

The key to understanding the rejection of the efficient market hypothesis is to consider what the EMH test really implies. The EMH test implies that the market is deviating from the fundamental value. Since the financial crisis meant that market participants were engaging in flights to liquidity or quality, this meant that prices were trending upwards faster than the fundamental value. This meant that the EMH test statistics significantly rejected the efficient market hypothesis for all the observed markets. A key factor in the deviation from the fundamental value was that market participants were reacting to events instead of the fundamentals. Furthermore as explained in the previous paragraph the continued upwards trend meant that in essence the markets were predictable to a certain extent.

Table 3 is associated with the Eurozone sovereign debt crises. In order to provide liquidity and boost the economy, many central banks embarked on non-standard

monetary policies. However, it became clear that monetary policy alone was not going to be enough to save the banking system and avert a deep recession turning into a full-scale depression. Essentially, the sovereign debt crises was the product of the governments providing much needed capital for the banking system and following a fiscal stimulus policy to support the economy after the financial crisis. This added a substantial amount to the total debt. However, it is worth remembering that these assets are fixed term contacts, which mature at a certain date, hence an influencing factor to bear in mind is the maturity effect.

Table 3
GARCH EMH test statistics of the 2012 bond (02/11/2009–30/12/2011)

	Greek	Italian	Portuguese	Spanish
ω	0.000860	1.51E-07	5.75E-07	4.33E-07
	(6.27E-05)	(3.32E-08)	(2.44E-07)	(1.49E-07)
α	2.526172	1.869897	1.74503	2.316483
	(0.119999)	(0.243632)	(0.135819)	(0.437554)
β	0.140287	0.04853	0.251716	0.099802
	(0.016319)	(0.025347)	(0.014035)	(0.022945)
Standard Deviation	11.4855	0.064861	1.51737	0.190863
EMH Test Statistics	0.145092	14.15993	0.656891	7.420427
Efficiency	Accept	Reject	Accept	Reject

The α coefficients seem to be reflecting the diverse impact of the sovereign debt crisis on the observed markets. The significant α coefficients of the Greek and Spanish markets are suggesting at high levels of sensitivity to market shocks. Notably the Greek market was at the centre of the Eurozone sovereign debt crisis. Although the Spanish market did not feel the impact of the sovereign debt crisis until the later parts, yet a combination of a weakening economy, continuation of the financial crisis and weak local government finance at a time when the spotlight was on government spending did make the Spanish market highly sensitivity to market shocks. Even before the financial crisis, the Italian debt to GDP ratio was the highest in the Eurozone, hence with such a high ratio the Italian market was highly sensitive to market shocks. Although the α coefficients of the Portuguese market were high, however they are not that high. As previously suggested, a possible explanation is size and liquidity of the market. Another explanation is the quick reaction of the Portuguese government, IMF and European Community to the Portuguese crisis.

The β coefficients seem to be suggesting at mixed picture underpinning the level of volatility persistence. The Portuguese market seems to be interesting due to the high volatility persistence providing a further explanation as to why the sensitivity to market shocks were relatively low. However, with the exception of the Greek market, all the remaining observed markets seem to be suggesting at a low level of volatility persistence. A possible explanation is mainly due to the indecision of the politicians both within Greece and the Eurozone, the Greek market was highly reactive to every decision and statement by the politicians.

The standard deviations seem to be suggesting at the Italian market being stable. However, the Greek and Portuguese markets are highly volatile. Interestingly the Greek market seems to be very significantly volatile, as expected since the Greek market was at the centre of the sovereign debt crisis in the Eurozone. Although the Spanish market does seem to suggest stability in comparison to some of the observed standard deviations, yet it also suggests a volatile market relative to other standard deviations. Hence, the Spanish market, seem to be suggesting indecision on the part of market participants.

As suggested previously, during the financial crisis the market participants were reacting to events instead of the fundamentals. Interestingly, the fundamentals of the sovereign debt markets were already highlighting many issues such as high longer-term unemployment and high debt/deficit. However, hindsight is a lovely tool to have but unfortunately; during any crisis, human nature dictates that market participant react to events rather than the fundamentals of the asset, which was the case during the financial crisis and to a certain extent the sovereign debt crisis. This is the key to understanding the significant acceptance of the null hypothesis of the markets being too volatile to be efficient with regards to the Italian and to a lesser extent the Spanish markets. During the early stages of the sovereign debt crisis, these markets were seen as risk free and liquid markets, hence the upwards trend continued making them more predictable. However, of greater interest is the Greek and Portuguese markets acceptance of the efficient market hypothesis. A possible explanation is that market participants had no option other than to accept the price as given by the fundamentals because the market was no longer dictating the price. In other words, the market participants were increasingly reacting to the fundamental information rather than events, which especially in the case of Greece shows that market participants obviously were not aware or did not take into account the reliability of the Greek national accounts.

V. CONCLUSION

In this paper, we used the variance bound test to analyse different periods. We used a GARCH (1, 1) to estimate the excess volatility in the GIPS markets in a fast changing environment encompassing periods of high and low volatility. By using daily data, we had enough degrees of freedom to create subsamples where we could test each subsample individually. The aim was to find out how the financial and sovereign debt crises may or may not have changed the efficiency of financial markets.

During the financial crisis, all the GIPS markets seem to be suggesting at inefficiency. Perhaps surprisingly, the Greek and Portuguese are the only markets that seem to be efficient during the sovereign debt crisis. Given that the markets show periods where they are inefficient, it turns out that the markets are actually inefficient in particular during a financial crisis period. The results indicate that market participants over- and/or underreact to news especially in times of crises, but also before the crisis actually happens. This seems to be suggesting that asymmetrical effects, structural breaks or regime switching affects market efficiency, as hinted by Hughes Hallett and Richter (2002) and Fakhry and Richter (2015), which would be worth analysing.

Perhaps the key finding is that sometimes the overreaction and underreaction may cancel each other out so that the market gives the impression of being efficient. This means where there are periods of overreaction and other periods of underreaction by the market participant, this leads to the overreaction/underreaction cancelation state.

However, a market deemed too volatile to be efficient, is a market where there is still over- or under-reaction remaining after the cancellation state, this would be interesting to analyse.

However, it should be pointed out that this does not mean market participants are "irrational". As they are acting under uncertainty and do not have the full information set, it is more appropriate speak of bounded rationality as opposed to unbounded rationality. In addition, other factors influence the efficiency of the market such as the actions of policy makers (e.g. central bankers and governments) and the volatility model.

We could therefore confirm earlier results that financial markets are not as efficient as it is assumed especially in the neoclassical theory. The problem is while both neoclassical economics and the efficient market hypothesis are powerful benchmark tools; they do not reflect the real world.

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