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Is Gold a Hedge and/or a Safe Haven? An empirical examination of European Equity and Bond markets from the Euro's introduction to the COVID-19 pandemic outbreak

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Master's in Finance

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I – Acknowledgements

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II – Resumo

O principal objetivo desta dissertação é examinar se o Ouro atua como Ativo de Cobertura de Risco ou como Ativo de Defesa face a várias classes de ativos tais como os mercados acionista e obrigacionista, neste sentido, o nosso foco centra-se nos mercados europeus, por forma a avaliar o desempenho do Ouro, desde a introdução do Euro. Para tal, selecionámos os seguintes índices bolsistas: EuroStoxx 600, EuroStoxx Banks, DAX, CAC 40, FTSEMIB, IBEX 35, PSI 20, ISEQ e ASE; assim como as obrigações alemãs, francesas, italianas, espanholas, portuguesas, irlandesas e gregas, com dois e dez anos de maturidade. Analisámos ainda as possíveis diferenças de efeito entre o curto/médio e o longo prazos, por meio de uma análise de subamostras. De modo a capturar os efeitos de cobertura e defesa utilizamos os modelos ADCC-GARCH e DCC-GARCH e as Regressões Quantílicas e de período específico, respetivamente, aplicando ainda o algoritmo de Bai e Perron (2003) para as subamostras.

Os nossos resultados evidenciam que o Ouro pode ser considerado um Ativo de Cobertura de Risco para ações, sendo visível um particular efeito após o colapso do Lehman Brothers, assim como um forte Ativo de Defesa para os retornos negativos mais extremos assim como para períodos específicos como o colapso do Lehman Brothers, o segundo resgate à Grécia e o referendo ao Brexit; todavia no período de pandemia COVID-19 não encontramos esta propriedade. Relativamente às obrigações, não são visíveis ambos os efeitos, sendo o Ouro caraterizado, na melhor das hipóteses, como um fraco Ativo tanto de Cobertura de Risco como de Defesa, uma vez que os maiores condutores do efeito parecem ser os emitentes.

Palavras-Chave: Ouro, Ativo de Cobertura, Ativo de Defesa, Mercado Acionista, Mercado Obrigacionista

Classificação JEL: C32; C52; C55.

III – Abstract

The main objective of this dissertation is to examine if Gold acts as a Hedge or as a Safe Haven against different classes of assets such as, equity and bond markets. Our focus is on the European markets, in order to evaluate Gold's performance since the introduction of the Euro, being the markets analysed the EuroStoxx 600, the EuroStoxx Banks, the DAX, the CAC 40, the FTSEMIB, the IBEX 35, the PSI 20, the ISEQ and the ASE, as well as German, French, Italian, Spanish, Portuguese, Irish and Greek two- and ten-years bonds. We also analyse the effect on the long run and the short/medium run periods, by performing subsamples analysis. We have used ADCC-GARCH and DCC-GARCH models to capture the Hedge ability and Quantile and Specific Periods' Regression to the Safe Haven, applying the Bai and Perron (2003) algorithm to the subsamples.

Our results show that Gold can be regarded as a Hedge for equities, with particular effects visible from the Lehman Brothers collapse onwards, as well as Strong Safe Haven properties for the most extreme negative returns (1% and 2.5% quantiles) and for some specific periods such as the Lehman Brothers collapse, the Greek bailout and the Brexit Referendum. However for the COVID-19 pandemic outbreak we do not find this property. Regarding bonds, both Hedge and Safe Haven effects are not strongly visible, being Gold characterised, at best, as weak Hedge and Safe Haven, as the issuers appear to be the drivers of this effect.

Keyword: Gold, Hedge, Safe Haven, Stock market, Bond market

JEL classification: C32; C52; C55.

IV – Index

V – Index of Tables

VI – Index of Figures

Glossary:

ADCC-GARCH – Asymmetric Dynamic Conditional Correlation – Generalised Autoregressive Conditional Heteroskedasticity

AIC – Akaike Information Criterion

ARCH – Autoregressive Conditional Heteroskedasticity

ARMA-GARCH – Autoregressive Moving Average – Generalised Autoregressive Conditional Heteroskedasticity

AUD – Australian Dollar

BFGS – Broyden Fletcher Goldfarb Shanno algorithm

BIC – Bayesian Information Criterion

BRIC – Brazil, Russia, India and China

CAD – Canadian Dollar

CHF – Swiss Franc

DCC-GARCH – Dynamic Conditional Correlation – Generalised Autoregressive Conditional Heteroskedasticity

ECB – European Central Bank

EGARCH – Exponential GARCH

EMU – European Monetary Union

EU – European Union

EUR – Euro

G7 – Group of Seven (consists of the seven major developed countries)

GARCH – Generalised Autoregressive Conditional Heteroskedasticity

GBP – Great Britain Pound

GED – Generalised Error Distribution

GJR-GARCH – Golsten, Jagannathan and Runkle – Generalised Autoregressive Conditional Heteroskedasticity

GSFCIEA – Goldman Sachs Financial Conditions Index for the Euro Area

i.d.d – independent and identically distributed

ICSS –Iterative Cumulative Sum of Squares algorithm

JPY – Japanese Yen

MSCI – Morgan Stanley Capital International

PIIGS – Portugal, Italy, Ireland, Greece and Spain

UK – United Kingdom

US – United States

USD – United States Dollar

VIX – CBOE Volatility Index

1 – Introduction

Gold has been intrinsically connected to Human History and its economic and civilizational development. Its rarity, durability, divisibility, trust, intrinsic value and purchasing power allowed it to be accepted as money, but also used as store of value and wealth in both prosperity and uncertainty periods (such as wars), easing trade and economic growth. Despite being used since the Ancient History, it was in the Early Modern period that it became an engine to economic growth, when the first gold rushes were taken. From that period onwards, many other Gold rushes have followed and, in the nineteenth century, the first Gold Standards were established; meaning, currencies were then linked to gold. After World War II, the Bretton Woods system was implemented, setting an ounce of gold at 35 USD, being the USD convertible into gold and the other currencies pegged to the USD. This system imploded in 1971 with the Nixon Shock. Nowadays there is no currency linked to it, however it still provides shelter to currencies and financial assets.

Financial markets are deeply affected by uncertainty (due to underlying economic factors, wars or sanitary events) and by investors' fear of loss (which can result in panic selling); when this reaches a certain point, it can result into crashes. The first noticed crash was the Tulip Mania in February 1637, after this other relevant crashes happened: the Great Crash of 1929, the 1973–1974 stock market crash, the Black Monday of 1987, the 1997 Asian financial crisis, the dot.com bubble, the Global Financial Crisis, the European Sovereign Debt crisis and the recent COVID-19 pandemic outbreak.

This contextualisation served as the starting point for the purpose of this dissertation, where we intend to examine *Gold's ability to protect wealth against declines on equity and bond markets, on average (hedging ability) and in troubled periods only (safe haven's role)*. Moreover, our focus is on this relation across time towards European markets, in order to analyse Gold's role measured in Euros, since the single currency introduction. This goal is reached by performing a sample and subsamples analyses, which allows to verify a long run and different short/medium-term relationships.

As mentioned, this topic is divided in two subjects: Gold's Hedge and Safe Haven analyses. For the first, the main contributor is Ciner, Gurdgiev and Lucey (2013), who study Gold's hedging ability towards different classes of assets, applying the Dynamic Conditional Correlation Generalised Autoregressive Conditional Heteroskedasticity model, onwards referred as DCC-GARCH (Engle, 2002) with the purpose of getting daily time varying-correlations. For the second, we identify Baur and Lucey (2010) and Baur and McDermott (2010) and (2016) as relevant studies, given that they develop quantile regressions, in order to find statistically significant estimates for the coefficients, on certain periods only.

Despite these referred works being the milestones to this dissertation, we still find some gaps to explore as they mainly focus on the US and in other G7 markets. Therefore, our dissertation contributes to the existent literature, by analysing Gold's Hedge and Safe Haven role against equity and bond markets declines, *comparing the two EU major economies markets* (which are part of the G7) *with the PIIGS and two of the European equity benchmarks: EuroStoxx 600 and the EuroStoxx Banks*, so that we have a wide variety of European markets; meaning, with this dataset we can add relevant conclusions to the existent literature in order to label (or not) Gold as an asset that provides shelter against equity or bond market (yield rate increases) declines, on average or in certain periods only. Furthermore, we analyse two different bonds maturities, in order to provide a short/medium and a long-term outlook. Finally, we find a lack of analysis concerning subsamples, which allows us to examine both shorter and full sample periods and compare them; being quite relevant in order to understand the Hedge and Safe Haven dynamics and behaviour throughout timespan, with implications in portfolio's allocation and in risk management.

To perform a Hedge analysis, we apply the Asymmetric Dynamic Conditional Correlation Generalised Autoregressive Conditional Heteroskedasticity, onwards mentioned as ADCC-GARCH, (Cappiello, Engle and Sheppard, 2006) and the DCC-GARCH (Engle, 2002) models, in order to get daily time-varying correlations amid Gold and each asset candidate to be Hedge. Then, we use t-tests to find the significance of the coefficient's estimates, thus deepening Ciner et al (2013). To perform the Safe Haven analysis, we take Baur and McDermott (2016) as a foundation, adding the 2.5% quantile to their quantile regression, in order to evaluate the gap amid the 1% and 5% quantiles of the returns' distribution. To produce subsamples, we apply the Bai and Perron (2003) algorithm, with the purpose of finding structural breaks in each time series.

From the empirical study, regarding equities, we observe that Gold's hedging ability exists, being highlighted after the Lehman Brothers collapse; while for the Safe Haven role, we state that, at the most extreme negative returns, it can perform this property. Concerning Bond markets, for both Hedge and Safe Haven, the bond issuer is the driver of Gold's role, existing some Hedge (from Global Financial Crisis to the European Sovereign Debt Crisis) and Safe Haven roles (during the European Sovereign Debt Crisis) for the PIIGS.

The remainder of this work is organised as follows: in Section 2, we present the Literature Review; in Section 3, we show the data analysis; in Section 4, we expound the methodology followed in this work; in Section 5, we provide the empirical results, for subsample and subsamples analysis; lastly, in Section 6 we expose our main conclusions as well as some considerations regarding future research.

2 – Literature Review

In this section, we aim to present a literature review regarding the topics in analysis. This is divided in four major subsections; two in-scope which concern to Hedge and Safe Haven assets, a subsection beyond the main scope that includes other relevant subjects vis-à-vis Gold market, with the intention to highlight the vastness Gold's related bibliography and a final where we identify literature gaps to be further analysed.

First and foremost, it is important to identify the definitions respecting Hedge and Safe Haven assets, introduced in Baur and Lucey (2010) and Baur and McDermott (2010), who extended the first definitions that are clearly followed by the majority of the authors, such as, Ciner et al (2013), Hood and Malik (2013), Gürgün and Ünalmış (2014) and Baur and McDermott (2016).

Therefore, quoting Baur and McDermott (2010) "a strong (weak) Hedge is defined as an asset that is negatively correlated (uncorrelated) with another asset or portfolio on average". By opposition "a strong (weak) Safe Haven is defined as an asset that is negatively correlated (uncorrelated) with another asset or portfolio in certain periods only, e.g. in times of falling stock markets" and a diversifier is defined as an asset that is positively (but not perfectly correlated) with another asset or portfolio on average.

2.1 – Hedge

With reference the Hedge features, we describe in this subsection an empirical analysis related to different assets, candidate to be designated or considered as Hedge against different classes of assets, based on a wide variety of methodologies.

As a starting point to the Hedge research, we focus on Gold hedging ability towards equity market, Baur and Lucey (2010) introduce the quantile regressions[1] and conclude, based on their statistically significant estimates for all markets, that "Gold is a Hedge for stocks in the United States and in the United Kingdom, but not in Germany". Baur and McDermott (2010) also analyse this question and suggest, based on their regression, which includes a dynamic process[2], and on their sample, that Gold is, on daily basis, a strong Hedge for the North American market, being the only regional index with that feature, as well as

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[1]A quantile regression is a regression that has on the right side of the equation variables the represent a quantile of a main variable. In this case they represent as dependent variable Gold's return and as explanatory variables a stock's return and its quantile and a bond's return and its quantile.
Their model is written as: $r_{gold,t} = \alpha + \beta 1 r_{stock,t} + \beta 2 r_{stock\ q\%,t} + \beta 3 r_{bond,t} + \beta 4 r_{bond\ q\%,t} + \varepsilon_t$

[2]Their model is written as: $r_{gold,t} = \alpha + \beta_t r_{stock,t} + \varepsilon_t$
The dynamic process is represent by: $\beta_t = C_0 + C_1 D(r_{stock,t} q10) + C_2 D(r_{stock,t} q5) + C_3 D(r_{stock,t} q1)$
A GARCH component: $h_t = \pi + a e_{t-1}^2 + \beta h_{t-1}$

for developed country markets, such as, France, Germany, Italy, Switzerland and the UK, besides the US, but not for Canada, Japan and Australia; meaning it exists, between the mentioned papers, an agreement in the US and UK markets and a disagreement in the German market, which can be justified by the fact that Baur and McDermott (2010) cover a 30-year period sample, while Baur and Lucey (2010) cover just a 10-year period. Although use different samples, Hood and Malik (2013) and Shahzad, Bouri, Roubaud and Kristoufek (2020), both apply the methodology developed by Baur and McDermott (2010) and reach the same conclusion regarding the US market, but also for the German, French and Italian markets, by the latter authors. Shahzad et al (2020) also analysed the UK and Japanese markets finding a weak Hedge property, which is different from Baur and McDermott (2010) and could also be caused by a different sample period, which in Shahzad et al (2020) includes a more recent dataset.

Gürgün and Ünalmış (2014), similarly to Hood and Malik (2013) and to Shahzad et al (2020), also apply Baur and McDermott (2010) methodology to emerging and developing markets in both domestic and foreign investor perspectives, concluding that Gold for domestic investors, in the majority of the markets, provides a strong or a weak hedging properties, however when the focus is on a foreign investor, Gold is considered a strong or weak Hedge for much less markets. This last conclusion, here highlighted for a wider range of developing and emerging country markets, is in agreement with the reported by Baur and McDermott (2010), which concerned just to the BRICs.

Introducing to this review the DCC-GARCH methodology[3], developed by Engle (2002), which produces time-varying correlations amid assets, Ciner et al (2013) applied it to the UK and the US markets and find a "clear negative relation (…) between Gold and equities" for the US market, which again highlights the hedging ability of Gold regarding this market, which allows them to support the idea that "Gold can play a role as a financial variable that is important for stock market investors".

It is relevant to underline the works developed by Coudert and Raymond-Feingold (2011), who use monthly real returns on Gold and stocks, concluding that Gold is a Hedge in most cases (seven out of ten) they have analysed. Beckmann, Berger and Czudaj (2015), with a regression that accounts for "asymmetries of positive and negative extreme shocks" using two equations by means of the BFGS numerical optimization method, find that Gold is a strong Hedge for the EMU, Indonesia, Russia and Turkey, does not have Hedge ability for China, Germany and the MSCI World, being a weak Hedge for the rest of the markets they have analysed, which is a quite different conclusion from the one found in Baur

[3] For further details: see methodology (section 4.1)

and McDermott (2010), as these authors do not find a "clear pattern that Gold just acts as (…) a Hedge (…) for European countries as well as the US".

Baur and Lucey (2010) produce a subsample defining the periods of analysis, by computing the "peaks and troughs within the full sample", and reach the conclusion that Gold is only Hedge when we face bear markets. In addition to the subsamples context, Gürgün and Ünalmış (2014) form an interval from September 2008 to September 2013, the period after Lehman Brothers went to bankruptcy, but do not clearly identify if the subsample starts after that day or in the beginning of September. They find that Gold is a strong Hedge for domestic investor in a lower number of markets and a weak Hedge in a higher number of markets when compared to the full sample, meaning that after this period Hedge ability of Gold is reduced; for the foreign investor, however, there is one weak Hedge less and the countries where strong Hedge exists in full sample are not hedged by gold in the subsample, but for two new countries gold is strong hedge. Hood and Malik (2013) produce different regimes of volatility based on the ICSS algorithm (Inclán and Tiao, 1994) and conclude that the VIX is strongly negative correlated with the S&P500 in all the regimes, while Gold is positively correlated during three periods and even when is negatively correlated it is less than the VIX.

Emphasising the bond market, Ciner et al (2013) suggest that there is little relation between Gold and bonds in US, which is in accordance with Baur and Lucey (2010) that conclude that Gold is not a Hedge for the US and UK bond markets, albeit it is Hedge for German bond market.

Finally, it is relevant to highlight other assets against which Gold can be considered as Hedge. Joy (2011) using the above referred DCC-GARCH approach concludes that "Gold has acted as a Hedge against the US dollar throughout the sample period", which is in line with Ciner et al (2013) who find a "clear negative relation between Gold and dollar" arguing that "Gold could be regarded as a monetary asset" as it "seems to act as an 'anti-dollar' during most of the sample period". Reboredo and Rivera-Castro (2014) and Capie, Mills and Wood (2005) also point out for this conclusion.

Reboredo (2013) tests Gold against Oil and states that "Gold cannot Hedge against Oil prices" due to a positive and significant relationship between the two assets. Beckmann and Czudaj (2013) reveal that "Gold is partially able to Hedge future inflation in the long-run", being stronger for the US and UK than for Japan and Euro Area. From an investor perspective, this Hedge effectiveness of Gold depends on the time horizon, meaning that for "very long-run, Gold is useful as a partial Hedge since a cointegrating relationship prevails", however, in periods "where no price adjustment is observed, Gold is not able to shield a portfolio".

To conclude the analysis of Hedge properties it is relevant to illustrate other assets that could provide protection, such as, the VIX, Oil or the Bitcoin. With the purpose to analyse the better Hedge, Hood and Malik (2013) compared the performance of Gold and VIX. Nonetheless, as stated before, they conclude that Gold is both a Hedge, on the long run, they find evidence that the VIX coefficient is more negative and more statistically significant than the Gold one, meaning, VIX is a better Hedge than Gold for the US market. Regarding the Oil, Ciner et al (2013) state that it "can be regarded as a Hedge against the potential declines in the US dollar" after 2003 (2nd Gulf War).

Recently, there is an asset gaining attention in this matter: the Bitcoin. As mentioned above, Shahzad, et al (2020) analysed Gold hedging properties as well as Bitcoin's and accomplish that Gold is a better Hedge than Bitcoin for the majority of the markets, as the cybercurrency is only considered a strong Hedge for Canada and Japan [markets where Gold is not, at least, a strong Hedge, as reported by this authors as well as in Baur and McDermott (2010)], and is a weak Hedge for Italy and France.

According to Bouri, Molnár, Azzi, Roubaud and Hagfors (2017), who looked at daily and weekly data, for daily data, Bitcoin is a strong Hedge for the Japanese and MSCI Asia Pacific indexes, as well as for the Standard & Poor's Goldman Sachs Commodity Index and a diversifier in the rest of the markets under analysis. At a weekly level, they find evidence that it is a strong Hedge for the Chinese market, and a diversifier for the rest of the markets, being Japan and MSCI Asia-Pacific the exceptions. Urquhart and Zhang (2019) analyse high-frequency data using the DCC-GARCH (Engle, 2002) and the ADCC-GARCH[4] (Cappiello, et al, 2006) to find time-varying correlations and decide which model to select based on Information Criterions, verifying that "Bitcoin does offer intraday hedging benefits to investors at specific periods of time" for the CHF, EUR and GBP (and CAD at lower level) currencies.

2.2 – Safe Haven

With the intention to analyse Safe Haven assets, we introduce in this subsection a number of assets for those exists evidence, based on different approaches, of a Safe Haven role against different classes of assets, with a special focus on Gold.

As foundation of our analysis, Baur and Lucey (2010) developed a quantile regression model and conclude that Gold is a Safe Haven for the 2.5% and 1% quantiles in the US and Germany. Besides that, they also prove that the Safe Haven effect is short-lived (15 trading days), also confirmed by Baur and

[4] For further details: see methodology (section 4.1)

McDermott (2016), however, the latter just use the cumulative returns, without any statistical measure to base that conclusion. Baur and McDermott (2016) also compute a quantile regression[5] with some differences from the prior mentioned, pointing out that Gold is a Safe Haven for the S&P500 and the MSCI World, when those markets exhibit extreme negative returns, meaning, left-tailed returns below or equal to the 1% quantile, which partially confirms the reported by Baur and Lucey (2010).

Baur and McDermott (2010) also analysed this problematic with their former mentioned dynamic process in the regression, finding evidence of the Safe Haven effect for most developed countries and regional stock markets, which are stronger at 1% quantile (daily data), suggesting based on these results that "Gold can be seen as a panic buy in the immediate aftermath of an extreme negative market shock". Notwithstanding the above exposed, Ciner et al (2013) state that Gold is not a Safe Haven for equity as their coefficient's estimates are not statistically significant for the US market, arguing that it might be related to a more recent dataset, in which Gold has sharply increased its price. Gold's popularity as investment and the rise of financial instruments related to it are mentioned to cause "a decline in its primary attraction for many financial market participants, which is the notion that Gold can be trusted as a Safe Haven against the equity market volatility". In order to reinforce these arguments, we enhance the critique of Baur and Glover (2012) who state that the more people holding Gold, the more likely Gold price is negatively affected in troubled periods, due to an increasing co-movement, which contributes to weaken the Safe Haven. The authors report that, due to the increase of Gold investments occurred in the first decade of the 21st century, during the financial crisis the duration of the Safe Haven effect of Gold was reduced from the 15 trading days mentioned in Baur and Lucey (2010), stating that in extreme cases it could be eliminated because of investors behaviour.

Other relevant approaches are the ones developed by Coudert and Raymond-Feingold (2011) and by Beckmann et al (2015). The former base their work on an ARMA-GARCH (1,1)-X, enabling them to infer that Gold is a Safe Haven against stocks, specifically being a strong Safe Haven for the French, German and MSCI G7 markets and weak Safe Haven for the US and the UK, while the latter find evidences of strong Safe Haven in India, the UK and MSCI World; withal no evidence is found in MSCI EMU, Indonesia and Russia but weak Safe Haven exist in all other markets analysed.

[5]The Baur and McDermott (2016) quantile regression is different from the Baur and Lucey (2010) (see footnote 1), as this allows to compute various quantiles in one step regression as well as each class of asset separately, which is not allowed in Baur and Lucey (2010) equation.
This model is written as: $r_{i,t} = a + \beta X_t + y_0 r_{s,t} + y_1 r_{s,t} Dq10 + y_2 r_{s,t} Dq5 + y_3 r_{s,t} Dq1 \; + \; \varepsilon_t$

Regarding emerging markets, Baur and McDermott (2010) conclude that (foreign) investors “react differently to shocks in emerging markets as opposed to developed markets” as Gold is not a Safe Haven for those markets, which is highlighted by Gürgün and Ünalmış (2014) who study a wider variety of developing and emerging markets. The second authors also analyse the domestic investors perspective, being Gold reckoned as a strong Safe Haven for extreme negative returns in many markets.

According to Hood and Malik (2013) estimates, who analyse Gold’s Safe Haven role as well as other precious metals, such as platinum or silver, and the VIX, Gold is perceived as a strong Safe Haven at the 10% quantile, while at more extreme quantiles it is a weak Safe Havens as the coefficient’s estimates are negative, but not significant. As for Silver and Platinum none is considered a Safe Haven at any quantile, whilst the VIX is a strong Safe Haven at all the quantiles, being better and stronger than Gold, due to its higher and more statistically significant coefficient’s estimates.

Lucey and Li (2015) with its quarterly analysis looking for which precious metals are Safe Haven for the US market and when, stating that, despite Gold having Safe Haven properties in some periods, there are other precious metals that are Safe Havens in periods when Gold is not (for instance, in the end of 1993 and during 2007, silver and palladium were Safe Havens and Gold was not); and in some periods even when Gold is a Safe Haven, it is not the better one (for example, Silver in the third quarter of 1996).

Baur and McDermott (2010), with their dynamic process, sought after not only the quantiles but also at specific crisis periods, being these periods defined taking the assumption that the “effects occurred in the first 20 trading days”. Finding evidence of Gold being “a strong Safe Haven for most developed markets during the peak” of the financial crisis, and also for “the US and Canada during 1987 stock market crash”, but not during the Asian crisis.

Lastly, Baur (2012), who study asymmetric volatility in Gold market, affirms that a positive shock in Gold’s price, increases more its volatility than when facing a negative shock. This finding is consistent across all frequencies and Gold denominated currencies, being the magnitude of the effect increased from the high-frequency to the low-frequency returns. The author states that, while, in equity, a negative return signs bad news and a positive return implies good news, in the Gold market the reverse is observed, meaning that a positive shock in Gold market could be related to bad “financial and macroeconomic news” and a negative return in Gold could mean good news. In a nutshell, “the inverted asymmetric volatility pattern of Gold does not compromise the safe-haven effect but instead strengthens it”.

In addition, similar to the Hedge analysis, Baur and Lucey (2010) and Gürgün and Ünalmış (2014) perform a subsample analysis. The former express that Gold is a Safe Haven, mainly in bear market periods, while the latter conclude that Gold is a strong Safe Haven for domestic investors during extreme negative returns in a wide range of developing and emerging markets. When the foreign investors are considered that statement is not so clear, meaning, Gold is a Safe Haven for a much lower number of equity markets.

In regard to the bond market, Ciner et al (2013) observe that Gold can be named a Safe Haven for the US bond market, which is consistent with Baur and Lucey (2010) who affirm that Gold is a Safe Haven for bonds in 5% quantile for the US and Germany, however it is not at most extreme quantiles under analysis, while regarding the UK, Gold is not a Safe Haven in any quantile.

According to Ciner et al (2013), Gold contains Safe Haven properties against declines in the US dollar and the Sterling Pound, supporting their previously reported conclusion of monetary asset, once it is Safe Haven towards two of the most important currencies in the world, while Joy (2011) reports that Gold's role as a Safe Haven against the US dollar "is negligible".

Adding the Oil market to the equation, Reboredo (2013) defends Gold's role as Safe Haven to the Oil markets, once he finds "evidence of tail interdependence, indicating that Gold acts as an effective Safe Haven in periods of Oil market stress."

With the intention to broaden the spectrum of the analysis, we should focus on some assets that contribute as Safe Haven against others. Hereupon, Ciner et al (2013) verify that Oil acts as Safe Haven for extreme declines in the US bond market, supporting the theory that "Oil, in addition to being one of the most important global commodities, has a financial variable role"; however as "it does not exhibit the same relation against other variables", indicates that it is not as relevant as Gold is. Moreover, Baur and McDermott (2016) sustain that, when the S&P500 and the MSCI World exhibit extreme negative returns, below the 1% quantile, the 3-month and 10-year US government bonds are Safe Havens, being that point of view supported by Ciner et al (2013). Furthermore, Ciner et al (2013) assert that equity plays a Safe Haven role for the British pound and for Oil.

Ultimately, with respect to traditional assets, Baur and McDermott (2016) state that the Swiss Franc is a strong Safe Haven for the extreme negative returns (in case the 1% and 5% quantiles of the MSCI World), nonetheless being only a weak Safe Haven for the S&P500 shocks. By opposition, the US dollar is not a strong Safe Haven for shocks in the MSCI World market; in fact, it is only a strong Safe Haven for the 10% quantile returns of the S&P500 and a weak Safe Haven for the 5% and 1% quantiles. In their view, the

"Swiss franc is used as a Safe Haven by global investors whilst the US dollar is predominantly used by investors related to the US market". Ranaldo and Söderling (2010) find that both the CHF and the JPY are Safe Haven currencies against the USD, as they exhibit an increasing excess of return when there is a decrease in the US stock prices as well as an increase in the US bond prices and US volatility; they still claim that "euro has similar, but weaker properties", while the GBP cannot be regarded as a Safe Haven currency.

As stated above when concerning hedging ability, Bitcoin has also attracted attention lately to the Safe Haven topic. Shahzad, Bouri, Roubaud, Kristoufek and Lucey (2019), who compared Bitcoin with Gold and other commodities based on a cross-quantilogram approach, support the notion that "Bitcoin, Gold, or commodities can be, at best, regarded as a weak Safe Haven". Shahzad et al (2020), however, argument that Bitcoin is only a weak Safe Haven for Canada and France, while regarding Gold they defend that it is a strong Safe Haven for Germany and US and weak Safe Haven for France, Italy, Japan and the UK. Bouri et al (2017)[6] back the idea that "Bitcoin cannot be regarded as weak or strong Safe Haven" on daily basis and that on weekly basis a Safe Haven property can be considered strong for the Chinese and Asia-Pacific markets at some quantiles, whilst for the rest of the markets it is not Safe Haven. Finally, Urquhart and Zhang (2019), who analyse the capacity of Bitcoin Safe Haven versus some of the most important exchange rates compared to the USD, uphold that Bitcoin is Safe Haven for CAD, CHF and GBP and does not have any Safe Haven property for AUD, EUR and JPY.

2.3 – Other relevant aspects regarding Gold

As mentioned, in this section, we provide a review of other relevant works concerning Gold that are out of the core of the work we are pursuing. One of the most referred works regarding Gold is the one developed by Aggarwal and Lucey (2007), who document the existence of psychological barriers for daily data, at round numbers in the hundreds digit, (for instance, 200, 300, 400 US dollars) as well as "strong evidences of changes in the variances of returns in the vicinity of and when crossing (especially from above) psychological price barriers".

Lucey and O'Conner (2013) analyse bubbles and conclude that in the lease rates (Gold's underlying interest rate), when the maturities two, three and twelve months "are used as the fundamental

[6] They compute the DCC-GARCH to get time-varying correlations, performing a quantile regression. Their model is written as: $DCC_t = m_0 + m_1 D(r_{Asset,t} q10) + m_2 D(r_{Asset,t} q10) + m_3 D(r_{Asset,t} q1) + \varepsilon_t$

determinant of Gold prices" there is a bubble, whilst when the one and six months maturity are considered the fundamental determinant of Gold prices, there is no bubble.

Cohen and Qadan (2010) analyse granger causality between Gold and VIX markets, stating that, when considering a full sample, the VIX rate of change does not granger cause Gold returns, but Gold returns granger causes VIX; although when restricting the sample to low volatility and high volatility periods, they find an "existence of bi-directional causality between both variables" in the former, while in the latter VIX does not granger cause Gold, however Gold return granger causes VIX.

Miyazaki and Hamori (2013) investigate causality amid S&P500 and Gold, concluding that in terms of mean "exists statistically significant causality" from the S&P500 to Gold and there is no reverse causality, meaning, it "exists a unidirectional causality in mean from the S&P500 index return to the Gold return". In terms of variance, "there is no evidence of causality from the S&P500 index to the Gold and vice-versa", meaning, it "exists no volatility transmission between the Gold market and the stock market during this sample period**"**.

2.4 – Literature Gap

As it is made clear, the above literature review is imperative, in order to evaluate the relevance of this work. We find that there is a vast analysis regarding Gold's role as both Hedge and Safe Haven towards the most important equity, bond and exchange rates markets in the world, as well as towards emerging and developing markets. It is also shown that there are other assets considered Hedge and Safe Haven to those major markets, however, we find some literature gaps that we are trying to fill-in concerning Gold's role as Hedge and Safe Haven related to European equity and bond markets, since the introduction of the single currency and with a particular focus on the PIIGS. Regarding the bond market there is not, to the best of our knowledge, any study that compares Gold's role in the face of different government bond maturities. Finally, we have discovered a lack of subsample analysis concerning not only the European markets, but actually across the majority of markets.

3 – Data

In this section, we present the data characterisation and the descriptive statistics. In the former, we highlight our sample period, the assets that we will analyse and the equations used in the returns' computation, while in the latter, we present and analyse the descriptive statistics measures.

3.1 – Dataset characterisation

The dataset used in this empirical analysis is collected from Bloomberg and Datastream. It is composed by daily closing returns covering a period of 21 years and 4 months, starting on the 4th of January 1999, due to the Euro's introduction, and ending on the 30th of April 2020, corresponding to a sample of 5434 observations, at the most.

In this dataset, there are four classes of assets which are a commodity (namely Gold measured in Euros), nine equity indexes, fourteen government bonds and an indicator of financial conditions [the Goldman Sachs Financial Conditions Index for the Euro Area onwards mentioned as GSFCIEA (Goldman Sachs, 2018)], used as a proxy for measuring the risk across European markets, as it combines data from the riskless interest rates, equities, exchange rates and credit spreads. The equity indexes encompass two aggregating indexes from European markets, the EuroStoxx 600 and the EuroStoxx Banks (consists of an index that encompasses 600 European large, mid and small capitalization companies across 17 European countries and an index that includes banking institutions that are part of the EMU, respectively), as well as the benchmarks for Germany (DAX), France (CAC 40), Italy (FTSEMIB), Spain (IBEX 35), Portugal (PSI 20), Ireland (ISEQ) and Greece (ASE). Regarding the government bond market, it comprises the two- and ten-years yield rates for Germany, France, Italy, Spain, Portugal, Ireland and Greece, as well.

Those previously mentioned daily returns are computed for stocks and Gold based on the equation 1 and, by opposition, for the bond market they are computed just by the difference between observation at time t and observation at time t-1, as stated in equation 2; as the quotation of the equity and Gold markets are in points (which can be converted in Euros) and in Euros, respectively, while the bond market data is measured in terms of the yield rate.

This distinction is vital to avoid having a massive percentual increase in the bond market (by using equation 1), when the yield rate is low and there is just a small increase in it, and have a smaller hike in percentage, when the yield rate is higher and the increase is higher too. To illustrate this issue with numbers, let's take the following example: admit that the yield rate of country "A" with maturity "X", on "day t-1" is at 0.01% and on the day after ("day t"), it increases to 0.02% (case 1); additionally, consider a second case (case 2), where in a different period of time, here defined as "n-1", the yield rate is at 1% and it raises on "day n" to 1.5%; finally, a third case, where the yield rate is on "day m-1" at 4% and it hikes to 5% at "day m" (case 3).

Applying the equation 1 to case 1, we face an increase of 100% in the yield, which is true indeed, however it represents a massive percentual increase from one day to another, when, in fact, it just increases by 1 basis point (equation 2); in case 2, we account an increase of 50% in the yield (lower than case 1), however when considering the yield difference it increases by 50 basis points (equation 2); in case 3, there is a yield boost of 25%, nonetheless it increases by 100 basis points (equation 2).

To sum up, if we compute the returns by equation 1 it can lead to an erroneous conclusion, as we are considering that the increase in the perceived risk is higher in case 1 than in cases 2 and 3, albeit it is clear that the increase in that risk is higher in case 3 than in case 2 and 1 (in this order). This issue is highlighted when computing the quantiles of returns distribution, as it considers case 1 the most extreme quantile compared to cases 2 and 3, which could mislead our analysis. Whilst, when using equation 2 that problem is eliminated.

The returns equations are the following:

$$SGr_t = \frac{P_t}{P_{t-1}} - 1 \tag{1}$$

for $t = 1, \dots, T$, in which SGr_t denotes the Stock or Gold Return at day t, P_t is the closing price at day t and P_{t-1} is the closing price at day t-1.

$$Bc_t = y_t - y_{t-1} \tag{2}$$

for $t = 1, \dots, T$, in which Bc_t denotes the change on the yield, y_t is the yield's closing price at day t, y_{t-1} is the yield's closing price at day t-1.

3.2 – Descriptive Statistics

In table 1, there is a clear pattern amid Gold and the stock markets, as Gold presents, simultaneously, an average return higher than all the markets under analysis and a lower risk measured by the mean and standard deviation, respectively. Furthermore, we can observe that Gold's most extreme, both, positive and negative returns are, in absolute value, lower than the ones for stock markets. Regarding kurtosis, both stocks and Gold represent a leptokurtic distribution, meaning more observations concentrated under the mean as well as fat tails, that is, more extreme returns than a Normal distribution. Concerning skewness, Gold is the one with a higher positive coefficient, while the majority of the stock distributions have a negative coefficient, which is a first interesting conclusion vis-à-vis the Hedge property to be studied later on this work, once a positive skewness coefficient indicates frequent small losses and uncommonly large gains, in opposition to a negative skewness coefficient where there are periodic small gains and rarely large losses.

With respect to the bond market, there is a negative return on average, meaning the yield rate has been reduced, which is consistent with the more recent years after the measures taken by the ECB. It is also noticeable the higher standard deviation in the countries affected by the European sovereign debt crisis, particularly shorter-term maturities; as well as the opposite relation regarding the bonds of the two major economies of the EU, with higher standard deviation in the longer maturity bond being both lower than in all the other countries' bonds. As one can see, these notions are also supported by the maximum and minimum; in some countries, it is visible a daily increase and decrease above 1 percentage point, in some cases sharply above, while for the others two countries, those maximum and minimum are below 0.5 percentage points difference. In terms of kurtosis, it is perceptible an obvious leptokurtic and, in many cases, extreme leptokurtic distribution; this is a statistical demonstration of both positive and negative extreme returns (fat-tails), and a concentration under the mean (close to zero). Focusing on the skewness, as we are dealing with yield rates, a positive skewness coefficient is related to low frequency large yield increases and high frequency small yield decreases; by contrast a negative skewness coefficient means high frequency small yield increases and low frequency large yield decreases.

Time-Series	Mean	Standard Deviation	Maximum	Minimum	Kurtosis	Skewness	Number of observations	Starting Date	Ending Date
EuroStoxx 600	0,011%	1,219%	9,867%	-11,478%	7,021	-0,222	5434	04/01/1999	30/04/2020
EuroStoxx Banks	-0,012%	1,916%	19,439%	-18,024%	8,920	0,036	5434	04/01/1999	30/04/2020
DAX30	0,024%	1,479%	11,402%	-12,239%	5,874	0,001	5434	04/01/1999	30/04/2020
CAC40	0,012%	1,434%	11,176%	-12,277%	6,266	-0,047	5434	04/01/1999	30/04/2020
FTSEMIB	-0,002%	1,523%	11,488%	-16,924%	7,953	-0,349	5434	04/01/1999	30/04/2020
IBEX35	0,003%	1,460%	14,435%	-14,059%	7,708	-0,117	5434	04/01/1999	30/04/2020
PSI20	-0,011%	1,184%	10,734%	-9,859%	7,264	-0,247	5434	04/01/1999	30/04/2020
ISEQ	0,011%	1,356%	10,223%	-13,032%	8,115	-0,526	5434	04/01/1999	30/04/2020
ASE	-0,011%	1,880%	14,375%	-16,233%	6,451	-0,205	5434	04/01/1999	30/04/2020
German Bonds 2 years	-0,0007	0,0393	0,3310	-0,3030	6,713	0,248	5434	04/01/1999	30/04/2020
German Bonds 10 years	-0,0008	0,0426	0,2290	-0,2570	1,877	0,211	5434	04/01/1999	30/04/2020
French Bonds 2 years	-0,0007	0,0405	0,4280	-0,2680	9,636	0,676	5434	04/01/1999	30/04/2020
French Bonds 10 years	-0,0007	0,0425	0,2670	-0,2900	2,442	0,257	5434	04/01/1999	30/04/2020
Italian Bonds 2 years	-0,0005	0,0840	1,8630	-1,0690	75,713	0,784	5434	04/01/1999	30/04/2020
Italian Bonds 10 years	-0,0004	0,0623	0,5840	-0,7980	18,794	-0,394	5434	04/01/1999	30/04/2020
Spanish Bonds 2 years	-0,0006	0,0723	0,7720	-1,1440	45,277	-1,683	5434	04/01/1999	30/04/2020
Spanish Bonds 10 years	-0,0006	0,0601	0,4330	-0,8840	18,575	-0,961	5434	04/01/1999	30/04/2020
Portuguese Bonds 2 years	-0,0006	0,1924	3,8310	-3,0960	130,172	4,127	5434	04/01/1999	30/04/2020
Portuguese Bonds 10 years	-0,0006	0,1055	2,1730	-1,6340	109,220	2,304	5434	04/01/1999	30/04/2020
Irish Bonds 2 years	-0,0007	0,1643	2,4260	-4,0100	181,422	-4,180	4201	06/11/2003	30/04/2020
Irish Bonds 10 years	-0,0007	0,0754	0,9230	-1,1730	41,564	-0,120	5433	05/01/1999	30/04/2020
Greek bonds 2 years	-0,0020	0,5679	10,9860	-8,4270	146,762	2,596	1484	07/07/2014	30/04/2020
Greek bonds 10 years	-0,0009	0,3885	3,9470	-19,9140	1292,874	-24,955	5434	04/01/1999	30/04/2020
Gold EUR	0,039%	1,036%	9,291%	-8,571%	7,427	0,266	5434	04/01/1999	30/04/2020

Table 1 – Descriptive Statistics of the daily returns of the Equity and Bond markets under analysis. It is presented the mean, the standard deviation, the maximum, the minimum, the kurtosis and the skewness, as well as the last three columns represent the number of observations and its starting and ending dates.

4 – Methodology

First and foremost, to pursue this work it is important to clarify and distinguish the concepts that we are dealing with. In order to do that, we have to introduce the definitions of Hedge and Safe Haven that are the milestones of this work.

In this work, we are following the previously mentioned definitions of Hedge and Safe Haven provided in Baur and McDermott (2010). On one hand, “a strong (weak) Hedge is defined as an asset that is negatively correlated (uncorrelated) with another asset or portfolio on average”, on the contrary “a strong (weak) Safe Haven is defined as an asset that is negatively correlated (uncorrelated) with another asset or portfolio in certain periods only”, being these certain periods market turmoils.

4.1 – Hedge

As a starting point to our analysis, with the purpose of capturing if an asset is a Hedge to another asset or portfolio, we will use the DCC-GARCH (Engle, 2002) and ADCC-GARCH (Capiello et al, 2006) models. These approaches allow to compute time-varying correlations, which permit us to conclude about the Hedge ability of Gold towards a certain asset. We introduce the EGARCH (Nelson, 1991) and GJR-GARCH (Golsten, Jagannathan and Runkle, 1993) specifications in the GARCH (Bollerslev, 1986) component of the models, with Normal, Student’s T and Generalised Error Distribution (GED) distributions, being the choice of the better model performed, first, by the minimization of both the Akaike and Bayesian Information Criterions, onwards mentioned as AIC and BIC, respectively. If these Information Criterion are in disagreement in which is the better model, we adopt the one selected by the BIC as it penalises mores the data.

The estimation of the DCC-GARCH and ADCC-GARCH processes consists of two steps. First, we fit each univariate GARCH models with each distribution to each asset time series, then we estimate the ADCC-GARCH and the DCC-GARCH models and produce the Daily Conditional Correlations.

The model is enunciated as:

$$r_t|I_{t-1} \sim N(0, H_t) \quad (3)$$

$$H_t = D_t R_t D_t \quad (4)$$

$$\varepsilon_t = H_t^{1/2} z_t \quad (5)$$

$$R = [diag(Q_t)^{-1/2}]Q_t[diag(Q_t)^{-1/2}] \quad (6)$$

where $r_t = [r_{1,t}, r_{2,t}]$ is a $2x1$ vector of returns including the assets to analyse Hedge role ($r_{1,t}$) and Gold ($r_{2,t}$), H_t denotes the conditional covariance matrix of r_t, D_t is the diagonal matrix containing the conditional standard deviations from the univariate EGARCH and GJR-GARCH models, and R_t represents the daily time-varying conditional correlation matrix. $\varepsilon_t = [\varepsilon_{1,t}, \varepsilon_{2,t}]'$ is a vector of residuals conditional on the information set at time $t-1$, z_t denotes a $2x1$ *i.d.d.* vector of standardised residuals, and Q_t is the conditional correlation matrix of the standardised returns.

Deriving the elements of H_t from the asymmetric univariate GARCH (1,1) models: the first is the EGARCH (Nelson, 1991), while the second is the GJR-GARCH (Golsten et al, 1993).

$$ln\,(h_{i,t}) \;=\; \omega_i \;+ \sum_{i=1}^{q} \alpha_i \frac{|\varepsilon_{t-i}|}{h_{t-i}} \;+\; \sum_{i=1}^{q} \gamma_i \frac{\varepsilon_{t-i}}{h_{t-i}} + \sum_{i=1}^{q} \beta_i ln(h_{t-i}) \qquad (7)$$

where $h_{i,t}$ is the conditional variance of the return time series, ω_i is a constant term, α_i the ARCH effect, β_i the persistence effect and γ_i the asymmetric effect.

$$h_{i,t} = \omega_i + \sum_{i=1}^{q} (\alpha_i \;+ \gamma_i I\varepsilon_{t-i<0})\varepsilon_{t-i}^2 + \sum_{i=1}^{q} \beta_i h_{t-i} \qquad (8)$$

where $I\varepsilon_{t-i<0} \;=\; \begin{cases} 1\; if\; \varepsilon_{t-i} < 0 \\ 0\; if\; \varepsilon_{t-i} > 0 \end{cases}$,

$h_{i,t}$ is the conditional variance of the return time series, ω_i is a constant term, α_i the ARCH effect, β_i the persistence effect and γ_i the asymmetric effect.

The dynamics of Q in the ADCC-GARCH model are presented as:

$$Q_t = (1 - \theta_1 - \theta_2)Q - \;\varphi N \;+\; \theta_1(z_{t\,-\,1}\;z'_{t\,-\,1}) \;+\; \theta_2 Q_{t-1} \;+\; \varphi(\eta_{t-1}\eta'_{t-1}) \qquad (9)$$

where θ_1, θ_2 and φ are parameter matrices, $\eta_t \;=\; I(z_t < 0) \circ\; z_t$ is an indicator function that takes the of value if the argument is true and zero otherwise, $\circ$ indicates the Hadamard product and $Q_j = E[z_t, z'_t]$ and $N = E[\eta_{t,}\eta'_t]$ are the unconditional correlation matrices of z_t and η_t, respectively. φ is the parameter of correlation asymmetry. If $\varphi = 0$, then ADCC-GARCH is reduced to a standard DCC-GARCH model no asymmetric effect in the conditional variance.

The daily time-varying correlation matrix of the ADCC-GARCH model is given by:

$$R_t \;=\; Q_t^{*\,-\,1} Q_t Q_t^{*\,-\,1} \qquad (10)$$

where Q_t^* is a diagonal matrix with a square root of the *ith* diagonal of Q_t in its *ith* diagonal position.

As result of this, with the purpose to analyse if Gold is a Hedge for an asset i, we formulate the t-test with the following hypothesis. Hypothesis testing 1 considers, under the null hypothesis (H0), that Gold is a weak Hedge and under the alternative hypothesis (Ha) Gold is either a strong Hedge or a diversifier. If it is concluded that there is statistical evidence to reject the null hypothesis in hypothesis testing 1, then, we introduce hypothesis testing 2, where it is tested if Gold is weak Hedge (H0) against a strong Hedge (Ha). Under this hypothesis, so that Gold is considered a strong Hedge for the stock markets, it is required the estimate for the ρ to be negative and statistically significant; while for bonds, as we are dealing with yields, the estimate for the ρ needs to be positive and statistically significant. If, simultaneously, in hypothesis testing 1 and 2, we reject the null hypothesis, we can conclude that Gold is a strong Hedge for the asset under analysis. However if, in hypothesis testing 2, we do not reject the null hypothesis, we suspect that Gold is a diversifier for that asset i, albeit this is not statistically confirmed, requiring to perform a third hypothesis testing. Once more, under the null hypothesis, Gold is a weak Hedge (already rejected in hypothesis testing 1) and under the alternative hypothesis, Gold is a diversifier for that asset; if, in fact, here we reject the null, we statistically confirm that Gold is, indeed, a diversifier for asset i.

These hypotheses are formulated as follows:

For stock market			For bond market		
	Hypothesis testing 1:			Hypothesis testing 1:	
H0:	ρ=0	(Gold is a weak Hedge for asset i)	H0:	ρ=0	(Gold is a weak Hedge for asset i)
Ha:	$\rho \neq 0$	(Gold is or a strong Hedge or a diversifier for	Ha:	$\rho \neq 0$	(Gold is or a strong Hedge or a diversifier for asset
	Hypothesis testing 2:			Hypothesis testing 2:	
H0:	ρ=0	(Gold is a weak Hedge for asset i)	H0:	ρ=0	(Gold is a weak Hedge for asset i)
Ha:	ρ<0	(Gold is a strong Hedge for asset i)	Ha:	ρ>0	(Gold is a strong Hedge for asset i)
	Hypothesis testing 3:			Hypothesis testing 3:	
H0:	ρ=0	(Gold is a weak Hedge for asset i)	H0:	ρ=0	(Gold is a weak Hedge for asset i)
Ha:	ρ>0	(Gold is a diversifier for asset i)	Ha:	ρ<0	(Gold is a diversifier for asset i)

Table 2 – Formulation of the t-tests hypothesis. The first column represents the stock markets hypothesis and the second represents the bond markets hypothesis.

4.2 – Safe Haven

Regarding the Safe Haven properties, there are two major analysis to develop: one based on Quantile Regressions; the other based on Specific Periods' Regressions.

4.2.1 – Quantile Regression

Our Quantile Regression is defined following the work developed by Baur and McDermott (2016), nonetheless we adapt their work. We model Gold's returns in terms of the candidate asset to Safe Haven returns and its own 1%, 2.5%, 5% and 10% quantiles, which corresponds to the 1%, 2.5%, 5% and 10% most negatively distributed returns, respectively. In terms of bonds, as we are dealing with the yield rate, the mentioned 1%, 2.5%, 5% and 10% quantiles corresponds to the 99%, 97.5%, 95% and 90% quantiles of the distribution of bond returns, as the increases in the yield rate are right-tail distributed and represent the negative scenario. Moreover, to ease the notation from now onwards it will be considered only the 1%, 2.5%, 5% and 10% quantiles, when considering both equity and bond returns. To capture these extreme returns we use dummy variables, which take value 1 when in presence of a return belonging to the quantile and 0 otherwise. That adaptation of Baur and McDermott (2016) work is done by excluding a vector of control, which included other potential Safe Haven assets, that are relevant in their work, but are not in ours; besides this, in our work *we also include the 2.5% quantile, given that in their work exists a huge gap of analysis between the 1% and 5% quantiles*.

Our Quantile Regression is enunciated as follows:

$$r_{G,t} = \alpha + \beta_2 r_{A,t} + \beta_3 D r_{A,t} q1\% + \beta_4 D r_{A,t} q2.5\% + \beta_5 D r_{A,t} q5\% + \beta_6 D r_{A,t} q10\% + \varepsilon_t \qquad (11)$$

for $t = 1, \dots, T$, in which $r_{G,t}$ is Gold return at time t, $r_{A,t}$ is the return of asset A at time t, $r_{A,t}q1\%$, $r_{A,t}q2.5\%$, $r_{A,t}q5\%$ and $r_{A,t}q10\%$ are the 1%, 2.5%, 5% and 10% most negatively distributed returns of asset A, respectively.

4.2.2 – Specific Periods' Regression

The Specific Periods' Regression is a regression where we consider period that are candidate to be a Safe Haven. Those periods are defined based on major events (financial, economic, political, sanitary and terrorist), where stock market, bond market or both suffered extreme losses and extreme yield increases, respectively. Furthermore, this regression is based on the work developed by Baur and McDermott (2010) who, as mentioned in section 2.2, analyse some financial crisis periods; here we *upgrade their work by including some more recent and not only financial events*, such as, events during the European Sovereign Debt Crisis, the Brexit Referendum and the COVID-19 pandemic outbreak.

Apart from that, it is pertinent to elucidate how the beginning and the culmination of each period is defined. The first is defined when one of those events happen, that is, the day when the effect exists. For the second, there are two approaches: in one, the end date is defined based on literature precedents, while in the other (which is applied when there is no precedent), the end of period is defined using the GSFCIEA as a proxy for volatility, with the aim of the end date being defined as the day when the volatility reached the existent level before the shock. Despite that, it can exist periods in which the volatility does not reach the same level as before the shock. In those cases, we have to, arbitrarily, define the end day, due to the demonstration of the Safe Haven short lived effect[7]. The volatility of the GSFCIEA is computed by the EGARCH (equation 7) and GJR-GARCH (equation 8) models with three different distribution: the Normal, the Student's T and the GED, meaning, we define six GARCH models. Finally, to decide which is the better GARCH specification, once more, we have to minimise the AIC and the BIC; if these information criterions disagree in which is the best GARCH specification, we adopt the one chosen by the BIC, due to its more penalising characteristics. Moreover, we introduce a stepwise algorithm (Venables and Ripley, 2002) in the regression, in order to eliminate the insignificant variables from our model, as there are included in it many candidates' periods.

In a nutshell, this model provides analysis of concrete periods glimpsing an event sequence, instead of the Quantile Regressions that simply analyses the periods where the assets' return is equal or exceeds that quantile.

The model is given by:

$$r_{G,t} = \alpha + \beta_2 r_{A,t} + \beta_3 D r_{A,t} September\ 11^{th} + \ldots + \beta_{16} D r_{A,t} COVID - 19\ pandemic\ outbreak\ +\ \varepsilon_t \quad (12)$$

for $t = 1, \ldots, T$, in which $r_{G,t}$ is Gold return at time t, $r_{A,t}$ is the return of asset A at time t, $r_{A,t} September\ 11^{th}$ is the return of asset A during the September 11th terrorist attacks, … , and $r_{A,t} COVID - 19\ pandemic\ outbreak$ is the return of asset A during the COVID-19 pandemic outbreak.

The residuals of each Quantile's and Specific Period's Regressions are modelled as an EGARCH (equation 7) and GJR-GARCH (equation 8) processes with Normal, Student's T and GED distributions for each specification, selecting, as in previous referred utilizations of the GARCH models, the better model with the AIC and the BIC, by minimising the Information Criterions.

[7] See Baur and Lucey (2010)

4.3 – Subsamples

In this work, we are not only exploring the Hedge and Safe Haven effect in the sample, we intend withal to verify Gold's hedging and Safe Haven properties in a subsample analysis, because of the possibility of Gold having the same features throughout the sample, howbeit in some periods it could have different characteristics.

To develop a subsample analysis, we adopt the Bai and Perron (2003) algorithm to *produce structural breaks in each of the time series in levels*, where each of the breaks defines the end of a subsample and the beginning of the following. This algorithm produces various break suggestions, where the better one is defined as the one which minimises the BIC.

After defining the subsamples, the analysis for the existence of Hedges and Safe Havens are equally performed to the sample itself, with the exception of the Specific Periods' Regression, due to the breaks computation might lead to a problem, that is, part of the candidate period to include in the regression is on one side of the break and the other part of the period is on the other side; for instance, part of the period in analysis is in subsample 1 and the rest of the period is in subsample 2, which misleads the conclusions by reducing the information structure in each of the subsamples. For those reasons that regression will not be performed in a subsample's environment.

5 – Empirical Analysis

In this section, we expose the results of our empirical analysis. It is divided in two major areas where we analyse the sample and the subsamples. Regarding the first, it is subdivided into a Hedge analysis and a Safe Haven analysis, this last being also divided into Quantile Regression and Specific Periods' Regression. Concerning the subsamples subsection, we present the computation of the structural breaks by the Bai and Perron (2003) algorithm that allow us to define the subsamples, then we present the Hedge and the Safe Haven analysis, being for the latter only presented the Quantile Regression as the Specific Periods' Regression cannot be computable due to the fact that the periods under analysis might for some assets be divided into two different subsamples, biasing the results.

5.1 – Sample Analysis

5.1.1 - Hedge

Gold's hedging ability to equity and bond markets is computed based on daily time-varying correlations, obtained by the ADCC-GARCH and the DCC-GARCH. As mentioned in section 4, we perform a wide variety of specifications for each combination of assets, being the optimal the ones enhanced in green in Annex B tables 18 and 19. As one can confirm, the DCC-EGARCH with Normal distribution is the one chosen for most of the assets; moreover the DCC-GARCH with GED distribution are chosen for the Irish Bonds 10-years and Greek Bonds 2-years, while the ADCC-GJR-GARCH and the DCC-GJR-GARCH, both with Normal distribution, are chosen for Portuguese Bonds 10-years and ASE and Irish Bonds 2-years, respectively.

As it is illustrated in table 3, when considering stock markets, we conclude that Gold is, on average, a strong Hedge for almost all of the assets, as the estimate for the correlation coefficient is negative and statistically significant at all default significance levels; excluding the EuroStoxx 600 for which Gold is statistically considered, on average, a diversifier asset. Analysing the coefficient estimate, we see that Gold's hedging ability is stronger for EuroStoxx Banks, FTSEMIB and PSI 20, when compared to the other stock markets, being for the DAX the lowest coefficient estimate in absolute value.

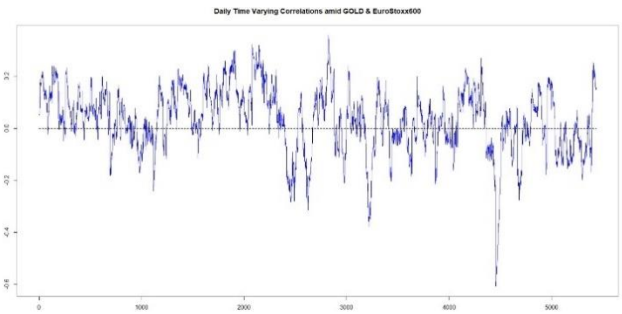
Regarding the bond market, there are wider conclusions as we acknowledge that German and French Bonds, despite of its maturity, are not Hedged by Gold as its coefficient estimate is visibly negative (opposite conclusion to stocks as we are dealing with the yield rate) and statistically significant at all default significance levels, meaning that for these four markets Gold is a diversifier asset. The same conclusion however with a different level of diversification, as it presents a lower coefficient estimate, is obtained for the Spanish 10-years, Irish (both maturities) and Greek 2-years bonds. For the Italian 2-years, Portuguese (both maturities) and Greek 10-years bonds, Gold is a strong Hedge, as it provides a positive and statistically significant coefficient estimate at all default significance levels. For the Italian Bonds with 10-years maturity, the estimate for the correlation coefficient is not statistically significant, under none of the hypothesis, meaning it is a weak Hedge. Last, for the Spanish 2-years bonds, under the first hypothesis, at a 5% significance level we reject the null hypothesis, while at a 1% and 2.5% significance levels we do not reject the null; for those reasons it is performed the other hypothesis testing, and with a 2.5% and 5% significance levels, we are able to conclude that Gold is a diversifier.

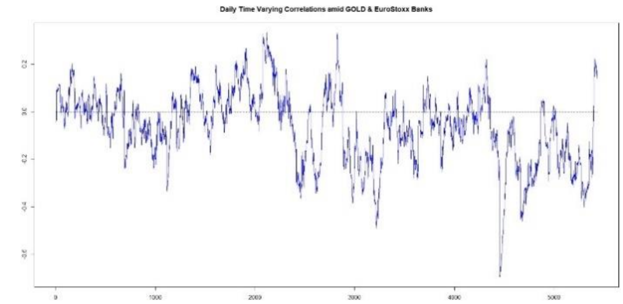
Finally, we can affirm that for the Italian and Spanish bond markets different bond maturities lead to different Gold hedging performance, while regarding the other country markets this different maturity conclusion does not exists. For the Greek market it produces different conclusions, but we have to consider that there is a large difference in the number of observations amongst maturities.

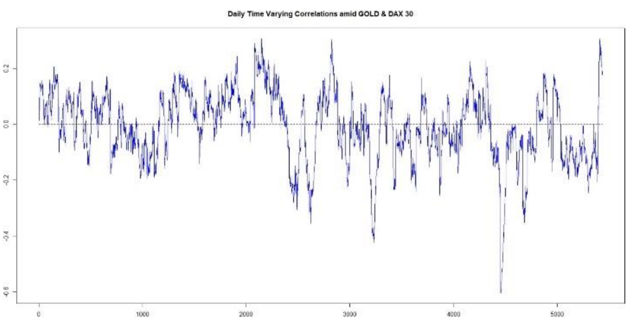
		t-tests		
Stocks	ρ	H0: ρ = 0 Ha: ρ ≠ 0 p-value	H0: ρ = 0 Ha: ρ < 0 p-value	H0: ρ = 0 Ha: ρ > 0 p-value
EuroStoxx600	0,0312	0,0000	1,0000	0,0000
EuroStoxx Banks	-0,0644	0,0000	0,0000	1,0000
DAX	-0,0076	0,0000	0,0000	1,0000
CAC40	-0,0100	0,0000	0,0000	1,0000
FTSEMIB	-0,0367	0,0000	0,0000	1,0000
IBEX35	-0,0289	0,0000	0,0000	1,0000
PSI20	-0,0304	0,0000	0,0000	1,0000
ISEQ	-0,0128	0,0000	0,0000	1,0000
ASE	-0,0206	0,0000	0,0000	1,0000
Bonds	ρ	H0: ρ = 0 Ha: ρ ≠ 0 p-value	H0: ρ = 0 Ha: ρ > 0 p-value	H0: ρ = 0 Ha: ρ < 0 p-value
German Bonds 2y	-0,1349	0,0000	1,0000	0,0000
German Bonds 10y	-0,1394	0,0000	1,0000	0,0000
French Bonds 2y	-0,1129	0,0000	1,0000	0,0000
French Bonds 10y	-0,1056	0,0000	1,0000	0,0000
Italian Bonds 2y	0,0054	0,0000	0,0000	1,0000
Italian Bonds 10y	-0,0005	0,6033	0,6983	0,3017
Spanish Bonds 2y	-0,0018	0,0413	0,9793	0,0207
Spanish Bonds 10y	-0,0130	0,0000	1,0000	0,0000
Portuguese Bonds 2y	0,0066	0,0000	0,0000	1,0000
Portuguese Bonds 10y	0,0060	0,0000	0,0000	1,0000
Irish Bonds 2y	-0,0127	0,0000	1,0000	0,0000
Irish Bonds 10y	-0,0397	0,0000	1,0000	0,0000
Greek Bonds 2y	-0,0306	0,0000	1,0000	0,0000
Greek Bonds 10y	0,0209	0,0000	0,0000	1,0000

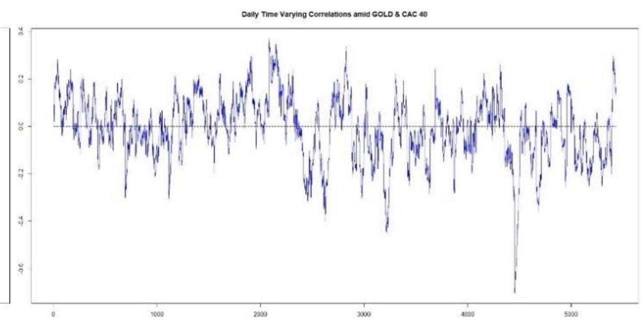
Table 3 – Sample Hedge ability: Testing the significance of the Daily Time Varying Correlation Coefficient's estimates between Gold and each of the assets.

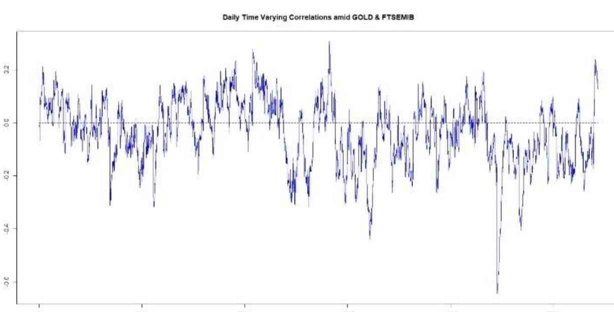
By analysing the daily time-varying correlations, which are plotted in figure 1, we suspect of different behaviours in Gold's hedging features across the sample period, as there are periods in which the above concluded long-term relationship exists and periods when it seems exist the opposite one; although, on average, that the long run relation is still true. In order to test the existence of this pattern, we will perform a subsample analysis.

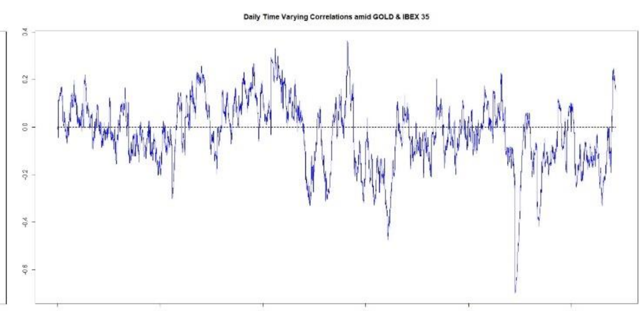

Daily Time Varying Correlations amid GOLD & EuroStoxx600

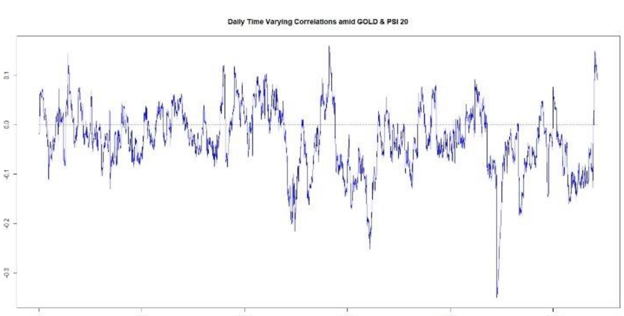

Daily Time Varying Correlations amid GOLD & EuroStoxx Banks

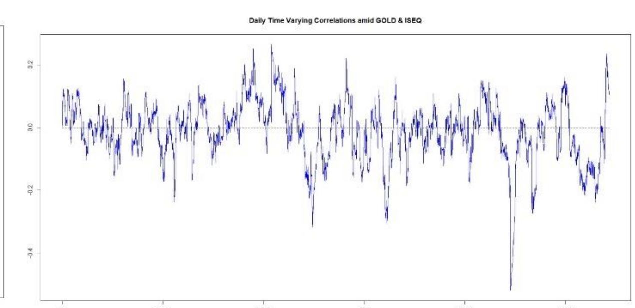

Daily Time Varying Correlations amid GOLD & DAX 30

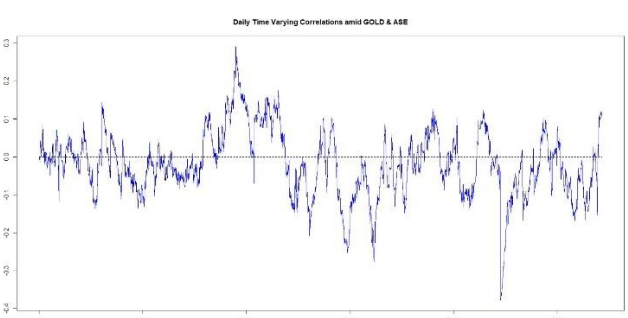

Daily Time Varying Correlations amid GOLD & CAC 40

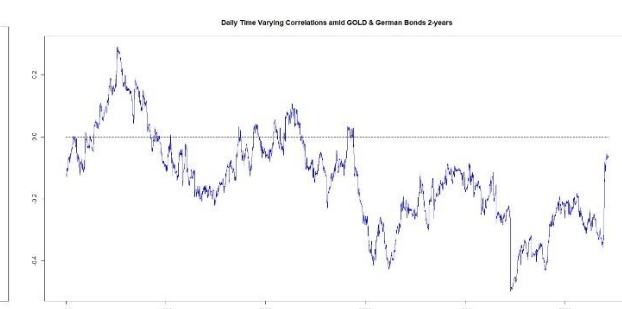

Daily Time Varying Correlations amid GOLD & FTSEMIB

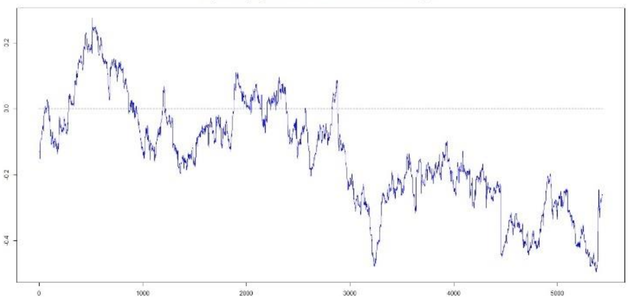

Daily Time Varying Correlations amid GOLD & IBEX 35

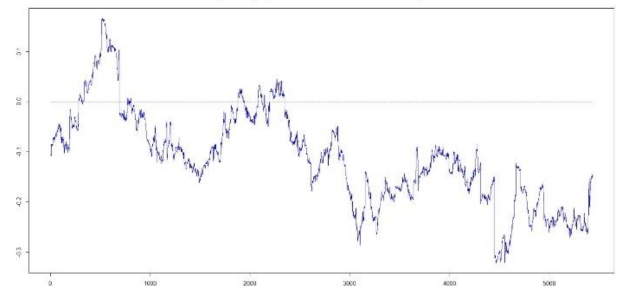

Daily Time Varying Correlations amid GOLD & PSI 20

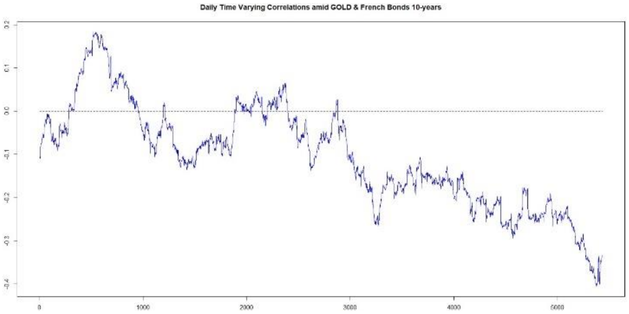

Daily Time Varying Correlations amid GOLD & ISEQ

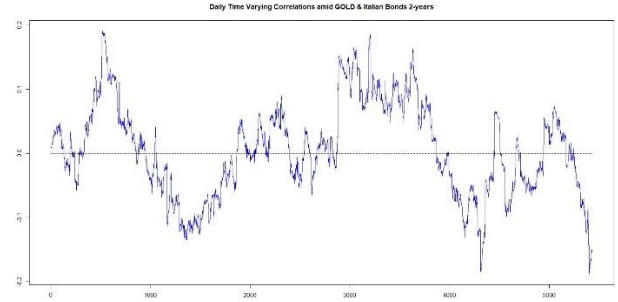

Daily Time Varying Correlations amid GOLD & ASE

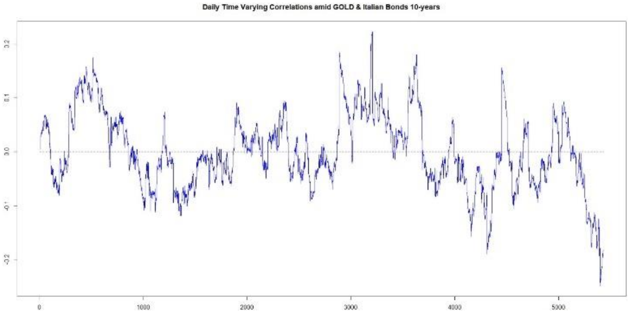

Daily Time Varying Correlations amid GOLD & German Bonds 2-years

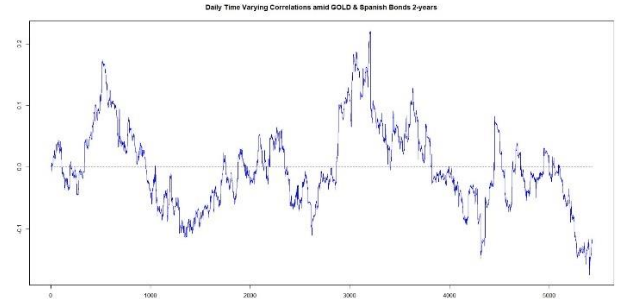

Daily Time Varying Correlations amid GOLD & German Bonds 10-years

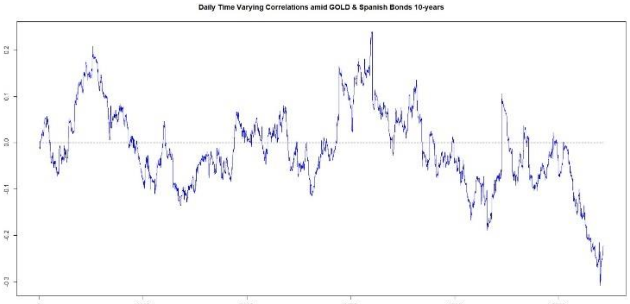

Daily Time Varying Correlations amid GOLD & French Bonds 2-years

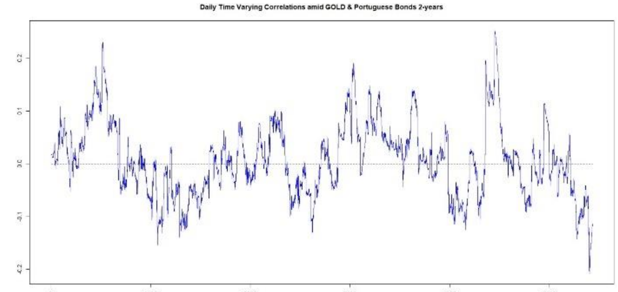

Daily Time Varying Correlations amid GOLD & French Bonds 10-years

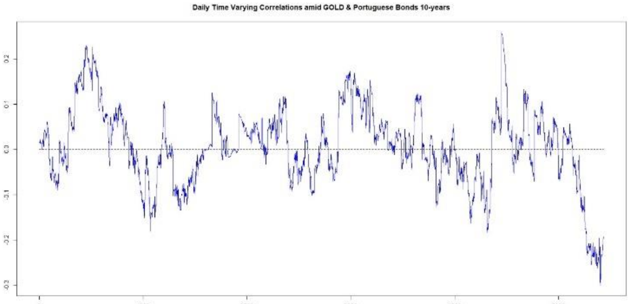

Daily Time Varying Correlations amid GOLD & Italian Bonds 2-years

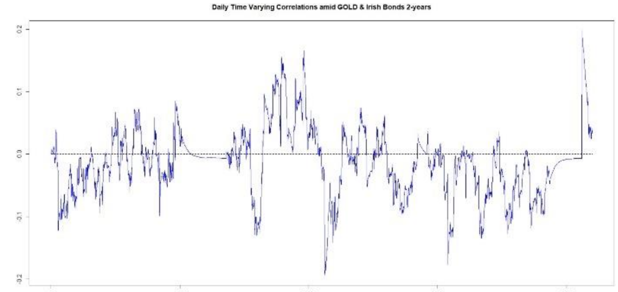

Daily Time Varying Correlations amid GOLD & Italian Bonds 10-years


Daily Time Varying Correlations amid GOLD & Spanish Bonds 2-years


Daily Time Varying Correlations amid GOLD & Spanish Bonds 10-years


Daily Time Varying Correlations amid GOLD & Portuguese Bonds 2-years


Daily Time Varying Correlations amid GOLD & Portuguese Bonds 10-years


Daily Time Varying Correlations amid GOLD & Irish Bonds 2-years

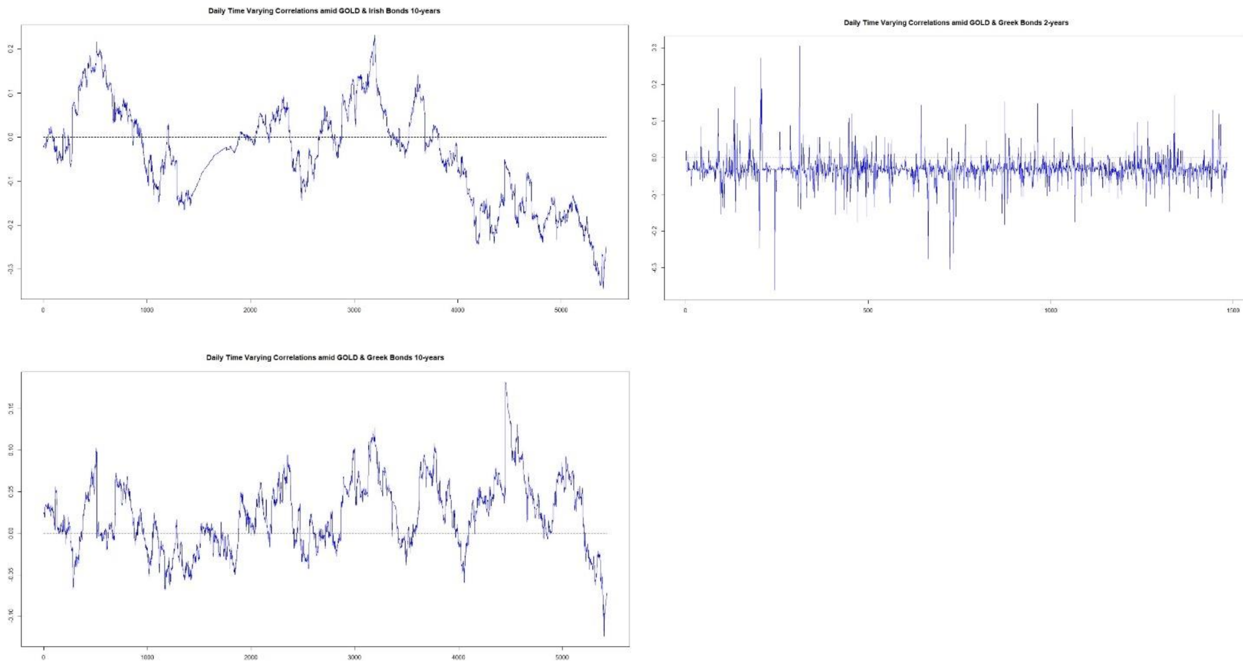


Figure 1 – Sample: Daily Time Varying Correlations between Gold and each asset. From the left to the right and from the top to the bottom, we present: EuroStoxx 600, EuroStoxx Banks, DAX, CAC 40, FTSEMIB, IBEX 35, PSI 20, ISEQ, ASE, German Bonds 2 years, German Bonds 10 years, French Bonds 2 years, French Bonds 10 years, Italian Bonds 2 years, Italian Bonds 10 years, Spanish Bonds 2 years, Spanish Bonds 10 years, Portuguese Bonds 2 years, Portuguese Bonds 10 years, Irish Bonds 2 years, Irish Bonds 10 years, Greek Bonds 2 years and Greek Bonds 10 years.

5.1.2 – Safe Haven

The goal of this analysis is to understand if Gold can be able to protect wealth, during financial markets turmoils; if this is true Gold can provide shelter for investors when they most need it. Previously, in section two, we highlighted diverse viewpoints regarding a Safe Haven asset, as well as distinct methodologies. In this section, we implement two different approaches to find out if Gold can be characterised as a Safe Haven asset, such as the Quantile Regression and a Specific Period Regression. Therefore, Gold is designated a strong (weak) Safe Haven for stock market indexes, if we identify a statistically significant (insignificant) negative coefficient estimate; by opposition, for the bond market, as we are dealing with the yield rate, Gold is considered a strong (weak) Safe Haven, if the coefficient estimate is positive and statistically significant (insignificant), otherwise Gold co-moves in these periods with the stock and bond markets, respectively.

5.1.2.1 – Quantile Regression

To conclude about Gold's Safe Haven role, when markets face extreme negative returns (left tailed distributed returns), we base our work on equation 11. The first step is to compute each asset quantiles, with the purpose to build the dummy variables, where this variable take value 1 if the return is equal or exceeds the quantile and 0 otherwise, after computing this we can perform the regression. The results of the Quantile Regression are illustrated in table 4.

With respect to the stock market, our empirical results show that Gold is a strong Safe Haven for the most extreme negative returns in the EuroStoxx 600, the FTSEMIB, the ISEQ and the ASE equity markets. Regarding, the EuroStoxx 600 and the ISEQ, we find a high coefficient estimate in absolute value with strong statistical significance, while the coefficient estimate for the FTSEMIB and the ASE is lower in absolute value and significant just for a significance level of 10%; meaning that the strong Safe Haven property is, indeed, stronger for the former than for the latter markets. When considering extreme returns, but not the most extreme (2.5% quantile), Gold can be considered a strong Safe Haven, only, for the CAC 40 (at 5% significance level) and the PSI 20 (at 10%), being considered a weak Safe Haven for the EuroStoxx Banks, the DAX and the IBEX 35. The same conclusion applies to the 5% quantiles, as Gold is only a strong Safe Haven for the EuroStoxx Banks, being a weak Safe Haven for the EuroStoxx 600, the FTSEMIB, the IBEX 35 and the PSI 20.

Despite neither being a Safe Haven for all the equity markets nor all the quantiles, Gold can be, overall, considered a Safe Haven for equity markets. This conclusion is particularly valid for the most extreme negative equity market movements, as we find more significant coefficient's estimates at the 1% and 2.5% quantiles, whilst for the less extreme market movements, Gold is, at best, characterised as a weak Safe Haven. Regarding the bond market, we clearly find less significant coefficient's estimates (only 5 significant), when compared to the stock markets, as well as many coefficient's estimates (being 5 significant) with different sign than the expected to be a Safe Haven asset; meaning that we cannot characterise Gold as strong Safe Haven for the bond market, in fact, it can, at best, be determined a weak Safe Haven for the bond market, especially for the 2.5% and 10% quantiles.

The model that better fits each of the regressions residuals is represented in Annex C tables 32 and 33; by analysing its output (right side of table 4), we find statistical evidence in the alfa, beta and gamma coefficient's estimates, meaning, there is, respectively, presence of ARCH, persistency (current volatility is affected by past volatility) and asymmetric effects (negative shocks affect more deeply residuals volatility), for all the regressions.

	Hedge	Safe Haven				GARCH				
		Quantile 1%	Quantile 2.5%	Quantile 5%	Quantile 10%	Omega	Alpha	Beta	Gamma	Shape
Stocks:										
EuroStoxx 600	0,0099	-0,1309 ***	0,1112 *	-0,0590	0,0226	0,0000 ****	0,0751 ****	0,9334 ****	-0,0324 ***	4,9292 ****
EuroStoxx Banks	-0,0436 ****	-0,0097	-0,0264	-0,0637 ^	0,0665 *	-0,1887 ****	0,1262 ****	0,9897 ****	0,0260 ***	5,0079 ****
DAX	-0,0084	-0,0090	-0,0291	0,0270	-0,0123	-0,1908 ****	0,1247 ****	0,9894 ****	0,0285 ****	4,9735 ****
CAC 40	-0,0124	0,0408	-0,0967 *	0,1041 *	-0,0533	-0,1916 ****	0,1254 ****	0,9893 ****	0,0271 ****	4,9599 ****
FTSEMIB	-0,0225 ^	-0,0646 ^	0,0229	-0,0493	0,0222	-0,1914 ****	0,1266 ****	0,9894 ****	0,0267 ****	4,9494 ****
IBEX 35	-0,0251 ^	0,0234	-0,0330	-0,0147	0,0083	-0,1887 ****	0,1245 ****	0,9896 ****	0,0277 ****	4,9908 ****
PSI 20	-0,0208	0,0803	-0,0952 ^	-0,0342	0,0423	-0,1905 ****	0,1247 ****	0,9894 ****	0,0278 ****	4,9967 ****
ISEQ	-0,0102	-0,1601 ****	0,0821 ^	0,0025	-0,0316	-0,1905 ****	0,1267 ****	0,9896 ****	0,0256 ***	4,9629 ****
ASE	-0,0112	-0,0564 ^	-0,0371	0,0444	0,0068	-0,1904 ****	0,1243 ****	0,9894 ****	0,0281 ****	4,9697 ****
Bonds:										
German 2 years	-0,0270 ****	-0,0024	-0,0026	0,0084	-0,0010	-0,2007 ****	0,1302 ****	0,9888 ****	0,0266 ****	4,9843 ****
German 10 years	-0,0316 ****	-0,0016	0,0171	-0,0479 ***	0,0286 **	-0,1961 ****	0,1295 ****	0,9892 ****	0,0251 ***	4,9877 ****
French 2 years	-0,0260 ****	0,0119	-0,0087	-0,0167	0,0224	-0,2006 ****	0,1301 ****	0,9888 ****	0,0270 ****	4,9835 ****
French 10 years	-0,0254 ****	-0,0459 ***	0,0074	-0,0013	0,0175	-0,1947 ****	0,1275 ****	0,9892 ****	0,0296 ****	5,0314 ****
Italian 2 years	0,0021	0,0008	0,0011	-0,0049	0,0066	-0,1893 ****	0,1238 ****	0,9895 ****	0,0285 ****	4,9553 ****
Italian 10 years	-0,0021	-0,0011	-0,0058	0,0085	0,0032	-0,1901 ****	0,1242 ****	0,9894 ****	0,0290 ****	4,9496 ****
Spanish 2 years	0,0023	0,0180 *	-0,0189 ^	0,0093	-0,0005	-0,1858 ****	0,1220 ****	0,9897 ****	0,0290 ****	4,9723 ****
Spanish 10 years	-0,0027	-0,0075	0,0061	-0,0161	0,0215 *	-0,1884 ****	0,1241 ****	0,9896 ****	0,0284 ****	4,9464 ****
Portuguese 2 years	0,0003	-0,0008	0,0022	-0,0054	0,0066	-0,1902 ****	0,1251 ****	0,9895 ****	0,0277 ****	4,9780 ****
Portuguese 10 years	-0,0009	0,0115 ^	-0,0022	-0,0056	0,0039	-0,1893 ****	0,1236 ****	0,9894 ****	0,0299 ****	4,9567 ****
Irish 2 years	0,0001	-0,0044	0,0278 ***	-0,0171	-0,0024	-0,1599 ****	0,1194 ****	0,9923 ****	0,0259 ***	5,1801 ****
Irish 10 years	-0,0005	0,0147 ^	-0,0002	0,0021	-0,0081	-0,1959 ****	0,1263 ****	0,9889 ****	0,0290 ****	4,9619 ****
Greek 2 years	-0,0004	0,0024	0,0040	-0,0140 ***	0,0068 ^	-0,2329 ***	0,1312 ****	0,9862 ****	0,0287 ^	5,8768 ****
Greek 10 years	0,0006	-0,0034 ^	0,0028	-0,0005	0,0008	-0,1916 ****	0,1249 ****	0,9893 ****	0,0282 ****	4,9633 ****

Note: Statistical Significance at: 10% ^; 5% *; 2.5% **; 1% ***; 0.1% ****

Table 4 – Sample: Quantile Regression results. It is presented the results for the mean equation on the left side and for the variance of the residuals on the right side.

5.1.2.2 – Specific Periods' Regression

The analysis of specific periods is important, since in a quantile regression we only capture the relationship between assets when a return exceeds a certain quantile; which, for instance, could happen in day t and only one-year later, while in a specific period regression, *we look at a period that had a relevant generator event (financial, economic, political, terrorist or sanitary event)*. Those specific periods are short intervals where markets have a first extreme negative return, followed by a succession of negative and some positive returns. The end of each period, as stated in section 5, is defined by the existent literature precedents as well as based on the proxy (GSFCIEA) for market volatility, being the chosen volatility model present in Annex D tables 48 and 49.

Our regression model is based on the work developed by Baur and McDermott (2010), as we use their concept of looking at specific periods. The candidate events, its beginning and ending dates and the justification to be included in this regression are exposed in Annex G table 51 (as well as the plots of the proxy volatility for the events we do not have a precedent to define its end date which are present in figure 8), applying the stepwise algorithm in order to select the significant events only for a final regression.

The results of specific periods analysis are reported in table 5. Regarding the equity markets, the stepwise algorithm helped us to select the events, considering that there is no significant estimate to the coefficient during the terrorist attacks in Madrid (March 11th 2004), the Spanish Banks Bailout and the third Bailout to the Hellenic Republic. We find out that there are events where the spectrum of assets selected are low, such as the Portuguese Bailout, where Gold is a significant Safe Haven for the IBEX 35 at 5% significance level and the approval of the second Bailout to Greece, period, in which, its own equity market is sheltered by Gold at the 10% significance level. Furthermore, a wider number of assets are included by the stepwise algorithm for the September 11th 2001, the first Bailout to Greece, the Irish Bailout and the Greek Elections 2012. In those periods, we notice negative coefficients estimates, however many of them are only significant for an alfa of 10%. Finally, four periods are selected by the algorithm for all equity markets (the Lehman Brothers collapse, the asking for second Bailout by the Hellenic Republic, the Brexit Referendum and the Covid-19 pandemic outbreak). For the first three periods (of financial, economic and financial and political nature, respectively), Gold disclosures a strong Safe Haven status, in terms of coefficient estimates and significance, that are even stronger for the ones that particularly affect the EU; whereas for the sanitary event the estimates for the coefficient's are positive, despite being all strongly significant, *which means that Gold, in a turmoil of sanitary nature* (not under Humankind control), *does not perform its Safe Haven role*, which is an extremely important conclusion to the literature.

In spite of being a different class of assets, the events of March 11th 2004, the Spanish Banks Bailout and the third Bailout to Greece are also excluded by the Stepwise for all of the bond markets. Moreover, for several other periods included in the regression, we do not find evidence of Gold being a Safe Haven for any bond market, in fact, it finds significance of the opposite effect. These periods are the Lehman Brothers collapse, the asking and the approval of the second Bailout to Greece, the Political Turbulence September to October 2012 and the Greek elections 2012. During the September 11th 2001 attacks, the algorithm indicates four assets to analyse, which are the German bonds both maturities, the French and the Portuguese bonds 2-years, finding a distinct relationship between them, as for the German bonds it is found Safe Haven status for a significance level of 10%, while for the other two markets there is no evidence of Safe Haven. We find different behaviours of Gold Safe Haven status in the first bailout to the Hellenic Republic, the Irish and the Portuguese bailouts as well as the Brexit Referendum, as Gold is a strong and statistically significant Safe Haven, despite of the maturity for the countries that suffered the higher increases on yield in the European sovereign debt crisis; while for the others the effect is the opposite. In addition, we must highlight the Covid-19 pandemic outbreak that caused a statistically significant relationship amid bonds and gold, where the last is not considered a Safe Haven asset, as it denoted negative returns simultaneously to yield rates increases.

In a nutshell, we can declare that Gold in periods of financial, economic and political turmoil can be a Safe Haven for the equity markets, however, in a sanitary turmoil, that property is not visible; while regarding the bond market that conclusion is not as simple as that, due to the need to identify the period of analysis, the maturity of the bond as well as its issuer, being this last the one with most important impact.

The model that better fits each regression residuals is represented in Annex C tables 34 and 35, by analysing its output we find, for all residuals, a statistical evidence in the alfa, beta and gamma coefficient's estimates, meaning, there is, respectively, presence of ARCH, persistency (current volatility is affected by past volatility) and asymmetric effects (negative shocks affect more deeply residuals volatility).

By comparing the results obtained in the Quantile Regressions with the ones got for the Specific Period's Regressions, we state that in accordance with Baur and McDermott (2010) Gold can be seen as a "panic buying asset" for equity markets, as we find that when faced with increased uncertainty (events such as the Lehman Brothers collapse, the asking for second Bailout and the Brexit Referendum) and with negative returns below the 2.5% quantile (and mainly below the 1% quantile investors tend to use Gold as a shelter, meaning, it can be seen as a panic buying asset.

	Hedge	September 11th 2011	Safe Haven: March 11th 2004	Lehman Brothers collapse	Greece: 1st Bail Out	Ireland: Bail Out	Portugal: Bail Out	Greece: 2nd Bail Out (asking)	Political Turbulence Sept to Oct 2012
Stocks:									
EuroStoxx 600	0,0307 **	-0,1643 **	---	-0,1613 ****	---	---	---	-0,6429 ****	---
EuroStoxx Banks	-0,0355 ****	---	---	-0,0616 *	-0,0793 *	-0,1919 ^	---	-0,3386 ****	---
DAX	---	-0,1096 ^	---	-0,1104 ***	---	---	---	-0,5194 ****	---
CAC 40	---	-0,1383 *	---	-0,1096 ***	-0,1153 ^	-0,4242 *	---	-0,5358 ****	---
FTSEMIB	-0,0153	-0,0930 ^	---	-0,1171 ***	-0,1504 **	-0,3090 ^	---	-0,4306 ****	---
IBEX 35	---	-0,1344 *	---	-0,0734 ^	-0,1449 ***	-0,2282 ^	-0,3798 *	-0,5334 ****	---
PSI 20	---	---	---	-0,1330 ***	-0,1442 **	-0,3532 ^	---	-0,5608 ****	---
ISEQ	---	---	---	-0,1784 ****	---	-0,4321 ^	---	-0,5220 ****	0,2016
ASE	---	---	---	-0,0706 ^	-0,1514 ***	---	---	-0,3077 ****	---
Bonds:									
German 2 years	-0.0221 ****	0.0587 ^	---	---	-0.1252 ***	-0.1182 **	---	-0.1119 ****	-0.0664 ^
German 10 years	-0,0255 ****	0,0943 ^	---	-0,0406 ^	-0,0656 *	-0,1004 **	-0,0795 *	-0,1278 ****	---
French 2 years	-0,0164 ****	-0,0667 **	---	-0,0223	-0,1130 ***	---	0,0490 ^	-0,0875 ***	-0,1054 ****
French 10 years	-0,0188 ****	---	---	-0,0710 ***	---	-0,0908 *	-0,0820 ^	-0,0938 ***	-0,0403
Italian 2 years	0,0049 ***	---	---	-0,0325 ^	0,0248 **	0,0314 ^	---	-0,0188 *	-0,0454 ^
Italian 10 years	---	---	---	-0,0601 **	0,0586 **	0,0465	---	-0,0222 *	---
Spanish 2 years	0,0041 ^	---	---	-0,0406 ***	0,0238 ***	---	0,0551 **	-0,0187 *	---
Spanish 10 years	---	---	---	-0,0704 ***	0,0417 **	0,0406 ^	0,0649 *	-0,0238 **	---
Portuguese 2 years	0,0015 *	-0,0909 **	---	---	---	---	0,0126 *	---	0,0086
Portuguese 10 years	0,0021	---	---	-0,0734 ***	0,0099 ^	---	---	-0,0221	---
Irish 2 years	0,0035 ***	---	---	---	---	---	---	-0,0049	---
Irish 10 years	---	---	---	-0,0928 ****	0,0125	0,0189	0,0148 *	-0,0126 ^	---
Greek 2 years	---	---	---	---	---	---	---	---	---
Greek 10 years	0,0006 ^	---	---	-0,0513 ***	---	---	0,0127 *	---	---

Note 1: Statistical Significance at: 10% ^; 5% *; 2.5% **; 1% ***; 0.1% ****
Note 2: "---" means Stepwise Regression excluded it from the final period regression

Safe Haven						GARCH				
Greece: 2nd Bail Out (approval)	Greece: Elections 2012	Spain: Banks Bail Out	Greece: 3rd Bail Out	Brexit Referendum	COVID-19 pandemic outbreak	Omega	Alpha	Beta	Gamma	Shape
---	-0,4090 **	---	---	-0,7019 ****	0,2056 ****	-0,1783 ****	0,1185 ****	0,9903 ****	0,0311 ****	5,0985 ****
---	---	---	---	-0,3085 ****	0,1858 ****	-0,1776 ****	0,1199 ****	0,9904 ****	0,0284 ****	5,0890 ****
---	-0,3993 ***	---	---	-0,7397 ****	0,2631 ****	-0,1775 ****	0,1184 ****	0,9903 ****	0,0292 ****	5,1055 ****
---	-0,2541 ^	---	---	-0,6795 ****	0,2176 ****	-0,1777 ****	0,1185 ****	0,9903 ****	0,0294 ****	5,0978 ****
---	---	---	---	-0,4592 ****	0,1859 ****	-0,1788 ****	0,1196 ****	0,9903 ****	0,0284 ****	5,0746 ****
---	---	---	---	-0,5177 ****	0,1923 ****	-0,1782 ****	0,1186 ****	0,9903 ****	0,0300 ****	5,0707 ****
---	---	---	---	-0,7660 ****	0,2806 ****	-0,1792 ****	0,1188 ****	0,9902 ****	0,0307 ****	5,1288 ****
---	-0,3251 *	---	---	-0,4087 ****	0,1800 ****	-0,1804 ****	0,1198 ****	0,9901 ****	0,0299 ****	5,0144 ****
-0,1596 ^	---	---	---	-0,5047 ****	0,1295 ****	-0,1754 ****	0,1178 ****	0,9905 ****	0,0311 ****	5,0968 ****
---	---	---	---	-0,7393 ****	0,1058 ***	-0,1942 ****	0,1282 ****	0,9893 ****	0,0252 ***	5,1201 ****
---	---	---	---	-0,3153 ****	---	-0,1976 ****	0,1322 ****	0,9893 ****	0,0237 ***	5,0675 ****
---	-0,0757 ^	---	---	-0,6599 ****	---	-0,2009 ****	0,1305 ****	0,9888 ****	0,0277 ****	5,1325 ****
---	---	---	---	-0,2419 ****	---	-0,1988 ****	0,1307 ****	0,9890 ****	0,0282 ****	5,0247 ****
---	---	---	---	0,3699 ****	-0,0260 ***	-0,1901 ****	0,1245 ****	0,9894 ****	0,0294 ****	5,0243 ****
---	---	---	---	0,1878 ****	-0,0293 ****	-0,1921 ****	0,1252 ****	0,9893 ****	0,0309 ****	5,0752 ****
---	---	---	---	0,2103 ***	-0,0573 *	-0,1909 ****	0,1246 ****	0,9894 ****	0,0291 ****	4,9861 ****
---	---	---	---	0,1019 ***	-0,0261 ^	-0,1937 ****	0,1261 ****	0,9892 ****	0,0297 ****	5,0210 ****
---	---	---	---	0,2002 ****	-0,0586 **	-0,1917 ****	0,1244 ****	0,9893 ****	0,0309 ****	5,0376 ****
-0,0103	---	---	---	0,1650 ****	-0,0314 **	-0,1907 ****	0,1247 ****	0,9894 ****	0,0310 ****	5,1003 ****
-0,0370 **	-0,0156 ^	---	---	0,2226 *	---	-0,1599 ****	0,1194 ****	0,9923 ****	0,0259 ***	5,1801 ****
---	---	---	---	---	-0,0516 *	-0,1959 ****	0,1263 ****	0,9889 ****	0,0290 ****	4,9619 ****
---	---	---	---	---	0,6543 ****	-0,2329 ***	0,1312 ****	0,9862 ****	0,0287 ^	5,8768 ****
---	-0,0026	---	---	0,0461 ****	---	-0,1916 ****	0,1249 ****	0,9893 ****	0,0282 ****	4,9633 ****

Table 5 – Sample: Specific Periods' Regression results. It is presented on the first part the events candidate to be considered as Safe Haven and on the second part the variance of the residuals.

5.2 – Subsample Analysis

The analysis of subsamples is of special importance, since it might confirm the conclusions obtained in the sample itself or, on the contrary, indicate that the relations obtained for the sample, despite occurring in long term, may have periods in which they do not occur and periods in which they occur; having implications for investors' portfolio constitution as well as the incurred risk.

5.2.1 – Structural Breaks

In order to perform a subsamples analysis, first we have to define time series structural breaks, in order to be able to define the end and the beginning of each period through the Bai and Perron (2003) algorithm.

The results of algorithm application are visible in Annex E table 50, which is divided in two parts. In the former, there is the number of breaks produced by the algorithm for each time series and its correspondent BIC (the optimal number of breaks where the BIC is minimised marked in green), while in the latter, there is the first and the last date plus the length of each subsample.

We can conclude that five is the optimal number of breaks for most of the assets, meaning, six subsample periods; albeit there are some assets for those which the optimal number of breaks is four, corresponding to five subsample periods. Despite this explanation, there are one exception, where we do not consider the optimal number of breaks produced by the algorithm: the Greek Bonds with 2-years maturity. Since it has very short observations and so that the extreme quantiles calculations are feasible. For those reasons, we decide to select one break, which allows us to have a period bigger than 2-years in each of the subsamples.

5.2.2 – Hedge

As mentioned above, in this subsection, we present the analysis of Gold's hedging ability to each subsample, with the purpose of finding if, in each period, Gold is, on average, a strong or weak Hedge, or a diversifier asset to verify if the long-term relationship that we find in subsection 5.1.1 also exists throughout the subsamples. We apply the ADCC-GARCH and DCC-GARCH models with the same specifications and distribution as we do in the sample (being the results for this choice present in Annex B from tables 20 to tables 31), which allow us to compute daily time-varying correlations amid assets (being its plots present in in Annex F from figures 2 to 7) and then we apply the t-test to it to conclude about its significance.

Stocks	ρ	H0: ρ = 0 Ha: ρ ≠ 0 p-value	H0: ρ = 0 Ha: ρ < 0 p-value	H0: ρ = 0 Ha: ρ > 0 p-value
		t-tests		
EuroStoxx600	0,1161	0,0000	1,0000	0,0000
EuroStoxx Banks	0,0532	0,0000	1,0000	0,0000
DAX30	0,0618	0,0000	1,0000	0,0000
CAC40	0,0652	0,0000	1,0000	0,0000
FTSEMIB	0,0478	0,0000	1,0000	0,0000
IBEX35	0,0429	0,0000	1,0000	0,0000
PSI20	0,0231	0,0000	1,0000	0,0000
ISEQ	0,0147	0,0000	1,0000	0,0000
ASE	0,0046	0,0000	1,0000	0,0000
Bonds	**ρ**	**H0: ρ = 0 Ha: ρ ≠ 0 p-value**	**H0: ρ = 0 Ha: ρ > 0 p-value**	**H0: ρ = 0 Ha: ρ < 0 p-value**
German Bonds 2y	0,1111	0,0000	0,0000	1,0000
German Bonds 10y	0,0893	0,0000	0,0000	1,0000
French Bonds 2y	0,0706	0,0000	0,0000	1,0000
French Bonds 10y	0,0823	0,0000	0,0000	1,0000
Italian Bonds 2y	0,0610	0,0000	0,0000	1,0000
Italian Bonds 10y	0,0829	0,0000	0,0000	1,0000
Spanish Bonds 2y	0,0729	0,0000	0,0000	1,0000
Spanish Bonds 10y	0,0865	0,0000	0,0000	1,0000
Portuguese Bonds 2y	0,0780	0,0000	0,0000	1,0000
Portuguese Bonds 10y	0,0766	0,0000	0,0000	1,0000
Irish Bonds 2y	0,0274	0,0000	0,0000	1,0000
Irish Bonds 10y	0,0375	0,0000	0,0000	1,0000
Greek Bonds 2y	-0,0448	0,0000	1,0000	0,0000
Greek Bonds 10y	-0,0031	0,0000	1,0000	0,0000

Table 6 – Subsample 1 Hedge ability: Testing the significance of the Daily Time Varying Correlation Coefficient's estimates between Gold and each of the assets.

Stocks	ρ	H0: ρ = 0 Ha: ρ ≠ 0 p-value	H0: ρ = 0 Ha: ρ < 0 p-value	H0: ρ = 0 Ha: ρ > 0 p-value
		t-tests		
EuroStoxx600	0,0568	0,0000	1,0000	0,0000
EuroStoxx Banks	-0,0064	0,0006	0,0003	0,9997
DAX30	0,0237	0,0000	1,0000	0,0000
CAC40	0,0369	0,0000	1,0000	0,0000
FTSEMIB	-0,0036	0,1002	0,0501	0,9499
IBEX35	0,0300	0,0000	1,0000	0,0000
PSI20	0,0249	0,0000	1,0000	0,0000
ISEQ	0,1434	0,0000	1,0000	0,0000
ASE	-0,0432	0,0000	0,0000	1,0000
Bonds	**ρ**	**H0: ρ = 0 Ha: ρ ≠ 0 p-value**	**H0: ρ = 0 Ha: ρ > 0 p-value**	**H0: ρ = 0 Ha: ρ < 0 p-value**
German Bonds 2y	-0,1180	0,0000	1,0000	0,0000
German Bonds 10y	-0,0264	0,0000	1,0000	0,0000
French Bonds 2y	-0,1185	0,0000	1,0000	0,0000
French Bonds 10y	-0,0271	0,0000	1,0000	0,0000
Italian Bonds 2y	-0,1353	0,0000	1,0000	0,0000
Italian Bonds 10y	-0,0375	0,0000	1,0000	0,0000
Spanish Bonds 2y	-0,1154	0,0000	1,0000	0,0000
Spanish Bonds 10y	-0,0445	0,0000	1,0000	0,0000
Portuguese Bonds 2y	-0,1108	0,0000	1,0000	0,0000
Portuguese Bonds 10y	0,0029	0,0000	0,0000	1,0000
Irish Bonds 2y	0,0254	0,0000	0,0000	1,0000
Irish Bonds 10y	0,0176	0,0000	0,0000	1,0000
Greek Bonds 2y	0,0063	0,0000	0,0000	1,0000
Greek Bonds 10y	-0,0530	0,0000	1,0000	0,0000

Table 7 – Subsample 2 Hedge ability: Testing the significance of the Daily Time Varying Correlation Coefficient's estimates between Gold and each of the assets.

Stocks	ρ	H0: ρ = 0 Ha: ρ ≠ 0 p-value	H0: ρ = 0 Ha: ρ < 0 p-value	H0: ρ = 0 Ha: ρ > 0 p-value
EuroStoxx600	0,1770	0,0000	1,0000	0,0000
EuroStoxx Banks	0,1242	0,0000	1,0000	0,0000
DAX30	0,0736	0,0000	1,0000	0,0000
CAC40	0,1464	0,0000	1,0000	0,0000
FTSEMIB	0,1482	0,0000	1,0000	0,0000
IBEX35	0,1564	0,0000	1,0000	0,0000
PSI20	0,0408	0,0000	1,0000	0,0000
ISEQ	-0,0966	0,0000	0,0000	1,0000
ASE	0,1538	0,0000	1,0000	0,0000
Bonds	**ρ**	**H0: ρ = 0 Ha: ρ ≠ 0 p-value**	**H0: ρ = 0 Ha: ρ > 0 p-value**	**H0: ρ = 0 Ha: ρ < 0 p-value**
German Bonds 2y	-0,0190	0,0000	1,0000	0,0000
German Bonds 10y	-0,1788	0,0000	1,0000	0,0000
French Bonds 2y	-0,0031	0,0000	1,0000	0,0000
French Bonds 10y	-0,1227	0,0000	1,0000	0,0000
Italian Bonds 2y	0,0205	0,0000	0,0000	1,0000
Italian Bonds 10y	0,0308	0,0000	0,0000	1,0000
Spanish Bonds 2y	-0,0166	0,0000	1,0000	0,0000
Spanish Bonds 10y	0,0311	0,0000	0,0000	1,0000
Portuguese Bonds 2y	0,0049	0,0007	0,0003	0,9997
Portuguese Bonds 10y	0,0385	0,0000	0,0000	1,0000
Irish Bonds 2y	-0,0130	0,0000	1,0000	0,0000
Irish Bonds 10y	-0,0172	0,0000	1,0000	0,0000
Greek Bonds 10y	0,0070	0,0049	0,0025	0,9975

t-tests

Table 8 – Subsample 3 Hedge ability: Testing the significance of the Daily Time Varying Correlation Coefficient's estimates between Gold and each of the assets.

Stocks	ρ	H0: ρ = 0 Ha: ρ ≠ 0 p-value	H0: ρ = 0 Ha: ρ < 0 p-value	H0: ρ = 0 Ha: ρ > 0 p-value
EuroStoxx600	-0,0373	0,0000	0,0000	1,0000
EuroStoxx Banks	-0,1713	0,0000	0,0000	1,0000
DAX30	-0,1012	0,0000	0,0000	1,0000
CAC40	-0,0917	0,0000	0,0000	1,0000
FTSEMIB	-0,1465	0,0000	0,0000	1,0000
IBEX35	-0,1549	0,0000	0,0000	1,0000
PSI20	-0,1277	0,0000	0,0000	1,0000
ISEQ	-0,0043	0,0000	0,0000	1,0000
ASE	-0,1277	0,0000	0,0000	1,0000
Bonds	**ρ**	**H0: ρ = 0 Ha: ρ ≠ 0 p-value**	**H0: ρ = 0 Ha: ρ > 0 p-value**	**H0: ρ = 0 Ha: ρ < 0 p-value**
German Bonds 2y	-0,2478	0,0000	1,0000	0,0000
German Bonds 10y	-0,2183	0,0000	1,0000	0,0000
French Bonds 2y	-0,2075	0,0000	1,0000	0,0000
French Bonds 10y	-0,1798	0,0000	1,0000	0,0000
Italian Bonds 2y	0,1291	0,0000	0,0000	1,0000
Italian Bonds 10y	0,0818	0,0000	0,0000	1,0000
Spanish Bonds 2y	0,0806	0,0000	0,0000	1,0000
Spanish Bonds 10y	0,1037	0,0000	0,0000	1,0000
Portuguese Bonds 2y	0,0739	0,0000	0,0000	1,0000
Portuguese Bonds 10y	0,0306	0,0000	0,0000	1,0000
Irish Bonds 2y	-0,0090	0,0034	0,9983	0,0017
Irish Bonds 10y	0,1247	0,0000	0,0000	1,0000
Greek Bonds 10y	0,0497	0,0000	0,0000	1,0000

t-tests

Table 9 – Subsample 4 Hedge ability: Testing the significance of the Daily Time Varying Correlation Coefficient's estimates between Gold and each of the assets.

		t-tests		
Stocks	ρ	H0: ρ = 0 Ha: ρ ≠ 0 p-value	H0: ρ = 0 Ha: ρ < 0 p-value	H0: ρ = 0 Ha: ρ > 0 p-value
EuroStoxx600	-0,0294	0,0000	0,0000	1,0000
EuroStoxx Banks	-0,0271	0,0000	0,0000	1,0000
DAX30	-0,0652	0,0000	0,0000	1,0000
CAC40	-0,0636	0,0000	0,0000	1,0000
FTSEMIB	-0,0461	0,0000	0,0000	1,0000
IBEX35	-0,0203	0,0000	0,0000	1,0000
PSI20	-0,0113	0,0000	0,0000	1,0000
ISEQ	-0,0762	0,0000	0,0000	1,0000
ASE	-0,0139	0,0000	0,0000	1,0000
Bonds	ρ	H0: ρ = 0 Ha: ρ ≠ 0 p-value	H0: ρ = 0 Ha: ρ > 0 p-value	H0: ρ = 0 Ha: ρ < 0 p-value
German Bonds 2y	-0,1837	0,0000	1,0000	0,0000
German Bonds 10y	-0,3470	0,0000	1,0000	0,0000
French Bonds 2y	-0,1662	0,0000	1,0000	0,0000
French Bonds 10y	-0,2812	0,0000	1,0000	0,0000
Italian Bonds 2y	-0,0924	0,0000	1,0000	0,0000
Italian Bonds 10y	-0,0893	0,0000	1,0000	0,0000
Spanish Bonds 2y	-0,0412	0,0000	1,0000	0,0000
Spanish Bonds 10y	-0,1009	0,0000	1,0000	0,0000
Portuguese Bonds 2y	0,0140	0,0000	0,0000	1,0000
Portuguese Bonds 10y	-0,0129	0,0000	1,0000	0,0000
Irish Bonds 2y	0,0045	0,0000	0,0000	1,0000
Irish Bonds 10y	-0,0244	0,0000	1,0000	0,0000
Greek Bonds 10y	0,0904	0,0000	0,0000	1,0000

Table 10 – Subsample 5 Hedge ability: Testing the significance of the Daily Time Varying Correlation Coefficient's estimates between Gold and each of the assets.

		t-tests		
Stocks	ρ	H0: ρ = 0 Ha: ρ ≠ 0 p-value	H0: ρ = 0 Ha: ρ < 0 p-value	H0: ρ = 0 Ha: ρ > 0 p-value
EuroStoxx600	-0,0554	0,0000	0,0000	1,0000
EuroStoxx Banks	-0,2564	0,0000	0,0000	1,0000
DAX30	-0,0939	0,0000	0,0000	1,0000
CAC40	-0,0854	0,0000	0,0000	1,0000
FTSEMIB	-0,1137	0,0000	0,0000	1,0000
IBEX35	-0,1190	0,0000	0,0000	1,0000
PSI20	-0,1006	0,0000	0,0000	1,0000
ASE	-0,0671	0,0000	0,0000	1,0000
Bonds	ρ	H0: ρ = 0 Ha: ρ ≠ 0 p-value	H0: ρ = 0 Ha: ρ > 0 p-value	H0: ρ = 0 Ha: ρ < 0 p-value
German Bonds 2y	-0,3128	0,0000	1,0000	0,0000
French Bonds 2y	-0,2529	0,0000	1,0000	0,0000
Spanish Bonds 2y	-0,0924	0,0000	1,0000	0,0000
Spanish Bonds 10y	-0,1969	0,0000	1,0000	0,0000
Portuguese Bonds 2y	-0,0850	0,0000	1,0000	0,0000
Portuguese Bonds 10y	-0,0921	0,0000	1,0000	0,0000
Irish Bonds 10y	-0,0499	0,0000	1,0000	0,0000
Greek Bonds 10y	-0,0185	0,0000	1,0000	0,0000

Table 11 – Subsample 6 Hedge ability: Testing the significance of the Daily Time Varying Correlation Coefficient's estimates between Gold and each of the assets.

The results of the Hedge analysis regarding subsamples are reported from table 6 to table 11. Starting with equity markets, for the EuroStoxx 600 market, we have previously found that Gold does not provide Hedge features to it in the long run, being characterised as a diversifier asset. However, in subsamples, we identify a notorious difference in its behaviour, as Gold is considered a diversifier in the first three subsamples, while in the last three that link is inverted, denoting a negative and statistically significant estimate to the coefficient; meaning, since the fourth subsample (period after the Lehman Brothers collapse) Gold is a Hedge for this equity market. Regarding the other supranational index, the EuroStoxx Banks, as mentioned, in the long run Gold, on average, is designated a strong Hedge to it, producing the highest coefficient estimate in absolute terms amid all the equity markets under analysis, in terms of subsamples this relationship is preserved for the majority of the subsamples (with particular effects in the fourth and sixth periods in which the coefficient estimate is quite high in absolute value), despite not being a strong Hedge during the first (until 2002) and third (between 2005 and 2008) subsamples.

In addition, Gold is defined as a strong Hedge for the equity markets of the two EU bigger economies, on the long run, which is consistent with the last three subsamples conclusion (from mid of 2010 and the Lehman Brothers collapse for the DAX and CAC 40, respectively), while in the first three subsamples Gold denotes diversifying effects for both markets.

The Italian equity market (FTSEMIB) is one of the markets where Gold hedging role presents most interesting characteristics, as, although on the long run it is a strong Hedge, it demonstrates in the first and third subsample a diversifier effect and in the second a weak Hedge status, whilst for the last three subsamples, it has presence of a strong Hedge effect, with quite high coefficient estimates for the fourth (August 2008 to October 2011) and sixth subsamples (from January 2015 until the end of the analysis).

Besides these markets, gold establishes a Hedge ability from the fourth subsample onwards in both Iberian equity markets, being this relation coherent with the long run, while until September 2008 (third subsample) it is considered a diversifier asset for the IBEX 35 and the PSI 20.

The unique equity market under our analysis for which the Bai and Perron (2003) algorithm produces four structural breaks, meaning, five subsamples is the ISEQ (Irish market). For this market, gold is named a strong Hedge on the long run, this conclusion is in accordance with subsamples from the third onwards, in which enhances the periods from the 2nd semester of 2008 until November 2011 (subsample three) and from February 2015 until the end of the period under analysis (subsample five), whilst, as well as for other markets, Gold is considered a diversifier asset until (the first semester of) 2008 (subsample two).

Finally, for the Greek equity market (ASE) Gold is treated as a strong Hedge in long-term, as well as in the majority of its subsamples, such as, the second, the fourth (the one with higher estimate to the coefficient, in absolute value, which corresponds to the period from the Lehman Brothers collapse till

November 2011), the fifth and the sixth; being only considered a diversifier for this market in the first and the third (from July 2005 to September 2008), this last with a high coefficient estimate.

To sum up, we state that the execution this subsamples analysis is strongly important with the purpose of identifying in which periods Gold is a diversifier and a Hedge asset, as this analysis leads us to sustain that Gold's hedging ability towards European equity markets is present since the 2008 financial crisis (despite for some markets Gold already performs this role earlier), whilst from the Euro's introduction until the financial crisis it demonstrates diversifying effects.

Focusing on the government bonds market, Gold's hedging ability towards the markets of two major EU economies (both maturities) is not present, both on the long run and for all subsample but the first one (being a strong Hedge for the 2-years maturity until July 2002 and for the 10-years until December 2002).

In spite of Gold being a strong Hedge on the long run for the 2-years Italian government bonds, it embodies different performances throughout the sample; as in the subsamples one, three and four this conclusion is fortified, whilst in the second and fifth is divergent, denoting diversifier effects. Moreover, in the Italian government market, Gold's hedging ability respecting to the 10-years maturity is a special case, as it presents weak Hedge ability on the long run, due to its coefficient estimate not being statistically different from zero, while when considering the subsamples it exhibits a strong Hedge behaviour in the first, third and fourth subsamples, whereas in the second and fifth subsamples it denotes diversifying features, meaning, the long-term relationship is not verified in any of the subsamples.

Despite its maturity, the Spanish government bonds are not Hedged by Gold on the long run, although we find, indeed, evidence of some periods in which they are hedged. Regarding the shorter maturity bond, this hedging ability is displayed in the first (until August 2002) and the fourth (from January 2009 to September 2013) subsamples, while in the longer maturity bond, there are three periods, where Gold has hedging ability: the first (till December 2002), the third (which starts in January 2007) and the fourth (which finishes in December 2013) subsamples.

Focusing on Portuguese bonds, notwithstanding its maturity, Gold is indicated as a Hedge on the long run. Besides, when considering the shorter maturity bond, Gold is a Hedge in all but the second (September 2002 to January 2006) and the sixth (February 2017 to 2020) subsamples; while in the longer maturity, it is not a Hedge in the fifth and sixth subsamples (from December 2013 onwards).

With respect to the Irish government bonds, despite of the observations' length not being equal for each of the maturities, Gold is a diversifier asset for both, in the long-term. Apart from that, the yellow metal is considered a Hedge in the first, second and fifth subsamples of the 2-years maturity bond, while for the 10-years bonds, it is a hedge during the first, second and fourth subsamples.

Finally, we present the results regarding the Greek government markets, for the 2-years maturity, which is the asset with lower length in this analysis, it is not hedged by Gold on the long run, being only hedged in the second subsample, while for the 10-years maturity, which have a time series with full length, it is obtained a long term Gold's hedging feature. Despite its long-term performance, Gold is not a Hedge in all subsamples, which is proven by the presence of diversifying ability in the first, second and sixth subsamples.

In short, when considering government bonds, we cannot see a Gold hedging pattern in the subsamples as clearly as in equity markets, owing to a wide difference of bonds behaviour during these periods, meaning, when considering Gold's hedging role to bonds, we have to account for the issuers and its maturity. Taking into account the issuer, we find a distinction between German and France and the rest, as to the first two Gold only denotes Hedge effect until 2002, while the others have mainly effects in this period and from the Global Financial Crisis until the European Sovereign Debt Crisis, with some countries having this property even in more periods than this, as mentioned above.

In a nutshell, as we suspected, when performing the plots in section 5.1.1, the implementation of this analysis was extremely relevant, given that we find that Gold can have different Hedge and diversifier abilities throughout the sample, despite of the long run conclusions, being this a great contribute to the literature.

5.2.3 – Safe Haven

In this section, we apply equation 11 to subsamples, with the purpose of analysing Gold's Safe Haven role in shorter periods. To perform this, first we compute each quantile for each subsample and then apply the mentioned equation to each of the subsamples separately. The results of the application of the Quantile Regression to the subsamples are reported from table 12 to table 17.

	Hedge	Safe Haven				Omega	Alpha	Beta	Gamma	Shape
		Quantile 1%	Quantile 2.5%	Quantile 5%	Quantile 10%					
Stocks:										
EuroStoxx 600	0.0649	-0.1441	0.0320	0.0091	0.0502	0,0000 ***	0.0923 ***	0.8871 ****	-0.0795 *	4.2666 ****
EuroStoxx Banks	0,0294	-0,1826	0,0592	-0,0105	0,0286	0,0000 ***	0,0906 ***	0,8909 ****	-0,0798 *	4,4467 ****
DAX	0,0309	-0,2469 *	0,0722	0,0766	-0,0118	0,0000 ***	0,0815 ***	0,8870 ****	-0,0701 ^	4,2578 ****
CAC 40	0,0351	-0,2054	0,2153	0,0012	-0,0440	0,0000 ***	0,0917 ***	0,8817 ****	-0,0734 ^	4,3223 ****
FTSEMIB	0,0203	-0,1954	0,0443	-0,1346	0,1569 ^	0,0000 ***	0,0983 ***	0,8845 ****	-0,0873 **	4,4813 ****
IBEX 35	0,0061	-0,0874	0,0024	-0,1108	0,1455	0,0000 ***	0,0909 ***	0,8853 ****	-0,0725 ^	4,3805 ****
PSI 20	0,0094	-0,1591	0,0062	0,0296	0,0871	0,0000 ***	0,0894 ***	0,8883 ****	-0,0748 *	4,3424 ****
ISEQ	0,0133	-0,0572	0,1690 ^	-0,2647 ***	0,1221	0,0000 ***	0,0899 ****	0,9085 ****	-0,0545 *	4,6677 ****
ASE	0,0240	-0,0040	0,1066	0,0690	-0,1468 *	0,0000 ***	0,0890 ***	0,8814 ****	-0,0716 ^	4,5215 ****
Bonds:										
German 2-years	0,0281 ***	-0,0123	0,0287	-0,0299	0.0001	0,0000 ***	0,0772 ***	0,8978 ****	-0,0645 ^	4,4548 ****
German 10-years	0,0239 **	-0,0594 ^	-0,0661 ^	0,0892 ***	-0,0337	0,0000 ***	0,0837 ***	0,8909 ****	-0,0682 *	4,5350 ****
French 2-years	0,0136	0,0587 ^	-0,0862 **	0,0017	0,0290	0,0000 ***	0,0788 ***	0,8899 ****	-0,0682 *	4,4289 ****
French 10-years	0,0158 ^	-0,0618 ^	-0,0127	-0,0066	0,0271	0,0000 ***	0,0854 ***	0,8923 ****	-0,0722 *	4,4957 ****
Italian 2-years	0,0222 *	-0,0179	0,0327	-0,0552	0,0047	0,0000 ***	0,0804 ***	0,8943 ****	-0,0703 *	4,3803 ****
Italian 10-years	0,0229 **	-0,0914 ***	-0,0086	0,0731 *	-0,0396	0,0000 ***	0,0772 ***	0,8994 ****	-0,0666 *	4,5580 ****
Spanish 2-years	0,0201 *	-0,0245	-0,0087	0,0117	-0,0043	0,0000 ***	0,1549 ****	0,9365 ****	0,0632 **	4,4496 ****
Spanish 10-years	0,0141	-0,0547	0,0115	-0,0514	0,0528 *	0,0000 ***	0,0808 ***	0,8989 ****	-0,0695 *	4,5779 ****
Portuguese 2-years	0,0049	-0,0231	-0,0020	0,0153	0,0103	0,0000 ***	0,0862 ***	0,8818 ****	-0,0612 ^	4,6053 ****
Portuguese 10-years	0,0075	-0,0169	-0,0705 *	0,0469	0,0193	0,0000 ***	0,0805 ***	0,8916 ****	-0,0575 ^	4,6790 ****
Irish 2-years	-0,0055	0,0182	-0,0295	-0,0225	0,0227	-0,0392	0,0266 ^	0,9977 ****	0,0603 ****	1,3746 ****
Irish 10-years	0,0119	-0,0029	-0,0146	0,0330	-0,0058	0,0000 ***	0,0811 ***	0,8919 ****	-0,0560 ^	4,5273 ****
Greek 2-years	0,0005	0,0022	-0,0011	0,0028	-0,0047	-0,3308 *	0,1291 ***	0,9755 ****	0,0165	5,1885 ****
Greek 10-years	0,0005	-0,0083	-0,0232	-0,0070	0,0218	0,0000 ***	0,0875 ***	0,8875 ****	-0,0705 *	4,2952 ****

Note: Statistical Significance at: 10% ^; 5% *; 2.5% **; 1% ***; 0.1% ****

Table 12 – Subsample 1: Quantile Regression results. It is presented the first subsample results for the mean equation on the left and for the variance of the residuals on the right.

	Hedge	Safe Haven Quantile 1%	Safe Haven Quantile 2.5%	Safe Haven Quantile 5%	Safe Haven Quantile 10%	Omega	Alpha	Beta	Gamma	Shape
Stocks:										
EuroStoxx 600	0,0097	0,1164	-0,1932 *	0,0075	0,0324	0,0000	0,0762 ***	0,9483 ****	-0,0577 **	6,1914 ****
EuroStoxx Banks	-0,0038	-0,0704	0,0239	-0,0174	-0,0324	-0,4409 *	0,1360 ***	0,9662 ****	0,0367 ***	1,3453 ****
DAX	-0,0017	-0,0273	0,0819	-0,0526	-0,0396	0,0000	0,0506 ***	0,9636 ****	-0,0368 *	1,3824 ****
CAC 40	0,0081	-0,0022	0,0730	-0,1576 *	0,0481	0,0000	0,0633 ***	0,9573 ****	-0,0501 **	1,3482 ****
FTSEMIB	-0,0053	0,0316	-0,0288	-0,0136	-0,0473	0,0000	0,0725 ***	0,9311 ****	-0,0411	1,3380 ****
IBEX 35	0,0160	-0,0195	-0,0842	0,1436	-0,1301 ^	0,0000	0,0641 ***	0,9520 ****	-0,0434 ^	5,8449 ****
PSI 20	0,0227	-0,0987	0,1329	-0,1973	0,0924	0,0000	0,0400 ****	0,9820 ****	-0,0452 ***	1,3740 ****
ISEQ	0,1188 ***	-0,2354 ^	0,2609 ^	0,0963	-0,1931 ^	-0,0474 ^	0,0382 *	0,9979 ****	0,0648 ****	1,4408 ****
ASE	-0,0400	-0,1011	0,1678	-0,0894	0,0444	0,0000	0,0466 ***	0,9753 ****	-0,0480 ***	1,3548 ****
Bonds:										
German 2-years	0.0281 ***	-0.0123	0.0287	-0.0299	0.0001	0.0000 ***	0.0772 ***	0.8978 ****	-0.0645 ^	4.4548 ****
German 10-years	0,0004	0,0428	-0,0385	-0,0474	0,0428 ^	-0,0503 ***	0,0371 ****	0,9977 ****	0,0656 ****	1,3838 ****
French 2-years	-0,0189 *	-0,0317	0,0232	-0,0126	0,0087	0,0000	0,0840 ***	0,9390 ****	-0,0714 **	1,4430 ****
French 10-years	-0,0004	0,0194	-0,0370	0,0090	0,0077	-0,0525 ***	0,0409 ****	0,9978 ****	0,0646 ****	1,3571 ****
Italian 2-years	-0,0131	-0,0422 ^	-0,0218	-0,0023	0,0120	0,0000	0,0748 ***	0,9510 ****	-0,0696 ***	1,4287 ****
Italian 10-years	-0,0076	0,0091	-0,0400	-0,0058	0,0363	0,0000	0,0676 ****	0,9680 ****	-0,0688 ****	1,3637 ****
Spanish 2-years	-0,0152 ^	-0,0077	-0,0020	-0,0074	-0,0024	0,0000	0,0719 ****	0,9550 ****	-0,0659 ***	1,4157 ****
Spanish 10-years	-0,0073	0,0009	-0,0577	0,0402	0,0091	0,0000	0,0719 ****	0,9653 ****	-0,0719 ****	1,3604 ****
Portuguese 2-years	-0,0186 *	-0,0283	0,0154	-0,0334	0,0302	-0,2212 **	0,0975 ****	0,9849 ****	0,0657 ***	1,4325 ****
Portuguese 10-years	-0,0158	0,0430	-0,0577	0,0154	0,0269	0,0000	0,0660 ****	0,9712 ****	-0,0703 ****	1,3031 ****
Irish 2-years	0,0040	0,0373	-0,0193	0,0279	-0,0465	-0,1466 ***	0,1004 ****	0,9918 ****	0,0240	4,7085 ****
Irish 10-years	-0,0040	-0,0045	-0,0162	-0,0416	0,0446	-0,0335 ^	0,0366 ***	0,9993 ****	0,0634 ****	1,4175 ****
Greek 2-years	0,0086	-0,0383	0,0562	-0,0552	0,0140	0,0000 *	0,1329 ***	0,8834 ****	-0,0826 ^	8,7498 ****
Greek 10-years	-0,0141	0,0143	-0,0664 *	0,0187	0,0328	0,0000	0,0844 ****	0,9537 ****	-0,0761 ****	5,9369 ****

Note: Statistical Significance at: 10% ^; 5% *; 2.5% **; 1% ***; 0.1% ****

Table 13 – Subsample 2: Quantile Regression results. It is presented the second subsample results for the mean equation on the left and for the variance of the residuals on the right.

	Hedge	Safe Haven				Omega	Alpha	Beta	Gamma	Shape
		Quantile 1%	Quantile 2.5%	Quantile 5%	Quantile 10%					
Stocks:										
EuroStoxx 600	0,1713 ****	0.1887	0.1818	-0.1580	-0.1082	-0.0919 *	0.0598 **	0,9948 ****	0,0427 ***	1,4064 ****
EuroStoxx Banks	0,0226	-0,0706	-0,3247 **	0,2321	0,1090	-0,0359	0,0367 ^	0,9992 ****	0,0653 ****	1,4397 ****
DAX	0,0021	0,0786	-0,1045	0,0234	0,0007	-0,1511 ***	0,0953 ****	0,9908 ****	0,0534 ****	5,1070 ****
CAC 40	0,1511 ***	-0,1890	0,1576	0,0694	-0,1843	-0,0789 ^	0,0613 **	0,9963 ****	0,0445 ***	1,4091 ****
FTSEMIB	0,1374 **	0,2083	-0,0551	-0,0521	0,0155	-0,0045	-0,0260 ***	0,9975 ****	0,0944 ****	7,1330 ****
IBEX 35	0,1089 *	0,2649 ^	-0,0878	-0,1284	0,0254	-0,0661 ^	0,0469 *	0,9966 ****	0,0546 ****	7,3647 ****
PSI 20	0,0649	0,3767 *	-0,5374 ***	0,2684	-0,1159	-0,2079 ***	0,0847 ***	0,9836 ****	0,0272	5,6103 ****
ISEQ	-0,0997 ***	-0,0186	-0,0248	-0,2742 ***	0,2291 ***	-0,3123 ***	0,1615 ****	0,9775 ****	0,0182	4,8107 ****
ASE	0,1013 **	0,0179	0,2226	-0,1241	0,0548	-0,0657 *	0,0381 ^	0,9959 ****	0,0640 ****	1,5062 ****
Bonds:										
German 2-years	-0.0050	0.0887 **	-0.0857 ^	0.0197	-0.0059	-0.1188 ^	0.0865 ***	0.9936 ****	0.0437 *	5.3117 ****
German 10-years	-0,0600 ****	0,0302	0,0131	-0,0256	0,0109	0,0000 *	0,0681 ***	0,9196 ****	-0,0115	4,4660 ****
French 2-years	-0,0064	0,0227	-0,0184	-0,0200	0,0211	-0,1140 ^	0,0875 ***	0,9943 ****	0,0415 *	5,2279 ****
French 10-years	-0,0428 ***	-0,1039 *	0,0417	0,0552	-0,0272	0,0000 ^	0,0635 ***	0,9268 ****	-0,0172	4,3994 ****
Italian 2-years	-0,0027	-0,0293	-0,0001	0,0391	-0,0006	0,0000	0,0615 ***	0,9617 ****	-0,0439 *	5,1717 ****
Italian 10-years	-0,0033	0,0168	0,0600	-0,0234	-0,0081	-0,1757 ***	0,1106 ****	0,9893 ****	0,0366 ^	4,6926 ****
Spanish 2-years	-0,0039	0,0556	-0,0596	0,0311	-0,0167	-0,1267 *	0,0908 ***	0,9929 ****	0,0468 **	4,9241 ****
Spanish 10-years	-0,0065	-0,0406	0,0162	0,0158	0,0100	-0,1593 ***	0,1063 ****	0,9907 ****	0,0388 *	4,4400 ****
Portuguese 2-years	-0,0005	-0,0089	0,0319	-0,0133	-0,0026	-0,1593 ***	0,1029 ****	0,9906 ****	0,0433 **	4,8117 ****
Portuguese 10-years	-0,0002	0,0189	0,0309	-0,0039	-0,0087	-0,1706 ***	0,1103 ****	0,9899 ****	0,0358 ^	5,2810 ****
Irish 2-years	-0,0020 ^	0,0006	-0,0085	0,0107	0,0007	0,0000	0,0694 ***	0,9296 ****	-0,0315	5,5736 ****
Irish 10-years	-0,0025	0,0559 ^	0,0159	0,0443	-0,0724 **	-0,2131 ***	0,1377 ****	0,9871 ****	0,0236	4,4581 ****
Greek 10-years	-0,0003	0,0059	-0,0005	0,0086	-0,0060	0,0000 *	0,0679 ****	0,9270 ****	-0,0159	5,1643 ****

Note: Statistical Significance at: 10% ^; 5% *; 2.5% **; 1% ***; 0.1% ****

Table 14 – Subsample 3: Quantile Regression results. It is presented the third subsample results for the mean equation on the left and for the variance of the residuals on the right.

	Hedge	Safe Haven Quantile 1%	Safe Haven Quantile 2.5%	Safe Haven Quantile 5%	Safe Haven Quantile 10%	Omega	Alpha	Beta	Gamma	Shape
Stocks:										
EuroStoxx 600	-0,0734 *	0,2963 ***	-0,3944 ***	0,2902 **	-0,0992	-0,2341 ****	0,1257 ****	0,9841 ****	-0,0004	4,858119 ****
EuroStoxx Banks	-0,1056 ****	0,2797 ****	-0,2291 ***	0,0927	-0,0160	0,0000 *	0,0908 ***	0,9086 ****	-0,0407	4,810829 ****
DAX	-0,0995 **	-0,6997 ****	0,4944 ****	-0,1368	0,0304	-0,4389 ***	0,1655 ****	0,9655 ****	-0,0810 ****	1,3094 ****
CAC 40	-0,0920 ****	0,2083 **	-0,0442	0,0021	-0,0398	0,0000 ***	0,0579 ***	0,9318 ****	-0,0184	4,5131 ****
FTSEMIB	-0,1057 ****	0,4207 ****	-0,1219	-0,0947	-0,0168	-0,1590 **	0,1028 ***	0,9905 ****	0,0543 **	4,9380 ****
IBEX 35	-0,1154 ****	0,3006 ***	-0,0988	0,1320	-0,1466	-0,1410 ***	0,0726 ***	0,9904 ****	0,0633 ****	1,3089 ****
PSI 20	-0,1043 **	0,2350 ^	0,2499 ^	-0,4773 ***	0,1098	-0,1928 ***	0,1057 ****	0,9874 ****	0,0439 *	1,3082 ****
ISEQ	0,0110	-0,0918	0,0264	-0,1998	0,1536	-0,3422 **	0,1409 ****	0,9742 ****	-0,0615 ***	5,0092 ****
ASE	-0,0864 ***	-0,0260	0,0447	-0,0996	0,0778	-0,1748 ****	0,0770 ***	0,9867 ****	0,0618 ***	5,1285 ****
Bonds:										
German 2-years	-0,0774 ****	-0,0603	0,0484	-0,0119	0,0145	0,0000 *	0,0638 ***	0,9298 ****	-0,0413	5,4222 ****
German 10-years	-0,0463 ****	0,0122	0,0098	0,0089	-0,0012	-0,1102 ****	-0,0063	0,9880 ****	-0,0985 ****	4,5211 ****
French 2-years	-0,0569 ****	-0,0034	0,0563	0,0175	-0,0399	-0,1488 *	0,0623 *	0,9887 ****	0,0656 ***	5,2214 ****
French 10-years	-0,0500 ****	0,0330	-0,0206	0,0181	0,0199	-0,1035 ***	0,0206	0,9909 ****	-0,0710 ****	5,3116 ****
Italian 2-years	0,0052	0,0016	-0,0019	-0,0131	0,0204 ^	-0,3587 ****	0,1440 ****	0,9720 ****	-0,0099	4,5732 ****
Italian 10-years	0,0024	-0,0132	0,0096	-0,0136	0,0237	-0,4607 ***	0,1764 ****	0,9635 ****	-0,0637 **	5,0664 ****
Spanish 2-years	0,0054	-0,0065	-0,0011	0,0097	-0,0009	-0,2881 ***	0,1327 ****	0,9788 ****	0,0028	4,8738 ****
Spanish 10-years	0,0057	-0,0187	-0,0059	0,0067	0,0080	-0,5804 ***	0,2020 ****	0,9523 ****	-0,0574 **	1,2098 ****
Portuguese 2-years	0,0003	-0,0047	0,0024	-0,0027	0,0066	-0,7088 ***	0,2223 ****	0,9399 ****	-0,0722 ***	1,2467 ****
Portuguese 10-years	0,0003	-0,0191 **	0,0212 ^	0,0050	-0,0054	-0,6371 ***	0,2208 ****	0,9476 ****	-0,0666 **	1,2423 ****
Irish 2-years	-0,0052	0,0107	-0,0558	0,0563	-0,0268	-0,5996 ***	0,1777 ****	0,9488 ****	-0,0645 *	5,3206 ****
Irish 10-years	0,0037	0,0127	-0,0324 **	0,0165	0,0064	0,0000 *	0,0726 ***	0,9210 ****	-0,0332	5,6198 ****
Greek 10-years	0,0005	0,0026	0,0010	-0,0132 ***	0,0091 ***	-0,3435 **	0,1431 ****	0,9736 ****	-0,0364	4,8862 ****

Note: Statistical Significance at: 10% ^; 5% *; 2.5% **; 1% ***; 0.1% ****

Table 15 – Subsample 4: Quantile Regression results. It is presented the fourth subsample results for the mean equation on the left and for the variance of the residuals on the right.

	Hedge	Safe Haven				Omega	Alpha	Beta	Gamma	Shape
		Quantile 1%	Quantile 2.5%	Quantile 5%	Quantile 10%					
Stocks:										
EuroStoxx 600	0.0294	-0.1939	-0.1150	-0.0604	-0.0065	-0.2921 ^	0.1143 ***	0.9778 ****	0.0049	4.8975 ****
EuroStoxx Banks	-0,0155	-0,0836	0,0463	-0,0952	0,0919	-0,4607 ***	0,1439	0,9619 ****	-0,0460 *	5,1356 ****
DAX	-0,0189	-0,1457	-0,0840	-0,1245	0,0757	-0,6112 *	0,1571 ***	0,9474 ****	-0,0014	5,0976 ****
CAC 40	-0,0039	-0,3231 ***	0,1915	-0,1525	-0,0305	-0,3235 *	0,1322 ****	0,9760 ****	-0,0011	4,9825 ****
FTSEMIB	-0,0058	-0,1202	-0,0344	0,0384	-0,0113	-0,2357 **	0,0815 ***	0,9812 ****	-0,0710 ***	4,7513 ****
IBEX 35	-0,0282	-0,1976	0,0897	-0,0374	0,0784	-0,3084 **	0,1284 ****	0,9768 ****	-0,0547 **	4,8403 ****
PSI 20	0,0147	-0,0746	0,1008	0,0507	-0,1103	-0,3988 ***	0,1432 ****	0,9685 ****	-0,0521 **	4,9728 ****
ISEQ	-0,0206	0,1434 *	-0,0055	-0,0581	-0,0318	0,0000 **	0,0773 ****	0,9177 ****	-0,0297	5,8657 ****
ASE	-0,0032	0,0072	-0,0913	-0,0428	0,0505	-0,5959 ***	0,1691 ****	0,9491 ****	-0,0776 ***	4,9777 ****
Bonds:										
German 2-years	-0,0745 ***	-0,1490 *	0,0504	-0,0752	0,0480	-0,4908 ***	0,1525 ****	0,9593 ****	-0,0587 **	4,5179 ****
German 10-years	-0,0658 ****	-0,0142	-0,0424	-0,0037	0,0306	-0,1945 ***	0,1225 ****	0,9896 ****	0,0279 ^	5,8261 ****
French 2-years	-0,0501 **	0,0852	-0,1207 ^	0,0656	-0,0316	-0,3992 ***	0,1550 ****	0,9693 ****	-0,0662 ***	5,0932 ****
French 10-years	-0,0505 ****	-0,0708 ***	0,0170	-0,0120	0,0127	-0,1966 ***	0,1162 ****	0,9889 ****	0,0351 *	5,8256 ****
Italian 2-years	-0,0066 ^	-0,0032	-0,0025	0,0007	0,0100	-0,2357 ***	0,1330 ****	0,9860 ****	0,0235	5,7279 ****
Italian 10-years	-0,0142 ***	-0,0185	0,0171	-0,0062	0,0068	-0,2557 ***	0,1308 ****	0,9838 ****	0,0318 ^	5,5178 ****
Spanish 2-years	-0,0298 *	-0,0195	-0,0148	-0,0082	0,0749	-0,5221 **	0,1464 ***	0,9560 ****	0,0034	4,8955 ****
Spanish 10-years	-0,0303 ****	0,0168	-0,0092	0,0003	0,0336	-0,3722 *	0,1271 ***	0,9708 ****	0,0120	5,0854 ****
Portuguese 2-years	-0,0239 ***	-0,0712 ****	0,0632 *	-0,0080	0,0575 ^	-0,3651 *	0,1158 ****	0,9707 ****	0,0200	5,0267 ****
Portuguese 10-years	-0,0160 ***	0,0550 ****	0,0053	-0,0037	0,0176	-0,3256 *	0,1211 ****	0,9752 ****	0,0165	5,1059 ****
Irish 2-years	-0,0086	0,0416	-0,0249	-0,1543 ***	0,1265 ***	-0,1899 ***	0,1073 ****	0,9889 ****	0,0272 ^	5,9562 ****
Irish 10-years	-0,0143	-0,0212	-0,0335	-0,0148	0,0308	-0,5234 **	0,1585 ****	0,9558 ****	-0,0415	5,0682 ****
Greek 10-years	0,0019	-0,0053	0,0177 ****	-0,0176 ***	0,0056	-0,4511 *	0,1518 ****	0,9639 ****	-0,0066	4,7056 ****

Note: Statistical Significance at: 10% ^; 5% *; 2.5% **; 1% ***; 0.1% ****

Table 16 – Subsample 5: Quantile Regression results. It is presented the fifth subsample results for the mean equation on the left and for the variance of the residuals on the right.

	Hedge	Safe Haven				Omega	Alpha	Beta	Gamma	Shape
		Quantile 1%	Quantile 2.5%	Quantile 5%	Quantile 10%					
Stocks:										
EuroStoxx 600	0.0665 ^	0.1872 *	0.1020	-0.1192	-0.0363	-0.1745 ^	0.0970 ***	0.9898 ****	0.0593 ***	7.113634 ****
EuroStoxx Banks	-0,0507 ***	-0,0400	0,0863	-0,0331	-0,0250	-0,2291 **	0,1312	0,9869 ****	0,0313 ^	5,953141 ****
DAX	0,0543 ^	0,1325 ^	0,1498	0,0474	-0,1752	-0,1799 ^	0,0994 ****	0,9895 ****	0,0588 ***	8,8653 ****
CAC 40	0,0417	0,0943	0,1807 ^	0,0399	-0,1767 ^	0,0000 *	0,1256 ****	0,8948 ****	-0,0944 ***	8,6256 ***
FTSEMIB	-0,0176	-0,1686 ***	0,1186	0,0716	-0,0678	-0,2080 ***	0,1168 ****	0,9878 ****	0,0280 ^	6,0033 ****
IBEX 35	-0,0183	-0,0142	-0,0078	-0,0071	-0,0037	-0,2221 ***	0,1210 ****	0,9867 ****	0,0267	5,9150 ****
PSI 20	-0,0164	0,0986	0,0386	-0,0763	-0,0038	-0,2100 **	0,1156 ****	0,9875 ****	0,0275	5,8568 ****
ASE	0,0126	-0,0004	-0,0143	-0,0111	-0,0027	-0,2037 ***	0,1180 ****	0,9883 ****	0,0279 ^	5,9698 ****
Bonds:										
German 2-years	-0,1082 ****	-0,0381	0,0704	0,0443	-0,0417	-0,3196 ***	0,1621 ****	0,9804 ****	0,0196	6,8961 ****
French 2-years	-0,0772 ****	-0,1022 **	0,1652 ***	-0,0729	0,0151	-0,2140 **	0,1208 ****	0,9875 ****	0,0275	5,9064 ****
Spanish 2-years	-0,0094	0,0604 ^	-0,0108	0,0521	-0,0940 ^	0,0000 ^	0,1025 ***	0,8988 ****	-0,0557 ^	7,7954 ****
Spanish 10-years	-0,0201 ***	0,0484 ^	-0,0151	-0,0026	-0,0287	0,0000 ^	0,1208 ****	0,8947 ****	-0,0840 **	7,7278 ****
Portuguese 2-years	-0,0118	0,0490 ^	-0,0258	0,0357	-0,0480	0,0000 ^	0,1233 ****	0,8828 ****	-0,0713 ^	8,7061 ****
Portuguese 10-years	-0,0076 ****	-0,0733 ***	0,0802	-0,0152	-0,0237	-0,2530 ^	0,1305 ****	0,9846 ****	0,0558 ***	8,2048 ****
Irish 10-years	-0,0453 ****	0,0101	-0,1531 ****	0,1076 ****	0,0125	-0,3330 ***	0,1208 ****	0,9760 ****	0,0487 *	5,6657 ****
Greek 10-years	-0,0023	0,0179	-0,0175	0,0031	0,0005	0,0000 ^	0,1187 ****	0,8818 ****	-0,0608 ^	8,6161 ****

Note: Statistical Significance at: 10% ^; 5% *; 2.5% **; 1% ***; 0.1% ****

Table 17 – Subsample 1: Quantile Regression results. It is presented the sixth subsample results for the mean equation on the left and for the variance of the residuals on the right.

Starting with the equity markets, Gold provides strong Safe Haven role to the EuroStoxx 600, for the most extreme negative returns on the long run, while, when considering subsamples, it only serves as strong Safe Haven at the 2.5% quantile for the second and fourth subsamples. Moreover, it provides weak Safe Haven role, in the long-term, at the 5% quantile and in different subsamples at many quantiles (for instance for the fifth subsample at all quantiles). With respect to EuroStoxx Banks, Gold is only a strong Safe Haven for the 5% quantile and at a weak significance level (10%), on the long run. Nonetheless when focusing subsamples, we find evidence of strong Safe Haven status at the 2.5% quantile, in both the third and fourth subsamples (periods that cover the financial and the beginning of the sovereign debt crisis, respectively).

Looking at the DAX, Gold does not perform any strong Safe Haven role, being just a weak one on the long run. Despite this, it offers a strong Safe Haven role for the most extreme negative returns at the first and the fourth subsamples, as well as for the 10% quantile, in the sixth subsample.

The French benchmark index is sheltered by Gold at 2.5% quantile, on the long run, with this property just holding for the 5% quantile in the second, for the most extreme quantile in the fifth and for 10% quantile (with a weak significance level) in the sixth subsamples.

In addition, the FTSEMIB is sheltered by Gold at the most extreme returns, in the long-term, but only at a 10% significance level, whilst when analysing subsamples, we just find strong evidence of Safe Haven in the sixth subsample at the most extreme quantile too.

With regard to the IBEX 35, Gold is on the long run, at best, a weak Safe Haven, which is consistent with the subsamples, as it only presents a strong Safe Haven role in the second subsample at the 10% quantile, albeit with weak significance. Additionally to the Iberian equity markets, the Portuguese stock market (PSI 20) is Safe Havened by Gold at the 2.5% quantile, even just at a 10% significance level on the long run. Whilst, when considering subsamples, we find evidence of strong Safe Haven status during the third and fourth subsamples, at the 2.5% and 5% quantiles, respectively (period that corresponds to the financial and beginning of the sovereign debt crisis, respectively too).

Analysing the ISEQ, we find evidence of strong Safe Haven for the most extreme quantile on the long run, as well as in the first and third subsamples at the 5% quantile. There is also a weaker evidence of strong Safe Haven at the 1% and the 10% quantiles, in the second subsample. Ultimately considering equity markets, we analyse the Greek benchmark (ASE). This market is Safe Havened by Gold at the most extreme quantile, in the long-term, while it just provides this status in the first subsample at the 10% quantile.

In brief, this subsample analysis to equity markets allows us to understand that, despite of Gold's behaviour, on the long run, in terms of subsamples we find less negative and significant estimates to the coefficients in each of the subsamples, existing only in the third and fourth subsamples (periods covering the Global Financial Crisis and the European Sovereign Debt Crisis) assets for which Gold denotes strong Safe Haven effect with a significance level lower than 1%, from that period onwards the existence of a Safe Haven is almost imperceptible.

Putting the spotlight on the government bonds, we find that for the German market Gold produces different conclusions to each maturity on the long run, as we find evidence of strong Safe Haven to the 10-year bonds, while to the 2-year not. Focusing on the subsamples, there is a presence of strong Safe Haven in the third subsample of 2-years bonds at the most extreme quantile, while for the 10-years we find that evidence at the 5% quantile in the first subsample and also at the 10% quantile in the second subsample, but at a weaker significance level.

Concerning the French government bond market, despite of its maturity, we do not find, on the long run, any strong Safe Haven status; when considering the subsamples we do not find it in any but the 2.5% quantile in the sixth subsample of 2-year maturity, meaning, Gold is, at best, a weak Safe Haven for the French government bond market, while for the 10-years bonds we do not find any strong safe haven status.

Similarly to the French government bonds, Gold does not fulfil the strong Safe Haven role to the Italian bonds, on the long run. When considering subsamples it has weak Safe Haven properties too, as it is only a strong Safe Haven at the 10% significance level for the 10% quantile (fourth subsample for the 2-years bonds), as well as at the 5% quantile (first subsample of the 10-years bonds).

The Spanish bonds are, in the long-term, strongly Safe Havened by Gold at different quantiles (for the 2-years maturity it is at the most extreme negative quantile and the 10-years are at the 10% quantile). Regarding subsamples, the 2-years only denote a strong Safe Haven status in the sixth subsample at a weak significance level, while the 10-years denote in the first subsample at the 10% quantile and in the sixth subsample at the most extreme quantile (with weak significance).

With respect to the Portuguese government bonds, Gold has strong Safe Haven status at the most extreme negative returns for the 10-years bonds on the long run (exhibiting significance at 10%). Concerning subsamples, in the 2-years bonds we find evidence of that property in the fifth and sixth subsamples, while in the 10-years we find it in the fourth and fifth subsamples, both at the most extreme quantiles.

The Irish government bonds are Safe Havened by Gold at the 2.5% quantile for the 2-years and at the most extreme quantile for the 10-years bonds, albeit this last is at a less significant level. Concerning subsamples, the 2-years bonds are just Safe Havened by Gold at the 10% quantile for the fifth subsample, while the 10-years bonds are strong Safe Havened by Gold at the most extreme quantile (at a less significant level), during the third subsample; in the sixth subsample, however, they are strongly Safe Havened at the 5% quantile.

Regarding the Greek government bonds with 2-years maturity, we find evidence of Gold's strong Safe Haven status at the 10% quantile (but only at 10% significance level), while in subsamples we do not find any evidence of strong Safe Haven at any quantile. Concerning the 10-years bonds, Gold is not a strong Safe Haven for the long run, but it is for the subsamples, in fact, a strong Safe Haven exists for the 10% quantile in the fourth subsample and at the 2.5% quantile in the fifth subsample, periods in which Hellenic Republic has deeply suffered with the debt crisis.

To summarise these subsamples analysis demonstrates that Gold's Safe Haven role, in terms of bonds, is highly dependent on the issuers of those bonds, particularly after the fourth subsample (European Sovereign Debt Crisis), as we see Safe Haven effects to the PIIGS from that period onwards; existing before that event there are evidence of some Safe Haven role to the German and French bonds.

Lastly, in Annex C tables 36 and 47, it is represented the model that better fits the residuals of the different subsamples Quantile Regressions, by analysing its output we find that throughout the different samples there exists a different behaviour in the Gamma coefficient estimates (asymmetric effect), as we find periods of highly significant estimates to the coefficients and others with no significance, this can be further explored in future research, despite this the Alfa and Beta are almost in for all assets and subsamples highly significant, meaning there is presence of both the ARCH and the persistence effects.

6 – Conclusion

The main objective of this dissertation was to examine Gold's role as both Hedge and Safe Haven asset to European Equity and Bond markets, for these last by analysing the two- and ten-years maturities. With the purpose of exposing a broader empirical study, we analyse a sample and subsamples to examine differences of behaviour in Gold's hedging and safe haven roles in shorter periods throughout the sample and comparing them with the long run conclusions.

Regarding Gold's Hedge role, we perform DCC-GARCH and ADCC-GARCH models, with the EGARCH and GJR-GARCH specifications in the univariate part of the model, assuming three conditional distributions: the Gaussian Normal, the Student's T and the GED. Among the various models we chose the one that minimises the AIC and the BIC, taking into account that when they disagree in which is the best, we follow the model selected by the BIC due to its more penalising characteristics. Those referred models are applied, in order to obtain daily time-varying correlations between Gold and each of the assets candidate to be Hedge, being computed the t-tests to it, with the purpose of scrutinising the significance of that correlation's coefficient's estimates.

With respect to Gold's Safe Haven status, we estimate two approaches: the first is a Quantile Regression, meaning, it is included in each quantile the returns that are equal or exceed the quantile (this regression is applied to the sample and the subsamples); the second is a Specific Periods' Regression, that is, a regression where we define candidate periods to include in it, based on a generator event. To be verified the (strong) Hedge or the (strong) Safe Haven property of Gold in the equity markets, the coefficient estimate must be negative (and statistically significant), and in the bond markets, as we are dealing with yield rates, the coefficient estimate must be positive (and statistically significant).

According to our empirical results, we sustain that Gold can be seen as a Hedge for the equity markets, with the exception of the EuroStoxx 600, on the long run. Despite this long run exception, our subsamples' results lead us to defend that Gold is a Hedge for all equity markets under analysis, on the period after the Lehman Brothers collapse, being a diversifier asset for almost all the assets in the period before it. With respect to Bond Markets, our results point to different behaviours depending on the issuer: for Germany and France, despite the bonds' maturity we find diversifier effect (being only hedged in the first subsample); for the rest we find that the majority are hedged by Gold from the Global Financial Crisis to the European Sovereign Debt Crisis periods, although in the long-term we verify different Gold roles. This means that the long-term Hedge effect does not exist for all the other bonds, having for Spain and Italy differences between the 2 and the 10 years bonds.

Regarding Safe Haven, we support that Gold can be useful as Safe Haven when in presence of a negative return equal or below the 2.5% quantile (particularly equal or below the 1% quantile), as well as, when some events that highly impact uncertainty occur (the Lehman Brothers collapse, the asking for a second Bailout program by Greece or the Brexit Referendum), however did not offer Safe Haven ability in the most recent sanitary crisis, the COVID-19 pandemic outbreak.

With respect to Bond Markets, our results indicate that there are a clear Safe Haven effect, as we do not find many significant estimates to the coefficients neither in terms of sample nor in terms of subsample, being the issuer the main driver of that effect, as we identify some statistically significant estimates to the coefficients in the PIIGS markets from the European Sovereign Debt Crisis onwards. Regarding bonds, when we consider specific periods we have to consider once more the issuer of the bond to find the Safe Haven effects, as we find periods in which Gold produces Safe Haven effects for all bonds but the German and French, such as, the Irish and the Portuguese Bailouts and Brexit Referendum.

Since this work has some limitations, future research should focus on developing it further. For instance, in our work we compute structural breaks in terms of levels to define each of the subsamples. A different approach could be to determine these structural breaks in terms of assets' volatility (or if it is desired that all subsamples are equal in time use a proxy to the markets' volatility), which might lead to different subsamples length; meaning, the analysis might lead to different results or could reinforce our conclusions. Another limitation in our work is that we have only focused on Gold measured in Euros. Future research might analyse Gold's role to these markets measured in other currencies, to check if the main driver of the effect is Gold or the Euro; other precious metals might also be considered such as Silver, Platinum or Palladium, as well as other classes of assets such as volatility indexes [as the VIX produces quite relevant results for the US market (see Hood and Malik, (2013))] and cybercurrencies, namely Bitcoin. As no methodology is perfect, applying other methodologies to this dataset could also be rewarding to literature. Furthermore, if a second or third vague of the COVID-19 pandemic strikes with deeper impacts on financial markets, updating this dataset to include new observations might also be worthy of analysis to verify if the effect obtained in the Specific Period's Regression continues or disappears. Moreover, it might be interesting to produce this analysis to different constituents of an index (portfolios of different stocks or isolated companies), instead of analysing the equity index itself, as this is an unexplored field, to the best of our knowledge. Finally, as we find different patterns in the residuals of our regressions, its analysis could also be interesting.

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8 – Annexes

Annex A – R Packages used in this dissertation

In this dissertation we used R software and the following packages to develop our models:

- rmgarch (Ghalanos, rmgarch: Multivariate GARCH Models, 2019)
- rugarch (Ghalanos, rugarch: Univariate GARCH Models, 2020)
- lmtest (Hothorn, et al., 2020)
- MASS (Ripley, et al., 2020)
- strucchange (Zeilis, et al., 2019)

Annex B – Choice of the ADCC-GARCH and DCC-GARCH models specification that minimises the Information Criterions

In Annex B, we show the tables where it is represented the results of the Akaike and Bayesian Information Criterions for each of the ADCC-GARCH and DCC-GARCH models and for the sample and the different subsamples. These Information Criterions are used to select which models is the better to the different asset combinations, being selected the model were the Information Criterions are minimised. This choice is made by: first, if both Information Criterions are in accordance, the model they select is the chosen one, second if they disagree in which is the best, we select by the BIC, as it penalises more the data.

DCC spec	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	
GARCH spec	EGARCH						GJR-GARCH						Min
Distribution	Normal		Student's T		GED		Normal		Student's T		GED		
IC	AIC												
EuroStoxx600	-12,97	-12,97	-12,96	-12,97	-12,97	-12,97	-12,96	-12,96	-12,96	-12,96	-12,96	-12,96	-12,97
EuroStoxx Banks	-12,11	-12,11	-12,11	-12,11	-12,11	-12,11	-12,10	-12,10	-12,10	-12,10	-12,10	-12,10	-12,11
DAX30	-12,53	-12,53	-12,53	-12,53	-12,53	-12,53	-12,52	-12,52	-12,52	-12,52	-12,52	-12,52	-12,53
CAC40	-12,61	-12,61	-12,60	-12,60	-12,60	-12,60	-12,59	-12,59	-12,59	-12,59	-12,59	-12,59	-12,61
FTSEMIB	-12,46	-12,46	-12,46	-12,46	-12,46	-12,46	-12,45	-12,45	-12,45	-12,45	-12,45	-12,45	-12,46
IBEX35	-12,53	-12,53	-12,53	-12,53	-12,53	-12,53	-12,52	-12,52	-12,52	-12,52	-12,52	-12,52	-12,53
PSI20	-12,92	-12,92	-12,92	-12,92	-12,92	-12,92	-12,91	-12,91	-12,90	-12,90	-12,90	-12,90	-12,92
ISEQ	-12,71	-12,71	-12,71	-12,71	-12,71	-12,71	-12,70	-12,70	-12,70	-12,70	-12,70	-12,70	-12,71
ASE	-11,67	-11,67	-11,90	-11,90	-11,93	-11,93	-11,96	-11,96	-11,92	-11,92	-11,94	-11,95	-11,96
German 2y	-10,71	-10,71	-10,71	-10,71	-10,71	-10,71	-10,70	-10,70	-10,69	-10,70	-10,70	-10,70	-10,71
German 10y	-10,17	-10,17	-10,17	-10,17	-10,17	-10,17	-10,17	-10,17	-10,17	-10,17	-10,17	-10,17	-10,17
French 2y	-10,60	-10,60	-10,59	-10,59	-10,60	-10,60	-10,58	-10,58	-10,57	-10,57	-10,57	-10,57	-10,60
French 10y	-10,15	-10,15	-10,15	-10,15	-10,15	-10,15	-10,15	-10,15	-10,15	-10,15	-10,15	-10,15	-10,15
Italian 2y	-9,72	-9,72	-9,71	-9,71	-9,71	-9,71	-9,69	-9,69	-9,69	-9,69	-9,69	-9,69	-9,72
Italian 10y	-9,67	-9,67	-9,66	-9,66	-9,66	-9,66	-9,67	-9,67	-9,66	-9,66	-9,66	-9,66	-9,67
Spanish 2y	-9,94	-9,94	-9,93	-9,93	-9,93	-9,93	-9,90	-9,90	-9,89	-9,89	-9,89	-9,89	-9,94
Spanish 10y	-9,76	-9,77	-9,76	-9,76	-9,76	-9,76	-9,76	-9,76	-9,76	-9,76	-9,76	-9,76	-9,77
Portuguese 2y	-9,02	-9,02	-9,00	-9,00	-8,99	-8,99	-8,97	-8,97	-8,93	-8,93	-8,94	-8,94	-9,02
Portuguese 10y	-8,87	-8,87	-6,62	-6,62	-8,55	-8,55	-9,03	---	---	---	-8,35	-8,35	-9,03
Irish 2y	---	---	---	---	-2,89	-2,89	-9,87	-9,87	---	---	---	---	-9,87
Irish 10y	---	---	---	---	-9,01	-9,01	---	---	5,4E+10	---	-8,60	-8,60	-9,01
Greek 2y	199,31	199,31	27,09	27,09	-7,52	-7,52	-7,03	-7,03	3,88	3,89	-6,79	-6,79	-7,52
Greek 10y	-8,38	-8,38	-8,32	-8,32	-8,33	-8,33	-8,35	-8,35	-8,29	-8,29	-8,33	-8,33	-8,38

Table 18 – Sample: Output of the AIC regarding the DCC-GARCH model specifications. The specification in which the AIC is minimised and better fits the model is in green.

DCC spec	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	Min
GARCH spec	EGARCH						GJR-GARCH						
Distribution	Normal		Student's T		GED		Normal		Student's T		GED		
IC	BIC												
EuroStoxx600	-12,95	-12,95	-12,94	-12,94	-12,94	-12,95	-12,94	-12,94	-12,93	-12,94	-12,93	-12,94	-12,95
EuroStoxx Banks	-12,09	-12,09	-12,09	-12,09	-12,09	-12,09	-12,08	-12,08	-12,08	-12,08	-12,08	-12,08	-12,09
DAX30	-12,51	-12,51	-12,50	-12,51	-12,51	-12,51	-12,50	-12,51	-12,50	-12,50	-12,50	-12,50	-12,51
CAC40	-12,59	-12,59	-12,58	-12,58	-12,58	-12,58	-12,57	-12,57	-12,57	-12,57	-12,57	-12,57	-12,59
FTSEMIB	-12,44	-12,44	-12,44	-12,44	-12,44	-12,44	-12,43	-12,43	-12,42	-12,43	-12,43	-12,43	-12,44
IBEX35	-12,51	-12,51	-12,51	-12,51	-12,51	-12,51	-12,50	-12,50	-12,50	-12,50	-12,50	-12,50	-12,51
PSI20	-12,90	-12,90	-12,89	-12,90	-12,89	-12,90	-12,89	-12,89	-12,88	-12,88	-12,88	-12,88	-12,90
ISEQ	-12,69	-12,69	-12,69	-12,69	-12,69	-12,69	-12,68	-12,69	-12,68	-12,68	-12,68	-12,68	-12,69
ASE	-11,65	-11,65	-11,88	-11,88	-11,91	-11,91	-11,94	-11,94	-11,90	-11,90	-11,92	-11,92	-11,94
German 2y	-10,69	-10,70	-10,69	-10,69	-10,69	-10,69	-10,68	-10,68	-10,67	-10,67	-10,68	-10,68	-10,70
German 10y	-10,15	-10,16	-10,15	-10,15	-10,15	-10,15	-10,15	-10,15	-10,15	-10,15	-10,15	-10,15	-10,16
French 2y	-10,58	-10,58	-10,57	-10,57	-10,57	-10,58	-10,56	-10,56	-10,55	-10,55	-10,55	-10,55	-10,58
French 10y	-10,13	-10,13	-10,13	-10,13	-10,13	-10,13	-10,13	-10,13	-10,12	-10,13	-10,12	-10,13	-10,13
Italian 2y	-9,70	-9,70	-9,69	-9,69	-9,69	-9,69	-9,67	-9,68	-9,67	-9,67	-9,67	-9,67	-9,70
Italian 10y	-9,65	-9,65	-9,64	-9,64	-9,64	-9,64	-9,65	-9,65	-9,64	-9,64	-9,64	-9,64	-9,65
Spanish 2y	-9,92	-9,92	-9,91	-9,91	-9,90	-9,91	-9,88	-9,88	-9,87	-9,87	-9,87	-9,87	-9,92
Spanish 10y	-9,75	-9,75	-9,74	-9,74	-9,74	-9,74	-9,74	-9,75	-9,74	-9,74	-9,74	-9,74	-9,75
Portuguese 2y	-9,00	-9,01	-8,98	-8,98	-8,96	-8,97	-8,95	-8,95	-8,91	-8,91	-8,92	-8,92	-9,01
Portuguese 10y	-8,85	-8,85	-6,60	-6,60	-8,53	-8,53	-9,01	---	---	---	-8,33	-8,33	-9,01
Irish 2y	---	---	---	---	-2,87	-2,87	-9,85	-9,85	---	---	---	---	-9,85
Irish 10y	---	---	---	---	-8,99	-8,99	---	---	5,4E+10	---	-8,58	-8,58	-8,99
Greek 2y	199,37	199,37	27,16	27,15	-7,46	-7,46	-6,97	-6,97	3,95	3,95	-6,72	-6,73	-7,46
Greek 10y	-8,36	-8,36	-8,30	-8,30	-8,31	-8,31	-8,33	-8,33	-8,27	-8,27	-8,30	-8,31	-8,36

Table 19 – Sample: Output of the BIC regarding the DCC-GARCH model specifications. The specification in which the BIC is minimised and better fits the model is in green.

DCC spec	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	Min
GARCH spec	EGARCH						GJR-GARCH						
Distribution	Normal		Student's T		GED		Normal		Student's T		GED		
IC	AIC												
EuroStoxx600	-12,49	-12,49	-12,47	-12,48	-12,48	-12,48	-12,48	-12,48	-12,47	-12,47	-12,47	-12,47	-12,49
EuroStoxx Banks	-12,37	-12,38	-12,36	-12,36	-12,36	-12,37	-12,36	-12,36	-12,35	-12,35	-12,35	-12,35	-12,38
DAX30	-11,98	-11,97	-11,97	-11,96	-11,97	-11,96	-11,97	-11,97	-11,96	-11,95	-11,97	-11,96	-11,98
CAC40	-12,09	-12,10	-12,08	-12,08	-12,08	-12,09	-12,09	-12,09	-12,07	-12,07	-12,08	-12,08	-12,10
FTSEMIB	-12,18	-12,18	-12,17	-12,17	-12,17	-12,17	-12,17	-12,18	---	---	-12,17	-12,17	-12,18
IBEX35	-12,01	-12,01	-12,00	-12,00	-12,00	-12,00	-11,99	-12,00	---	---	-11,99	-11,99	-12,01
PSI20	-12,51	-12,51	-12,49	-12,49	-12,50	-12,50	-12,49	-12,49	-12,48	-12,48	-12,48	-12,49	-12,51
ISEQ	-13,02	-13,03	-13,01	-13,01	-13,02	-13,02	-13,01	-13,01	-12,99	-12,99	-13,00	-13,00	-13,03
ASE	-11,46	-11,47	-11,45	-11,45	-11,45	-11,46	-11,46	-11,46	-11,44	-11,44	-11,45	-11,45	-11,47
German 2y	-9,76	-9,76	-9,74	-9,74	-9,75	-9,75	-9,74	-9,74	-9,73	-9,73	-9,73	-9,73	-9,76
German 10y	-10,02	-10,02	-10,00	-10,01	-10,01	-10,01	-9,93	-10,01	-9,99	-10,00	-10,00	-10,00	-10,02
French 2y	-9,80	-9,80	-9,78	-9,78	-9,79	-9,79	-9,78	-9,79	-9,77	-9,77	-9,77	-9,78	-9,80
French 10y	-9,91	-9,91	-9,89	-9,89	-9,90	-9,90	-9,89	-9,90	-9,88	-9,88	-9,89	-9,89	-9,91
Italian 2y	-9,74	-9,74	-9,72	-9,72	-9,73	-9,73	-9,73	-9,74	-9,72	-9,72	-9,72	-9,73	-9,74
Italian 10y	-10,01	-10,01	-10,00	-10,00	-10,00	-10,00	-10,00	-10,00	-9,99	-9,99	-9,99	-9,99	-10,01
Spanish 2y	-9,57	-9,57	-9,52	-9,52	-9,54	-9,54	-9,54	-9,54	-9,50	-9,50	-9,51	-9,51	-9,57
Spanish 10y	-9,97	-9,97	-9,96	-9,96	-9,96	-9,96	-9,96	-9,96	-9,95	-9,95	-9,95	-9,95	-9,97
Portuguese 2y	-9,36	-9,36	-9,34	-9,35	-9,35	-9,35	-9,34	-9,34	-9,33	-9,33	-9,33	-9,34	-9,36
Portuguese 10y	-9,94	-9,95	-9,93	-9,93	-9,94	-9,94	-9,94	-9,94	-9,92	-9,92	-9,93	-9,93	-9,95
Irish 2y	-9,67	-9,67	-9,64	-9,64	-9,65	-9,65	-9,64	-9,64	-9,62	-9,62	-9,63	-9,63	-9,67
Irish 10y	-9,81	-9,81	-9,79	-9,79	-9,80	-9,80	-9,79	-9,80	-9,78	-9,78	-9,79	-9,79	-9,81
Greek 2y	20,41	20,42	-3,02	-3,02	-4,39	-4,39	-5,41	-5,41	5,75	5,75	-0,83	-0,83	-5,41
Greek 10y	-9,40	-9,40	-9,36	-9,36	-9,38	-9,38	-9,34	-9,35	-9,31	-9,31	-9,31	-9,32	-9,40

Table 20 – Subsample 1: Output of the AIC regarding the DCC-GARCH model specifications. The specification in which the AIC is minimised and better fits the model is in green.

DCC spec	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	Min
GARCH spec	EGARCH						GJR-GARCH						
Distribution	Normal		Student's T		GED		Normal		Student's T		GED		
IC	BIC												
EuroStoxx600	-12,40	-12,41	-12,37	-12,38	-12,38	-12,39	-12,39	-12,40	-12,36	-12,37	-12,37	-12,38	-12,41
EuroStoxx Banks	-12,28	-12,29	-12,25	-12,26	-12,26	-12,27	-12,27	-12,28	-12,24	-12,25	-12,25	-12,26	-12,29
DAX30	-11,89	-11,89	-11,87	-11,87	-11,87	-11,87	-11,89	-11,89	-11,86	-11,86	-11,87	-11,87	-11,89
CAC40	-12,00	-12,01	-11,98	-11,99	-11,98	-11,99	-12,00	-12,00	-11,97	-11,98	-11,97	-11,98	-12,01
FTSEMIB	-12,09	-12,10	-12,06	-12,07	-12,07	-12,08	-12,08	-12,09	---	---	-12,06	-12,07	-12,10
IBEX35	-11,92	-11,93	-11,89	-11,90	-11,90	-11,90	-11,90	-11,91	---	---	-11,88	-11,89	-11,93
PSI20	-12,41	-12,42	-12,39	-12,40	-12,39	-12,40	-12,40	-12,41	-12,37	-12,38	-12,38	-12,39	-12,42
ISEQ	-12,97	-12,98	-12,95	-12,96	-12,96	-12,96	-12,95	-12,96	-12,93	-12,94	-12,94	-12,94	-12,98
ASE	-11,37	-11,38	-11,34	-11,35	-11,35	-11,36	-11,36	-11,37	-11,34	-11,35	-11,34	-11,35	-11,38
German 2y	-9,67	-9,68	-9,64	-9,65	-9,65	-9,66	-9,65	-9,66	-9,63	-9,64	-9,64	-9,64	-9,68
German 10y	-9,94	-9,95	-9,92	-9,92	-9,92	-9,93	-9,93	-9,94	-9,91	-9,91	-9,91	-9,92	-9,95
French 2y	-9,72	-9,72	-9,69	-9,69	-9,70	-9,70	-9,70	-9,71	-9,67	-9,68	-9,68	-9,69	-9,72
French 10y	-9,83	-9,83	-9,80	-9,81	-9,81	-9,82	-9,82	-9,82	-9,79	-9,80	-9,80	-9,81	-9,83
Italian 2y	-9,66	-9,67	-9,63	-9,63	-9,64	-9,64	-9,65	-9,66	-9,62	-9,63	-9,63	-9,64	-9,67
Italian 10y	-9,93	-9,94	-9,91	-9,92	-9,91	-9,92	-9,92	-9,93	-9,90	-9,91	-9,90	-9,91	-9,94
Spanish 2y	-9,48	-9,49	-9,42	-9,43	-9,44	-9,45	-9,45	-9,46	-9,40	-9,41	-9,42	-9,42	-9,49
Spanish 10y	-9,89	-9,90	-9,87	-9,88	-9,87	-9,88	-9,88	-9,89	-9,86	-9,87	-9,86	-9,87	-9,90
Portuguese 2y	-9,28	-9,29	-9,25	-9,26	-9,26	-9,26	-9,26	-9,27	-9,24	-9,24	-9,24	-9,25	-9,29
Portuguese 10y	-9,87	-9,87	-9,84	-9,85	-9,85	-9,85	-9,86	-9,86	-9,83	-9,84	-9,84	-9,85	-9,87
Irish 2y	-9,55	-9,56	-9,51	-9,52	-9,52	-9,53	-9,52	-9,53	-9,49	-9,50	-9,50	-9,51	-9,56
Irish 10y	-9,73	-9,73	-9,70	-9,71	-9,71	-9,72	-9,72	-9,72	-9,69	-9,70	-9,70	-9,70	-9,73
Greek 2y	20,50	20,51	-2,92	-2,92	-4,28	-4,29	-5,32	-5,32	5,85	5,85	-0,73	-0,74	-5,32
Greek 10y	-9,31	-9,32	-9,26	-9,27	-9,28	-9,29	-9,26	-9,27	-9,21	-9,22	-9,22	-9,23	-9,32

Table 21 – Subsample 1: Output of the BIC regarding the DCC-GARCH model specifications. The specification in which the BIC is minimised and better fits the model is in green.

DCC spec	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	Min
GARCH spec	EGARCH						GJR-GARCH						
Distribution	Normal		Student's T		GED		Normal		Student's T		GED		
IC	AIC												
EuroStoxx600	- 13,50	- 13,50	- 13,49	- 13,49	- 13,49	- 13,49	- 13,50	-13,51	-13,49	-13,49	- 13,50	- 13,50	- 13,51
EuroStoxx Banks	- 13,20	- 13,20	- 13,18	- 13,18	- 13,19	- 13,19	- 13,20	-13,21	-13,19	-13,19	- 13,20	- 13,20	- 13,21
DAX30	- 12,89	- 12,90	- 12,88	- 12,89	- 12,89	- 12,89	- 12,89	-12,89	---	---	- 12,89	- 12,89	- 12,90
CAC40	- 13,10	- 13,11	- 13,09	- 13,10	- 13,10	- 13,10	- 13,10	-13,10	-13,09	-13,09	- 13,09	- 13,10	- 13,11
FTSEMIB	- 13,47	- 13,47	- 13,45	- 13,46	- 13,46	- 13,46	- 13,47	-13,48	-13,46	-13,46	- 13,47	- 13,47	- 13,48
IBEX35	- 13,35	- 13,35	- 13,34	- 13,34	- 13,34	- 13,34	- 13,36	-13,36	-13,34	-13,35	- 13,35	- 13,35	- 13,36
PSI20	- 14,04	- 14,04	- 14,02	- 14,03	- 14,03	- 14,03	- 14,06	-14,06	-14,04	-14,04	- 14,05	- 14,05	- 14,06
ISEQ	- 12,67	- 12,67	- 12,66	- 12,66	- 12,66	- 12,67	- 12,66	-12,66	-12,65	-12,65	- 12,65	- 12,66	- 12,67
ASE	- 13,37	- 13,37	- 13,36	- 13,36	- 13,36	- 13,36	- 13,38	-13,38	-13,37	-13,37	- 13,38	- 13,38	- 13,38
German 2y	- 10,77	- 10,78	- 10,76	- 10,76	- 10,77	- 10,77	- 10,77	-10,77	-10,76	-10,76	- 10,76	- 10,77	- 10,78
German 10y	- 10,45	- 10,45	- 10,44	- 10,44	- 10,44	- 10,44	- 10,44	-10,44	-10,44	-10,44	- 10,44	- 10,44	- 10,45
French 2y	---	---	- 10,71	- 10,71	- 10,72	- 10,72	- 10,66	-10,66	-10,63	-10,64	- 10,64	- 10,65	- 10,72
French 10y	- 10,43	- 10,44	- 10,43	- 10,43	- 10,43	- 10,43	- 10,43	-10,43	-10,42	-10,42	- 10,42	- 10,42	- 10,44
Italian 2y	- 10,78	- 10,79	- 10,79	- 10,79	- 10,79	- 10,79	- 10,79	-10,80	-10,78	-10,78	- 10,78	- 10,79	- 10,80
Italian 10y	- 10,55	- 10,56	- 10,55	- 10,55	- 10,55	- 10,55	- 10,55	-10,55	-10,54	-10,54	- 10,54	- 10,54	- 10,56
Spanish 2y	- 10,82	- 10,83	- 10,81	- 10,82	- 10,82	- 10,82	- 10,82	-10,82	-10,81	-10,81	- 10,81	- 10,81	- 10,83
Spanish 10y	- 10,56	- 10,56	- 10,55	- 10,56	- 10,55	- 10,56	- 10,55	-10,56	-10,55	-10,55	- 10,55	- 10,55	- 10,56
Portuguese 2y	- 10,52	- 10,53	- 10,47	- 10,48	- 10,50	- 10,50	- 10,52	-10,53	-10,47	-10,47	- 10,50	- 10,50	- 10,53
Portuguese 10y	6,07	6,07	---	---	-9,06	-9,07	---	---	---	---	19,40	19,40	-9,07
Irish 2y	---	---	---	---	22,95	22,95	---	---	7,3E+05	7,3E+05	-5,20	-5,20	-5,20
Irish 10y	---	---	---	---	27,54	27,54	---	---	---	---	10,70	10,70	10,70
Greek 2y	- 11,33	- 11,33	- 11,30	- 11,30	- 11,30	- 11,31	- 11,31	-11,31	-11,28	-11,28	- 11,29	- 11,29	- 11,33
Greek 10y	- 10,50	- 10,50	- 10,49	- 10,49	- 10,49	- 10,49	- 10,50	-10,50	-10,49	-10,49	- 10,49	- 10,49	- 10,50

Table 22 – Subsample 2: Output of the AIC regarding the DCC-GARCH model specifications. The specification in which the AIC is minimised and better fits the model is in green.

DCC spec	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	Min
GARCH spec	EGARCH						GJR-GARCH						
Distribution	Normal		Student's T		GED		Normal		Student's T		GED		
IC	BIC												
EuroStoxx600	-13,40	-13,41	-13,38	-13,39	-13,38	-13,39	-13,41	-13,42	-13,39	-13,40	-13,39	-13,40	-13,42
EuroStoxx Banks	-13,10	-13,11	-13,08	-13,09	-13,08	-13,09	-13,11	-13,12	-13,09	-13,10	-13,09	-13,10	-13,12
DAX30	-12,80	-12,81	-12,78	-12,79	-12,78	-12,79	-12,80	-12,81	---	---	-12,78	-12,79	-12,81
CAC40	-13,01	-13,02	-12,99	-13,00	-12,99	-13,00	-13,01	-13,02	-12,99	-12,99	-12,99	-13,00	-13,02
FTSEMIB	-13,38	-13,39	-13,35	-13,36	-13,36	-13,36	-13,38	-13,39	-13,36	-13,36	-13,36	-13,37	-13,39
IBEX35	-13,26	-13,26	-13,23	-13,24	-13,24	-13,24	-13,27	-13,27	-13,24	-13,25	-13,25	-13,26	-13,27
PSI20	-13,95	-13,96	-13,92	-13,93	-13,93	-13,94	-13,97	-13,97	-13,94	-13,95	-13,95	-13,95	-13,97
ISEQ	-12,58	-12,58	-12,56	-12,57	-12,56	-12,57	-12,57	-12,58	-12,55	-12,56	-12,55	-12,56	-12,58
ASE	-13,28	-13,29	-13,26	-13,26	-13,26	-13,27	-13,29	-13,30	-13,27	-13,28	-13,27	-13,28	-13,30
German 2y	-10,68	-10,69	-10,65	-10,66	-10,66	-10,67	-10,68	-10,69	-10,65	-10,66	-10,66	-10,67	-10,69
German 10y	-10,39	-10,39	-10,38	-10,38	-10,38	-10,38	-10,38	-10,39	-10,37	-10,37	-10,37	-10,38	-10,39
French 2y	---	---	-10,61	-10,61	-10,62	-10,63	-10,57	-10,58	-10,53	-10,54	-10,54	-10,55	-10,63
French 10y	-10,37	-10,38	-10,36	-10,37	-10,36	-10,37	-10,37	-10,37	-10,36	-10,36	-10,36	-10,36	-10,38
Italian 2y	-10,69	-10,70	-10,68	-10,69	-10,69	-10,70	-10,70	-10,71	-10,67	-10,68	-10,68	-10,69	-10,71
Italian 10y	-10,48	-10,48	-10,46	-10,47	-10,46	-10,47	-10,47	-10,48	-10,45	-10,46	-10,46	-10,46	-10,48
Spanish 2y	-10,73	-10,74	-10,71	-10,72	-10,71	-10,72	-10,73	-10,73	-10,70	-10,71	-10,71	-10,71	-10,74
Spanish 10y	-10,48	-10,49	-10,47	-10,47	-10,47	-10,48	-10,48	-10,48	-10,46	-10,47	-10,46	-10,47	-10,49
Portuguese 2y	-10,43	-10,44	-10,37	-10,38	-10,40	-10,41	-10,43	-10,44	-10,36	-10,37	-10,40	-10,41	-10,44
Portuguese 10y	6,14	6,14	---	---	-8,98	-8,99	---	---	---	---	19,49	19,48	-8,99
Irish 2y	---	---	---	---	23,04	23,03	---	---	7,3E+05	7,3E+05	-5,11	-5,12	-5,12
Irish 10y	---	---	---	---	27,64	27,63	---	---	---	---	10,79	10,79	10,79
Greek 2y	-11,22	-11,23	-11,18	-11,19	-11,18	-11,19	-11,20	-11,21	-11,16	-11,17	-11,16	-11,17	-11,23
Greek 10y	-10,43	-10,44	-10,41	-10,42	-10,42	-10,42	-10,43	-10,43	-10,41	-10,42	-10,41	-10,42	-10,44

Table 23 – Subsample 2: Output of the BIC regarding the DCC-GARCH model specifications. The specification in which the BIC is minimised and better fits the model is in green.

DCC spec	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	
GARCH spec	EGARCH						GJR-GARCH						Min
Distribution	Normal		Student's T		GED		Normal		Student's T		GED		
IC	AIC												
EuroStoxx600	-12,89	-12,89	-12,88	-12,88	-12,88	-12,88	-12,86	-12,86	-12,85	-12,85	-12,85	-12,85	-12,89
EuroStoxx Banks	-12,45	-12,45	-12,44	-12,44	-12,44	-12,45	-12,44	-12,45	-12,44	-12,44	-12,44	-12,44	-12,45
DAX30	-11,93	-11,93	-11,92	-11,92	-11,92	-11,92	-11,92	-11,93	-11,92	-11,92	-11,92	-11,92	-11,93
CAC40	-11,62	-12,62	-12,61	-12,62	-12,61	-12,62	-12,60	-12,60	-12,59	-12,59	-12,59	-12,59	-12,62
FTSEMIB	-12,91	-12,91	-12,90	-12,90	-12,90	-12,90	-12,88	-12,89	-12,88	-12,88	-12,88	-12,88	-12,91
IBEX35	-12,68	-12,68	-12,67	-12,67	-12,67	-12,67	-12,67	-12,67	-12,66	-12,66	-12,66	-12,66	-12,68
PSI20	-13,03	-13,03	-13,01	-13,02	-13,02	-13,02	-13,02	-13,02	-13,01	-13,01	-13,01	-13,02	-13,03
ISEQ	-11,06	-11,06	-11,05	-11,05	-11,05	-11,05	-11,04	-11,04	-11,03	-11,04	-11,04	-11,04	-11,06
ASE	-12,45	-12,45	-12,44	-12,44	-12,44	-12,44	-12,45	-12,46	-12,45	-12,45	-12,45	-12,45	-12,46
German 2y	-9,38	-9,38	-9,37	-9,37	-9,37	-9,37	-9,37	-9,37	-9,36	-9,36	-9,36	-9,37	-9,38
German 10y	-9,00	-9,00	-8,99	-8,99	-8,99	-8,99	-8,99	-8,99	-8,98	-8,98	-8,98	-8,98	-9,00
French 2y	-9,43	-9,43	-9,42	-9,43	-9,43	-9,43	-9,43	-9,43	-9,42	-9,42	-9,42	-9,42	-9,43
French 10y	-9,24	-9,25	-9,23	-9,24	-9,24	-9,24	-9,24	-9,24	-9,23	-9,23	-9,23	-9,23	-9,25
Italian 2y	-9,45	-9,45	-9,44	-9,44	-9,44	-9,45	-9,45	-9,45	-9,44	-9,44	-9,44	-9,44	-9,45
Italian 10y	-9,53	-9,53	-9,51	-9,52	-9,52	-9,52	-9,53	-9,53	-9,52	-9,52	-9,52	-9,52	-9,53
Spanish 2y	-9,50	-9,50	-9,49	-9,49	-9,50	-9,50	-9,49	-9,49	-9,48	-9,48	-9,49	-9,49	-9,50
Spanish 10y	-9,29	-9,29	-9,27	-9,28	-9,28	-9,29	-9,29	-9,29	-9,28	-9,28	-9,28	-9,29	-9,29
Portuguese 2y	-8,74	-8,74	-8,71	-8,71	-8,72	-8,72	-8,71	-8,71	-8,69	-8,69	-8,69	-8,69	-8,74
Portuguese 10y	-8,91	-8,91	-8,89	-8,89	-8,90	-8,90	-8,94	-8,94	-8,92	-8,92	-8,93	-8,93	-8,94
Irish 2y	-6,04	-6,04	-5,88	-5,89	-5,99	-6,00	---	---	-6,02	-6,02	-6,04	-6,05	-6,05
Irish 10y	-9,19	-9,19	-9,18	-9,18	-9,18	-9,18	-9,19	-9,19	-9,17	-9,18	-9,18	-9,18	-9,19
Greek 10y	-8,40	-8,40	-8,38	-8,39	-8,39	-8,39	-8,40	-8,40	-8,39	-8,39	-8,39	-8,39	-8,40

Table 24 – Subsample 3: Output of the AIC regarding the DCC-GARCH model specifications. The specification in which the AIC is minimised and better fits the model is in green.

DCC spec	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	Min
GARCH spec	EGARCH						GJR-GARCH						
Distribution	Normal		Student's T		GED		Normal		Student's T		GED		
IC	BIC												
EuroStoxx600	-12,80	-12,80	-12,78	-12,78	-12,78	-12,79	-12,77	-12,77	-12,75	-12,75	-12,75	-12,75	-12,80
EuroStoxx Banks	-12,36	-12,37	-12,34	-12,35	-12,34	-12,35	-12,35	-12,36	-12,33	-12,34	-12,33	-12,34	-12,37
DAX30	-11,86	-11,87	-11,85	-11,85	-11,85	-11,85	-11,86	-11,86	-11,84	-11,85	-11,84	-11,85	-11,87
CAC40	-11,53	-12,54	-12,51	-12,52	-12,51	-12,52	-12,50	-12,51	-12,48	-12,49	-12,49	-12,49	-12,54
FTSEMIB	-12,81	-12,82	-12,79	-12,80	-12,79	-12,80	-12,79	-12,80	-12,77	-12,78	-12,77	-12,78	-12,82
IBEX35	-12,59	-12,59	-12,56	-12,57	-12,56	-12,57	-12,58	-12,58	-12,55	-12,56	-12,56	-12,56	-12,59
PSI20	-12,93	-12,94	-12,91	-12,92	-12,91	-12,92	-12,93	-12,94	-12,91	-12,91	-12,91	-12,92	-12,94
ISEQ	-10,97	-10,98	-10,95	-10,96	-10,95	-10,96	-10,95	-10,96	-10,94	-10,94	-10,94	-10,95	-10,98
ASE	-12,36	-12,37	-12,34	-12,35	-12,34	-12,35	-12,36	-12,37	-12,34	-12,35	-12,34	-12,35	-12,37
German 2y	-9,29	-9,29	-9,27	-9,27	-9,27	-9,28	-9,28	-9,29	-9,26	-9,26	-9,26	-9,27	-9,29
German 10y	-8,90	-8,91	-8,88	-8,89	-8,88	-8,89	-8,90	-8,90	-8,88	-8,88	-8,88	-8,89	-8,91
French 2y	-9,34	-9,35	-9,32	-9,33	-9,32	-9,33	-9,33	-9,34	-9,31	-9,32	-9,32	-9,32	-9,35
French 10y	-9,15	-9,16	-9,13	-9,14	-9,13	-9,14	-9,15	-9,15	-9,13	-9,13	-9,13	-9,13	-9,16
Italian 2y	-9,36	-9,37	-9,34	-9,35	-9,34	-9,35	-9,35	-9,36	-9,33	-9,34	-9,36	-9,34	-9,37
Italian 10y	-9,45	-9,45	-9,43	-9,43	-9,43	-9,44	-9,45	-9,46	-9,43	-9,44	-9,43	-9,44	-9,46
Spanish 2y	-9,41	-9,42	-9,39	-9,40	-9,39	-9,40	-9,40	-9,41	-9,38	-9,39	-9,38	-9,39	-9,42
Spanish 10y	-9,21	-9,22	-9,18	-9,19	-9,19	-9,20	-9,21	-9,21	-9,19	-9,19	-9,19	-9,20	-9,22
Portuguese 2y	-8,67	-8,68	-8,63	-8,64	-8,64	-8,65	-8,64	-8,65	-8,61	-8,62	-8,62	-8,62	-8,68
Portuguese 10y	-8,83	-8,83	-8,79	-8,80	-8,80	-8,81	-8,85	-8,86	-8,82	-8,83	-8,83	-8,84	-8,86
Irish 2y	-5,93	-5,94	-5,76	-5,77	-5,87	-5,88	---	---	-5,89	-5,90	-5,92	-5,93	-5,94
Irish 10y	-9,09	-9,10	-9,07	-9,08	-9,08	-9,08	-9,09	-9,10	-9,07	-9,08	-9,08	-9,08	-9,10
Greek 10y	-8,30	-8,31	-8,28	-8,29	-8,28	-8,29	-8,30	-8,31	-8,28	-8,29	-8,28	-8,29	-8,31

Table 25 – Subsample 3: Output of the BIC regarding the DCC-GARCH model specifications. The specification in which the BIC is minimised and better fits the model is in green.

DCC spec	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	
GARCH spec	EGARCH						GJR-GARCH						
Distribution	Normal		Student's T		GED		Normal		Student's T		GED		Min
IC	AIC												
EuroStoxx600	-12,08	-12,08	-12,07	-12,07	-12,07	-12,08	-12,08	-12,08	-12,07	-12,07	-12,07	-12,07	-12,08
EuroStoxx Banks	-10,48	-10,48	-10,47	-10,47	-10,47	-10,47	-10,47	-10,47	-10,46	-10,46	-10,46	-10,46	-10,48
DAX30	-12,31	-12,31	-12,29	-12,29	-12,30	-12,30	-12,28	-12,29	-12,26	-12,27	-12,27	-12,28	-12,31
CAC40	-11,63	-11,64	-11,63	-11,63	-11,63	-11,63	-11,62	-11,62	-11,61	-11,61	-11,61	-11,61	-11,64
FTSEMIB	-11,13	-11,13	-11,12	-11,12	-11,13	-11,13	-11,11	-11,11	-11,10	-11,10	-11,11	-11,11	-11,13
IBEX35	-11,22	-11,23	-11,21	-11,22	-11,22	-11,22	-11,20	-11,21	-11,19	-11,20	-11,20	-11,20	-11,23
PSI20	-11,72	-11,73	-11,71	-11,71	-11,72	-11,72	-11,71	-11,71	-11,70	-11,70	-11,70	-11,71	-11,73
ISEQ	-12,85	-12,85	-12,84	-12,84	-12,84	-12,84	-12,84	-12,85	-12,83	-12,83	-12,84	-12,84	-12,85
ASE	-10,62	-10,62	-10,61	-10,61	-10,61	-10,61	-10,61	-10,61	-10,60	-10,60	-10,60	-10,60	-10,62
German 2y	-9,35	-9,35	-9,34	-9,34	-9,34	-9,34	-9,34	-9,34	-9,33	-9,33	-9,33	-9,33	-9,35
German 10y	-9,89	-9,90	-9,88	-9,88	-9,89	-9,89	-9,88	-9,89	-9,87	-9,87	-9,88	-9,88	-9,90
French 2y	-9,14	-9,15	-9,12	-9,13	-9,13	-9,14	-9,13	-9,13	-9,11	-9,12	-9,12	-9,12	-9,15
French 10y	-9,80	-9,80	-9,78	-9,78	-9,79	-9,79	-9,79	-9,79	-9,77	-9,78	-9,78	-9,78	-9,80
Italian 2y	-8,13	-8,13	-8,11	-8,11	-8,11	-8,12	-8,10	-8,10	-8,07	-8,08	-8,08	-8,08	-8,13
Italian 10y	-8,33	-8,33	-8,32	-8,32	-8,32	-8,32	-8,32	-8,32	-8,31	-8,31	-8,31	-8,32	-8,33
Spanish 2y	-7,93	-7,94	-7,89	-7,90	-7,91	-7,91	-7,94	-7,94	-7,91	-7,91	-7,92	-7,92	-7,94
Spanish 10y	-8,11	-8,11	-8,09	-8,09	-8,10	-8,10	-8,09	-8,09	-8,06	-8,06	-8,07	-8,07	-8,11
Portuguese 2y	-5,54	-5,54	-4,92	-4,92	-5,40	-5,40	-5,43	-5,44	-5,25	-5,26	-5,26	-5,26	-5,54
Portuguese 10y	-6,70	-6,70	-6,61	-6,61	-6,65	-6,65	-6,65	-6,65	-6,58	-6,59	-6,60	-6,61	-6,70
Irish 2y	-11,04	-11,04	-11,14	-11,14	-10,62	-10,62	-10,25	-10,26	-10,37	-10,38	-10,31	-10,32	-11,14
Irish 10y	-7,51	-7,51	-6,62	-6,61	-7,49	-7,49	-7,52	-7,52	-7,49	-7,49	-7,49	-7,50	-7,52
Greek 10y	-4,76	-4,76	-4,19	-4,20	-4,62	-4,62	-4,73	-4,73	-4,47	-4,47	-4,64	-4,64	-4,76

Table 26 – Subsample 4: Output of the AIC regarding the DCC-GARCH model specifications. The specification in which the AIC is minimised and better fits the model is in green.

DCC spec	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	
GARCH spec	EGARCH						GJR-GARCH						
Distribution	Normal		Student's T		GED		Normal		Student's T		GED		Min
IC	BIC												
EuroStoxx600	-12,01	-12,02	-12,00	-12,00	-12,00	-12,01	-12,01	-12,02	-11,99	-12,00	-12,00	-12,00	-12,02
EuroStoxx Banks	-10,38	-10,39	-10,36	-10,37	-10,37	-10,38	-10,37	-10,38	-10,35	-10,36	-10,36	-10,36	-10,39
DAX30	-12,21	-12,22	-12,18	-12,19	-12,19	-12,20	-12,19	-12,20	-12,16	-12,17	-12,17	-12,18	-12,22
CAC40	-11,57	-11,57	-11,55	-11,56	-11,55	-11,56	-11,55	-11,56	-11,54	-11,54	-11,54	-11,54	-11,57
FTSEMIB	-11,04	-11,05	-11,02	-11,03	-11,02	-11,03	-11,02	-11,03	-11,00	-11,01	-11,00	-11,01	-11,05
IBEX35	-11,13	-11,14	-11,11	-11,12	-11,11	-11,12	-11,11	-11,12	-11,09	-11,10	-11,09	-11,10	-11,14
PSI20	-11,63	-11,64	-11,61	-11,62	-11,61	-11,62	-11,62	-11,63	-11,60	-11,60	-11,60	-11,61	-11,64
ISEQ	-12,75	-12,76	-12,73	-12,74	-12,73	-12,74	-12,75	-12,76	-12,73	-12,74	-12,73	-12,74	-12,76
ASE	-10,53	-10,53	-10,50	-10,51	-10,51	-10,52	-10,52	-10,53	-10,49	-10,50	-10,50	-10,51	-10,53
German 2y	-9,25	-9,26	-9,23	-9,24	-9,24	-9,24	-9,24	-9,25	-9,22	-9,23	-9,23	-9,23	-9,26
German 10y	-9,80	-9,81	-9,78	-9,78	-9,78	-9,79	-9,79	-9,80	-9,77	-9,77	-9,77	-9,78	-9,81
French 2y	-9,05	-9,06	-9,02	-9,03	-9,03	-9,04	-9,04	-9,05	-9,01	-9,02	-9,02	-9,02	-9,06
French 10y	-9,70	-9,71	-9,68	-9,69	-9,68	-9,69	-9,70	-9,70	-9,67	-9,68	-9,67	-9,68	-9,71
Italian 2y	-8,06	-8,07	-8,04	-8,04	-8,04	-8,04	-8,03	-8,03	-8,00	-8,00	-8,00	-8,01	-8,07
Italian 10y	-8,24	-8,25	-8,21	-8,22	-8,22	-8,23	-8,23	-8,24	-8,20	-8,21	-8,21	-8,22	-8,25
Spanish 2y	-7,87	-7,87	-7,82	-7,82	-7,83	-7,84	-7,87	-7,88	-7,83	-7,84	-7,84	-7,85	-7,88
Spanish 10y	-8,02	-8,02	-7,99	-7,99	-7,99	-8,00	-8,00	-8,00	-7,95	-7,96	-7,97	-7,97	-8,02
Portuguese 2y	-5,45	-5,45	-4,81	-4,82	-5,29	-5,30	-5,34	-5,35	-5,15	-5,16	-5,16	-5,17	-5,45
Portuguese 10y	-6,61	-6,62	-6,50	-6,51	-6,55	-6,55	-6,56	-6,56	-6,48	-6,49	-6,50	-6,51	-6,62
Irish 2y	-10,93	-10,93	-11,01	-11,02	-10,49	-10,50	-10,14	-10,15	-10,25	-10,26	-10,19	-10,20	-11,02
Irish 10y	-7,42	-7,42	-6,52	-6,51	-7,38	-7,39	-7,42	-7,43	-7,39	-7,39	-7,39	-7,40	-7,43
Greek 10y	-4,67	-4,68	-4,09	-4,10	-4,52	-4,53	-4,64	-4,65	-4,37	-4,38	-4,54	-4,54	-4,68

Table 27 – Subsample 4: Output of the BIC regarding the DCC-GARCH model specifications. The specification in which the BIC is minimised and better fits the model is in green.

DCC spec	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	Min
GARCH spec	EGARCH						GJR-GARCH						
Distribution	Normal		Student's T		GED		Normal		Student's T		GED		
IC	AIC												
EuroStoxx600	-13,04	-13,04	-13,02	-13,03	-13,03	-13,03	-13,02	-13,02	-13,02	-13,00	-13,01	-13,01	-13,04
EuroStoxx Banks	-11,63	-11,63	-11,62	-11,62	-11,63	-11,63	-11,63	-11,63	-11,61	-11,61	-11,62	-11,62	-11,63
DAX30	-12,57	-12,58	-12,56	-12,56	-12,56	-12,57	-12,56	-12,56	-12,54	-12,54	-12,55	-12,55	-12,58
CAC40	-12,77	-12,78	-12,76	-12,76	-12,77	-12,77	-12,74	-12,75	-12,73	-12,73	-12,74	-12,74	-12,78
FTSEMIB	-11,94	-11,95	-11,93	-11,94	-11,93	-11,94	-11,93	-11,93	-11,91	-11,91	-11,92	-11,92	-11,95
IBEX35	-12,25	-12,25	-12,24	-12,25	-12,24	-12,25	-12,22	-12,23	-12,21	-12,21	-12,22	-12,22	-12,25
PSI20	-12,39	-12,39	-12,38	-12,38	-12,39	-12,39	-12,38	-12,38	-12,36	-12,36	-12,37	-12,38	-12,39
ISEQ	-13,39	-13,39	-13,39	-13,39	-13,39	-13,39	-13,38	-13,38	-13,37	-13,37	-13,37	-13,37	-13,39
ASE	-11,22	-11,22	-11,21	-11,21	-11,21	-11,22	-11,21	-11,22	-11,20	-11,20	-11,21	-11,21	-11,22
German 2y	-11,90	-11,90	-11,89	-11,89	-11,90	-11,89	-11,88	-11,88	-11,86	-11,85	-11,88	-11,88	-11,90
German 10y	-10,91	-10,91	-10,89	-10,90	-10,90	-10,90	-10,91	-10,91	-10,90	-10,90	-10,90	-10,90	-10,91
French 2y	-11,41	-11,41	-11,40	-11,40	-11,40	-11,40	-11,38	-11,38	-11,36	-11,36	-11,36	-11,37	-11,41
French 10y	-10,81	-10,81	-10,80	-10,80	-10,80	-10,80	-10,82	-10,82	-11,80	-10,80	-10,81	-10,81	-11,80
Italian 2y	-10,65	-10,65	-10,64	-10,64	-10,64	-10,64	-10,62	-10,62	-10,60	-10,60	-10,60	-10,60	-10,65
Italian 10y	-9,75	-9,75	-9,74	-9,74	-9,74	-9,74	-9,75	-9,75	-9,74	-9,74	-9,74	-9,74	-9,75
Spanish 2y	-10,71	-10,71	-10,60	-10,60	-10,61	-10,62	-10,69	-10,69	-10,60	-10,60	-10,61	-10,61	-10,71
Spanish 10y	-9,63	-9,64	-9,61	-9,62	-9,62	-9,62	-9,63	-9,63	-9,60	-9,61	-9,61	-9,62	-9,64
Portuguese 2y	-9,55	-9,55	-9,51	-9,51	-9,51	-9,51	-9,58	-9,58	-9,54	-9,55	-9,55	-9,55	-9,58
Portuguese 10y	-8,91	-8,91	-8,89	-8,89	-8,90	-8,89	-8,91	-8,90	-8,88	-8,87	-8,89	-8,88	-8,91
Irish 2y	---	---	---	---	109,61	109,61	---	---	---	---	16,08	16,08	16,08
Irish 10y	-9,70	-9,71	-9,67	-9,67	-9,69	-9,69	-9,71	-9,71	-9,63	-9,64	-9,69	-9,69	-9,71
Greek 10y	-6,87	-6,87	-6,43	-6,43	-6,18	-6,18	-6,87	-6,87	-6,84	-6,84	-6,82	-6,82	-6,87

Table 28 – Subsample 5: Output of the AIC regarding the DCC-GARCH model specifications. The specification in which the AIC is minimised and better fits the model is in green.

DCC spec	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	Min
GARCH spec	EGARCH						GJR-GARCH						
Distribution	Normal		Student's T		GED		Normal		Student's T		GED		
IC	BIC												
EuroStoxx600	-12,95	-12,96	-12,93	-12,93	-12,93	-12,94	-12,93	-12,94	-12,90	-12,91	-12,91	-12,92	-12,96
EuroStoxx Banks	-11,56	-11,57	-11,54	-11,54	-11,54	-11,55	-11,55	-11,56	-11,52	-11,53	-11,54	-11,54	-11,57
DAX30	-14,48	-12,49	-12,45	-12,46	-12,46	-12,47	-12,46	-12,47	-12,43	-12,44	-12,44	-12,45	-14,48
CAC40	-12,69	-12,70	-12,66	-12,67	-12,67	-12,68	-12,66	-12,67	-12,63	-12,64	-12,64	-12,65	-12,70
FTSEMIB	-11,85	-11,86	-11,83	-11,84	-11,83	-11,84	-11,83	-11,85	-11,81	-11,82	-11,81	-11,82	-11,86
IBEX35	-12,16	-12,16	-12,14	-12,15	-12,14	-12,15	-12,13	-12,14	-12,11	-12,12	-12,11	-12,12	-12,16
PSI20	-12,31	-12,32	-12,29	-12,30	-12,29	-12,30	-12,30	-12,31	-12,27	-12,27	-12,28	-12,29	-12,32
ISEQ	-13,33	-13,33	-13,32	-13,32	-13,32	-13,32	-13,31	-13,32	-13,30	-13,30	-13,30	-13,31	-13,33
ASE	-11,13	-11,14	-11,11	-11,12	-11,11	-11,12	-11,12	-11,13	-11,10	-11,11	-11,10	-11,11	-11,14
German 2y	-11,82	-11,82	-11,80	-11,80	-11,80	-11,80	-11,80	-11,80	-11,76	-11,77	-11,78	-11,79	-11,82
German 10y	-10,85	-10,86	-10,83	-10,83	-10,83	-10,84	-10,85	-10,86	-10,83	-10,83	-10,83	-10,84	-10,86
French 2y	-11,32	-11,33	-11,30	-11,30	-11,30	-11,30	-11,29	-11,30	-11,25	-11,26	-11,26	-11,27	-11,33
French 10y	-10,75	-10,76	-10,73	-10,73	-10,74	-10,74	-10,76	-10,76	-10,73	-10,74	-10,74	-10,74	-10,76
Italian 2y	-10,60	-10,61	-10,58	-10,58	-10,58	-10,58	-10,56	-10,57	-10,54	-10,54	-10,54	-10,54	-10,61
Italian 10y	-9,69	-9,70	-9,68	-9,68	-9,68	-9,68	-9,69	-9,70	-9,68	-9,68	-9,68	-9,68	-9,70
Spanish 2y	-10,61	-10,62	-10,49	-10,50	-10,51	-10,52	-10,60	-10,61	-10,50	-10,51	-10,51	-10,51	-10,62
Spanish 10y	-9,54	-9,55	-9,51	-9,52	-9,52	-9,53	-9,54	-9,55	-9,50	-9,51	-9,51	-9,52	-9,55
Portuguese 2y	-9,46	-9,47	-9,40	-9,41	-9,41	-9,42	-9,49	-9,50	-9,44	-9,45	-9,44	-9,45	-9,50
Portuguese 10y	-8,82	-8,82	-8,79	-8,79	-8,79	-8,79	-8,82	-8,82	-8,77	-8,78	-8,78	-8,79	-8,82
Irish 2y	---	---	---	---	109,68	109,67	---	---	---	---	16,15	16,15	16,15
Irish 10y	-9,61	-9,62	-9,56	-9,57	-9,58	-9,59	-9,62	-9,62	-9,53	-9,54	-9,59	-9,60	-9,62
Greek 10y	-6,79	-6,79	-6,33	-6,34	-6,08	-6,09	-6,79	-6,79	-6,75	-6,75	-6,72	-6,73	-6,79

Table 29 – Subsample 5: Output of the BIC regarding the DCC-GARCH model specifications. The specification in which the BIC is minimised and better fits the model is in green.

DCC spec	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	Min
GARCH spec	EGARCH						GJR-GARCH						
Distribution	Normal		Student's T		GED		Normal		Student's T		GED		
IC	AIC												
EuroStoxx600	-14,31	-14,31	-14,30	-14,30	-14,30	-14,31	-14,33	-14,33	-14,32	-14,33	-14,33	-14,33	-14,33
EuroStoxx Banks	-12,64	-12,64	-12,62	-12,63	-12,63	-12,63	-12,62	-12,62	-12,61	-12,61	-12,62	-12,62	-12,64
DAX30	-13,87	-13,88	-13,86	-13,86	-13,87	-13,87	-13,88	-13,88	-13,87	-13,87	-13,88	-13,88	-13,88
CAC40	-14,01	-14,01	-14,00	-14,00	-14,00	-14,00	-14,01	-14,01	-14,00	-14,00	-14,01	-14,01	-14,01
FTSEMIB	-12,95	-12,95	-12,94	-12,94	-12,95	-12,95	-12,93	-12,93	-12,91	-12,92	-12,92	-12,92	-12,95
IBEX35	-13,27	-13,27	-13,26	-13,27	-13,27	-13,27	-13,26	-13,26	-13,25	-13,25	-13,26	-13,26	-13,27
PSI20	-13,61	-13,61	-13,60	-13,60	-13,60	-13,60	-13,60	-13,61	-13,59	-13,59	-13,60	-13,60	-13,61
ASE	-11,43	-11,43	-12,28	-12,28	-12,38	-12,38	-12,48	-12,48	-12,35	-12,35	-12,40	-12,40	-12,48
German 2y	-12,51	-12,51	-12,49	-12,49	-12,50	-12,50	-12,51	-12,51	-12,49	-12,49	-12,50	-12,50	-12,51
French 2y	-12,47	-12,47	-12,46	-12,46	-12,46	-12,46	-12,44	-12,44	-12,42	-12,42	-12,42	-12,43	-12,47
Spanish 2y	-12,34	-12,34	-12,32	-12,32	-12,32	-12,32	-12,32	-12,32	-12,30	-12,30	-12,30	-12,30	-12,34
Spanish 10y	-11,05	-11,05	-11,04	-11,05	-11,05	-11,05	-11,06	-11,06	-11,05	-11,06	-11,05	-11,06	-11,06
Portuguese 2y	-11,48	-11,49	-11,30	-11,30	-11,31	-11,31	-11,42	-11,42	-11,35	-11,36	-11,37	-11,37	-11,49
Portuguese 10y	-10,62	-10,62	-10,60	-10,61	-10,61	-10,61	-10,61	-10,61	-10,59	-10,59	-10,60	-10,60	-10,62
Irish 10y	-10,99	-10,99	-10,97	-10,97	-10,98	-10,98	-10,98	-10,98	-10,95	-10,96	-10,96	-10,97	-10,99
Greek 10y	-9,64	-9,65	-9,61	-9,61	-9,62	-9,62	-9,63	-9,64	-9,61	-9,62	-9,61	-9,61	-9,65

Table 30 – Subsample 6: Output of the AIC regarding the DCC-GARCH model specifications. The specification in which the AIC is minimised and better fits the model is in green.

DCC spec	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	ADCC	DCC	Min
GARCH spec	EGARCH						GJR-GARCH						
Distribution	Normal		Student's T		GED		Normal		Student's T		GED		
IC	BIC												
EuroStoxx600	-14,22	-14,23	-14,20	-14,21	-14,20	-14,21	-14,24	-14,25	-14,22	-14,23	-14,22	-14,23	-14,25
EuroStoxx Banks	-12,56	-12,57	-12,54	-12,55	-12,55	-12,55	-12,55	-12,55	-12,53	-12,53	-12,53	-12,54	-12,57
DAX30	-13,79	-13,79	-13,76	-13,77	-13,77	-13,77	-13,79	-13,80	-13,77	-13,78	-13,78	-13,78	-13,80
CAC40	-13,92	-13,93	-13,89	-13,90	-13,90	-13,91	-13,92	-13,93	-13,90	-13,91	-13,90	-13,91	-13,93
FTSEMIB	-12,89	-12,89	-12,87	-12,88	-12,88	-12,88	-12,87	-12,87	-12,85	-12,85	-12,85	-12,86	-12,89
IBEX35	-13,21	-13,22	-13,19	-13,20	-13,20	-13,20	-13,20	-13,21	-13,18	-13,19	-13,19	-13,19	-13,22
PSI20	-13,54	-13,54	-13,52	-13,53	-13,52	-13,53	-13,54	-13,54	-13,52	-13,52	-13,52	-13,53	-13,54
ASE	-11,36	-11,37	-12,21	-12,21	-12,31	-12,31	-12,41	-12,42	-12,28	-12,29	-12,33	-12,33	-12,42
German 2y	-12,44	-12,45	-12,41	-12,42	-12,42	-12,42	-12,44	-12,45	-12,41	-12,42	-12,42	-12,43	-12,45
French 2y	-12,41	-12,41	-12,38	-12,39	-12,38	-12,39	-12,38	-12,38	-12,34	-12,35	-12,35	-12,36	-12,41
Spanish 2y	-12,25	-12,26	-12,22	-12,23	-12,22	-12,23	-12,23	-12,24	-12,20	-12,21	-12,20	-12,21	-12,26
Spanish 10y	-10,96	-10,97	-10,94	-10,95	-10,94	-10,95	-10,97	-10,98	-10,95	-10,96	-10,95	-10,96	-10,98
Portuguese 2y	-11,39	-11,40	-11,20	-11,20	-11,21	-11,22	-11,32	-11,33	-11,25	-11,26	-11,26	-11,27	-11,40
Portuguese 10y	-10,53	-10,54	-10,50	-10,51	-10,51	-10,51	-10,52	-10,53	-10,49	-10,49	-10,49	-10,50	-10,54
Irish 10y	-10,91	-10,92	-10,88	-10,89	-10,89	-10,90	-10,90	-10,91	-10,87	-10,88	-10,88	-10,88	-10,92
Greek 10y	-9,55	-9,56	-9,51	-9,51	-9,52	-9,53	-9,54	-9,55	-9,51	-9,52	-9,51	-9,51	-9,56

Table 31 – Subsample 6: Output of the BIC regarding the DCC-GARCH model specifications. The specification in which the BIC is minimised and better fits the model is in green.

Annex C – Choice of the GARCH models that better fits the residuals

In Annex C, we present the results for the AIC and BIC that are supportive of which GARCH model better fits the residuals of the Safe Haven regressions. We have here the choice for the sample regression (Quantile and Specific Periods' Regression) and for the subsamples Quantile regressions. As in Annex A, the selection of the best model is made by: first, if they are in accordance of the two Information Criterions, the chosen is the better; second, if they disagree in which is the best, we select by the BIC, as it penalises more the data.

GARCH spec		EGARCH			GJR-GARCH		
Distribution	Normal	Student-t	GED	Normal	Student-t	GED	Min
IC	AIC						
EuroStoxx600	-6,5281	-6,4015	-6,6111	-6,5223	-6,6173	-6,6078	-6,6173
EuroStoxx Banks	-6,5349	-6,6276	-6,6181	-6,5310	-6,6255	-6,6160	-6,6276
DAX30	-6,5255	-6,6197	-6,6098	-6,5196	-6,6165	-6,6066	-6,6197
CAC40	-6,5256	-6,6208	-6,6111	-6,5198	-6,6177	-6,6080	-6,6208
FTSEMIB	-6,5303	-6,6240	-6,6148	-6,5261	-6,6217	-6,6125	-6,6240
IBEX35	-6,5273	-6,6215	-6,6115	-6,5216	-6,6183	-6,6083	-6,6215
PSI20	-6,5254	-6,6202	-6,6105	-6,5196	-6,6169	-6,6073	-6,6202
ISEQ	-6,5285	-6,6216	-6,6121	-6,5233	-6,6187	-6,6092	-6,6216
ASE	-6,5250	-6,6187	-6,6089	-6,5195	-6,6162	-6,6061	-6,6187
German 2y	-6,5352	-6,6305	-6,6201	-6,5301	-6,6272	-6,6171	-6,6305
German 10y	-6,5475	-6,6430	-6,6323	-6,5427	-6,6399	-6,6294	-6,6430
French 2y	-6,5336	-6,6279	-6,6182	-6,5283	-6,6244	-6,6149	-6,6279
French 10y	-6,5389	-6,6332	-6,6219	-6,5319	-6,6293	-6,6180	-6,6332
Italian 2y	-6,5253	-6,6216	-6,6106	-6,5191	-6,6184	-6,6074	-6,6216
Italian 10y	-6,5251	-6,6211	-6,6104	-6,5189	-6,6177	-6,6070	-6,6211
Spanish 2y	-6,5271	-6,6219	-6,6118	-6,5207	-6,6185	-6,6084	-6,6219
Spanish 10y	-6,5244	-6,6201	-6,6098	-6,5186	-6,6169	-6,6066	-6,6201
Portuguese 2y	-6,5263	-6,6212	-6,6111	-6,5200	-6,6179	-6,6077	-6,6212
Portuguese 10y	-6,5267	-6,6215	-6,6115	-6,5203	-6,6181	-6,6081	-6,6215
Irish 2y	-6,5480	-6,6282	-6,6199	-6,5408	-6,6235	-6,6154	-6,6282
Irish 10y	-6,5270	-6,6223	-6,6121	-6,5207	-6,6191	-6,6089	-6,6223
Greek 2y	-6,9502	-7,0230	-7,0096	-6,9396	-7,0169	-7,0032	-7,0230
Greek 10y	-6,5254	-6,6205	-6,6105	-6,5191	-6,6171	-6,6070	-6,6205

Table 32 – Sample: Output of the AIC regarding the Quantile Regression residuals. The GARCH specification in which the AIC is minimised and better fits the model is in green.

GARCH spec	EGARCH			GJR-GARCH			
Distribution	Normal	Student-t	GED	Normal	Student-t	GED	Min
IC	BIC						
EuroStoxx600	-6,5232	-6,3954	-6,6050	-6,5174	-6,6112	-6,6018	-6,6112
EuroStoxx Banks	-6,5300	-6,6216	-6,6120	-6,5262	-6,6194	-6,6099	-6,6216
DAX30	-6,5206	-6,6136	-6,6037	-6,5148	-6,6104	-6,6006	-6,6136
CAC40	-6,5207	-6,6147	-6,6050	-6,5150	-6,6116	-6,6020	-6,6147
FTSEMIB	-6,5254	-6,6180	-6,6088	-6,5213	-6,6156	-6,6065	-6,6180
IBEX35	-6,5224	-6,6154	-6,6054	-6,5168	-6,6122	-6,6022	-6,6154
PSI20	-6,5205	-6,6141	-6,6044	-6,5148	-6,6108	-6,6012	-6,6141
ISEQ	-6,5236	-6,6156	-6,6060	-6,5184	-6,6126	-6,6032	-6,6156
ASE	-6,5201	-6,6126	-6,6028	-6,5146	-6,6101	-6,6001	-6,6126
German 2y	-6,5303	-6,6244	-6,6141	-6,5252	-6,6212	-6,6110	-6,6244
German 10y	-6,5426	-6,6369	-6,6262	-6,5379	-6,6338	-6,6233	-6,6369
French 2y	-6,5288	-6,6218	-6,6121	-6,5234	-6,6183	-6,6089	-6,6218
French 10y	-6,5340	-6,6272	-6,6158	-6,5270	-6,6232	-6,6119	-6,6272
Italian 2y	-6,5205	-6,6155	-6,6045	-6,5143	-6,6123	-6,6013	-6,6155
Italian 10y	-6,5202	-6,6150	-6,6043	-6,5141	-6,6116	-6,6009	-6,6150
Spanish 2y	-6,5222	-6,6158	-6,6057	-6,5159	-6,6124	-6,6023	-6,6158
Spanish 10y	-6,5195	-6,6141	-6,6037	-6,5138	-6,6108	-6,6006	-6,6141
Portuguese 2y	-6,5215	-6,6152	-6,6050	-6,5152	-6,6118	-6,6017	-6,6152
Portuguese 10y	-6,5218	-6,6154	-6,6055	-6,5155	-6,6120	-6,6020	-6,6154
Irish 2y	-6,5420	-6,6207	-6,6123	-6,5348	-6,6159	-6,6079	-6,6207
Irish 10y	-6,5221	-6,6162	-6,6061	-6,5159	-6,6130	-6,6028	-6,6162
Greek 2y	-6,9359	-7,0051	-6,9917	-6,9253	-6,9991	-6,9853	-7,0051
Greek 10y	-6,5205	-6,6145	-6,6044	-6,5142	-6,6110	-6,6010	-6,6145

Table 33 – Sample: Output of the BIC regarding the Quantile Regression residuals. The GARCH specification in which the BIC is minimised and better fits the model is in green.

GARCH spec	EGARCH			GJR-GARCH			
Distribution	Normal	Student-t	GED	Normal	Student-t	GED	Min
IC	AIC						
EuroStoxx600	-6,5455	-6,6299	-6,6220	-6,5429	-6,6278	-6,6202	-6,6299
EuroStoxx Banks	-6,5505	-6,6373	-6,6292	-6,5485	-6,6356	-6,6277	-6,6373
DAX30	-6,5462	-6,6305	-6,6232	-6,5443	-6,6286	-6,6217	-6,6305
CAC40	-6,5463	-6,6311	-6,6236	-6,5442	-6,6291	-6,6219	-6,6311
FTSEMIB	-6,5465	-6,6323	-6,6249	-6,5445	-6,6304	-6,6233	-6,6323
IBEX35	-6,5465	-6,6326	-6,6249	-6,5445	-6,6308	-6,6234	-6,6326
PSI20	-6,5432	-6,6288	-6,6204	-6,5407	-6,6265	-6,6184	-6,6288
ISEQ	-6,5405	-6,6278	-6,6199	-6,5372	-6,6254	-6,6177	-6,6278
ASE	-6,5421	-6,6287	-6,6207	-6,5400	-6,6268	-6,6191	-6,6287
German 2y	-6,5505	-6,6372	-6,6285	-6,5494	-6,6352	-6,6271	-6,6372
German 10y	-6,5603	-6,6500	-6,6407	-6,5577	-6,6475	-6,6386	-6,6500
French 2y	-6,5469	-6,6332	-6,6249	-6,5446	-6,6310	-6,6230	-6,6332
French 10y	-6,5448	-6,6365	-6,6258	-6,5398	-6,6333	-6,6226	-6,6365
Italian 2y	-6,5327	-6,6234	-6,6138	-6,5279	-6,6209	-6,6111	-6,6234
Italian 10y	-6,5336	-6,6215	-6,6127	-6,5293	-6,6189	-6,6101	-6,6215
Spanish 2y	-6,5313	-6,6235	-6,6139	-6,5257	-6,6208	-6,6110	-6,6235
Spanish 10y	-6,5316	-6,6226	-6,6132	-6,5262	-6,6198	-6,6102	-6,6226
Portuguese 2y	-6,5360	-6,6236	-6,6153	-6,5330	-6,6216	-6,6135	-6,6236
Portuguese 10y	-6,5345	-6,6214	-6,6126	-6,5315	-6,6195	-6,6108	-6,6214
Irish 2y	-6,5480	-6,6282	-6,6199	-6,5408	-6,6235	-6,6154	-6,6282
Irish 10y	-6,5270	-6,6223	-6,6121	-6,5207	-6,6191	-6,6089	-6,6223
Greek 2y	-6,9502	-7,0230	-7,0096	-6,9396	-7,0169	-7,0032	-7,0230
Greek 10y	-6,5254	-6,6205	-6,6105	-6,5191	-6,6171	-6,6070	-6,6205

Table 34 – Sample: Output of the AIC regarding the Specific Periods' Regression residuals. The GARCH specification in which the AIC is minimised and better fits the model is in green.

GARCH spec		EGARCH			GJR-GARCH		
Distribution	Normal	Student-t	GED	Normal	Student-t	GED	Min
IC			BIC				
EuroStoxx600	-6,5406	-6,6238	-6,6159	-6,5381	-6,6217	-6,6141	-6,6238
EuroStoxx Banks	-6,5456	-6,6313	-6,6232	-6,5436	-6,6295	-6,6216	-6,6313
DAX30	-6,5413	-6,6244	-6,6171	-6,5395	-6,6225	-6,6156	-6,6244
CAC40	-6,5415	-6,6250	-6,6175	-6,5393	-6,6231	-6,6158	-6,6250
FTSEMIB	-6,5416	-6,6263	-6,6189	-6,5396	-6,6243	-6,6172	-6,6263
IBEX35	-6,5417	-6,6265	-6,6188	-6,5396	-6,6247	-6,6173	-6,6265
PSI20	-6,5384	-6,6227	-6,6143	-6,5358	-6,6204	-6,6123	-6,6227
ISEQ	-6,5357	-6,6218	-6,6139	-6,5323	-6,6193	-6,6117	-6,6218
ASE	-6,5373	-6,6226	-6,6146	-6,5351	-6,6208	-6,6131	-6,6226
German 2y	-6,5457	-6,6311	-6,6224	-6,5446	-6,6292	-6,6210	-6,6311
German 10y	-6,5554	-6,6439	-6,6346	-6,5529	-6,6414	-6,6325	-6,6439
French 2y	-6,5420	-6,6272	-6,6188	-6,5398	-6,6249	-6,6169	-6,6272
French 10y	-6,5400	-6,6305	-6,6197	-6,5350	-6,6272	-6,6166	-6,6305
Italian 2y	-6,5278	-6,6173	-6,6077	-6,5230	-6,6148	-6,6051	-6,6173
Italian 10y	-6,5287	-6,6154	-6,6066	-6,5244	-6,6128	-6,6040	-6,6154
Spanish 2y	-6,5265	-6,6175	-6,6078	-6,5209	-6,6147	-6,6049	-6,6175
Spanish 10y	-6,5268	-6,6165	-6,6071	-6,5213	-6,6137	-6,6042	-6,6165
Portuguese 2y	-6,5311	-6,6175	-6,6093	-6,5281	-6,6156	-6,6074	-6,6175
Portuguese 10y	-6,5297	-6,6153	-6,6065	-6,5266	-6,6134	-6,6047	-6,6153
Irish 2y	-6,5420	-6,6207	-6,6123	-6,5348	-6,6159	-6,6079	-6,6207
Irish 10y	-6,5221	-6,6162	-6,6061	-6,5159	-6,6130	-6,6028	-6,6162
Greek 2y	-6,9359	-7,0051	-6,9917	-6,9253	-6,9991	-6,9853	-7,0051
Greek 10y	-6,5205	-6,6145	-6,6044	-6,5142	-6,6110	-6,6010	-6,6145

Table 35 – Sample: Output of the BIC regarding the Specific Periods' Regression residuals. The GARCH specification in which the BIC is minimised and better fits the model is in green.

GARCH spec		EGARCH			GJR-GARCH		
Distribution	Normal	Student-t	GED	Normal	Student-t	GED	Min
Information Criteria			AIC				
EuroStoxx600	-6,3686	-6,5205	-6,5060	-6,3570	-6,5226	-6,5051	-6,5226
EuroStoxx Banks	-6,3550	-6,4994	-6,4872	-6,3429	-6,5008	-6,4862	-6,5008
DAX30	-6,3916	-6,5338	-6,5259	-6,3796	-6,5355	-6,5248	-6,5355
CAC40	-6,3614	-6,5115	-6,4992	-6,3526	-6,5130	-6,4986	-6,5130
FTSEMIB	-6,3690	-6,5115	-6,4994	-6,3551	-6,5128	-6,4981	-6,5128
IBEX35	-6,3510	-6,5033	-6,4895	-6,3397	-6,5043	-6,4885	-6,5043
PSI20	-6,3455	-6,4995	-6,4995	-6,3368	-6,5021	-6,4852	-6,5021
ISEQ	-6,6921	-6,8049	-6,7934	-6,6841	-6,8052	-6,7921	-6,8052
ASE	-6,3499	-6,4967	-6,4792	-6,3410	-6,4987	-6,4792	-6,4987
German 2y	-6,4041	-6,5404	-6,5260	-6,3935	-6,5426	-6,5258	-6,5426
German 10y	-6,4761	-6,6139	-6,5998	-6,4659	-6,6164	-6,5997	-6,6164
French 2y	-6,3988	-6,5391	-6,5237	-6,3864	-6,5423	-6,5239	-6,5423
French 10y	-6,4723	-6,6109	-6,5961	-6,4625	-6,6133	-6,5960	-6,6133
Italian 2y	-6,4139	-6,5530	-6,5413	-6,4041	-6,5560	-6,5415	-6,5560
Italian 10y	-6,4698	-6,4698	-6,5896	-6,4621	-6,6087	-6,5908	-6,6087
Spanish 2y	-6,4052	-6,5462	-6,5332	-6,3934	-6,5479	-6,5323	-6,5479
Spanish 10y	-6,4686	-6,6009	-6,5882	-6,4580	-6,6030	-6,5877	-6,6030
Portuguese 2y	-6,4123	-6,5523	-6,5386	-6,4019	-6,5544	-6,5382	-6,5544
Portuguese 10y	-6,4671	-6,6011	-6,5841	-6,4605	-6,6032	-6,5841	-6,6032
Irish 2y	-7,0737	-7,0905	-7,0956	-7,0602	-7,0880	-7,0936	-7,0956
Irish 10y	-6,4651	-6,6052	-6,5904	-6,4551	-6,6077	-6,5902	-6,6077
Greek 2y	-6,7137	-6,8115	-6,7921	-6,6996	-6,8057	-6,7849	-6,8115
Greek 10y	-6,4013	-6,5467	-6,5371	-6,3920	-6,5491	-6,5372	-6,5491

Table 36 – Subsample 1: Output of the AIC regarding the Quantile Regression residuals. The GARCH specification in which the AIC is minimised and better fits the model is in green.

GARCH spec	EGARCH			GJR-GARCH			
Distribution	Normal	Student-t	GED	Normal	Student-t	GED	Min
Information Criteria	BIC						
EuroStoxx600	-6,3461	-6,4923	-6,4779	-6,3344	-6,4944	-6,4769	-6,4944
EuroStoxx Banks	-6,3321	-6,4707	-6,4585	-6,3200	-6,4721	-6,4575	-6,4721
DAX30	-6,3696	-6,5063	-6,4984	-6,3576	-6,5080	-6,4973	-6,5080
CAC40	-6,3389	-6,4833	-6,4711	-6,3301	-6,4849	-6,4705	-6,4849
FTSEMIB	-6,3460	-6,4827	-6,4706	-6,3320	-6,4840	-6,4693	-6,4840
IBEX35	-6,3279	-6,4744	-6,4607	-6,3166	-6,4755	-6,4597	-6,4755
PSI20	-6,3224	-6,4706	-6,4706	-6,3137	-6,4732	-6,4564	-6,4732
ISEQ	-6,6786	-6,7881	-6,7766	-6,6707	-6,7884	-6,7753	-6,7884
ASE	-6,3268	-6,4678	-6,4503	-6,3179	-6,4698	-6,4503	-6,4698
German 2y	-6,3829	-6,5139	-6,4995	-6,3723	-6,5161	-6,4993	-6,5161
German 10y	-6,4565	-6,5894	-6,5753	-6,4463	-6,5919	-6,5752	-6,5919
French 2y	-6,3776	-6,5127	-6,4972	-6,3652	-6,5159	-6,4974	-6,5159
French 10y	-6,4527	-6,5864	-6,5716	-6,4429	-6,5888	-6,5715	-6,5888
Italian 2y	-6,3932	-6,5271	-6,5154	-6,3834	-6,5301	-6,5156	-6,5301
Italian 10y	-6,4502	-6,4502	-6,5651	-6,4425	-6,5842	-6,5663	-6,5842
Spanish 2y	-6,3842	-6,5199	-6,5070	-6,3724	-5,5217	-6,5061	-6,5199
Spanish 10y	-6,4489	-6,5763	-6,5637	-6,4384	-6,5784	-6,5632	-6,5784
Portuguese 2y	-6,3918	-6,5266	-6,5129	-6,3814	-6,5287	-6,5125	-6,5287
Portuguese 10y	-6,4475	-6,5766	-6,5596	-6,4409	-6,5787	-6,5596	-6,5787
Irish 2y	-7,0454	-7,0551	-7,0602	-7,0319	-7,0526	-7,0583	-7,0602
Irish 10y	-6,4455	-6,5806	-6,5659	-6,4355	-6,5831	-6,5657	-6,5831
Greek 2y	-6,6910	-6,7831	-6,7637	-6,6768	-6,7773	-6,7564	-6,7831
Greek 10y	-6,3802	-6,5203	-6,5107	-6,3709	-6,5227	-6,5108	-6,5227

Table 37 – Subsample 1: Output of the BIC regarding the Quantile Regression residuals. The GARCH specification in which the BIC is minimised and better fits the model is in green.

GARCH spec	EGARCH			GJR-GARCH			
Distribution	Normal	Student-t	GED	Normal	Student-t	GED	Min
Information Criteria	AIC						
EuroStoxx600	-7,1094	-7,0753	-7,1493	-7,1169	-7,1519	-7,1095	-7,1519
EuroStoxx Banks	-7,1121	-7,1494	-7,1509	-7,1155	-7,1498	-6,8980	-7,1509
DAX30	-7,1262	-7,1598	-7,1611	-7,0801	-7,1280	-7,1635	-7,1635
CAC40	-7,1065	-7,1468	-7,1485	-7,1145	-7,1506	-7,1525	-7,1525
FTSEMIB	-7,1028	-7,1413	-7,1436	-7,1060	-7,1025	-7,1439	-7,1439
IBEX35	-7,0945	-7,1341	-7,1354	-7,1025	-7,1359	-7,1013	-7,1359
PSI20	-7,0981	-7,1316	-7,1334	-7,1041	-7,0953	-7,1374	-7,1374
ISEQ	-6,3465	-6,3714	-6,3721	-6,3408	-6,3664	-6,3680	-6,3721
ASE	-7,0956	-7,1330	-7,1346	-7,1027	-7,1360	-7,1381	-7,1381
German 2y	-7,1679	-7,1937	-7,1943	-7,1723	-7,1951	-7,1966	-7,1966
German 10y	-6,6680	-6,7011	-6,7030	-6,6679	-6,7005	-6,7025	-6,7030
French 2y	-7,1600	-7,1838	-7,1839	-7,1648	-7,1856	-7,1864	-7,1864
French 10y	-6,6669	-6,7032	-6,7059	-6,6675	-6,7027	-6,7056	-6,7059
Italian 2y	-7,1646	-7,1886	-7,1908	-7,1672	-7,1897	-7,1922	-7,1922
Italian 10y	-6,7500	-6,7848	-6,7866	-6,7514	-6,7854	-6,7870	-6,7870
Spanish 2y	-7,1514	-7,1757	-7,1785	-7,1542	-7,1773	-7,1802	-7,1802
Spanish 10y	-6,7456	-6,7823	-6,7838	-6,7492	-6,7845	-6,7857	-6,7857
Portuguese 2y	-7,0644	-7,0864	-7,0894	-7,0652	-7,0859	-7,0892	-7,0894
Portuguese 10y	-6,7159	-6,7655	-6,7674	-6,7226	-6,7676	-6,7701	-6,7701
Irish 2y	-6,0222	-6,1083	-6,1023	-6,0221	-6,1076	-6,1021	-6,1083
Irish 10y	-6,8060	-6,8350	-6,8360	-6,8075	-6,8336	-6,8352	-6,8360
Greek 2y	-7,2658	-7,2899	-7,2844	-7,2721	-7,2961	-7,2898	-7,2961
Greek 10y	-6,7586	-6,8018	-6,8006	-6,7602	-6,8045	-6,8030	-6,8045

Table 38 – Subsample 2: Output of the AIC regarding the Quantile Regression residuals. The GARCH specification in which the AIC is minimised and better fits the model is in green.

GARCH spec	EGARCH			GJR-GARCH			
Distribution	Normal	Student-t	GED	Normal	Student-t	GED	Min
Information Criteria	BIC						
EuroStoxx600	-7,0863	-7,0465	-7,1205	-7,0939	-7,1231	-7,0807	-7,1231
EuroStoxx Banks	-7,0890	-7,1206	-7,1220	-7,0924	-7,1209	-6,8691	-7,1220
DAX30	-7,1035	-7,1314	-7,1327	-7,0574	-7,0996	-7,1351	-7,1351
CAC40	-7,0835	-7,1179	-7,1196	-7,0914	-7,1217	-7,1237	-7,1237
FTSEMIB	-7,0797	-7,1124	-7,1148	-7,0829	-7,0736	-7,1151	-7,1151
IBEX35	-7,0719	-7,1059	-7,1071	-7,0799	-7,1076	-7,0731	-7,1076
PSI20	-7,0758	-7,1037	-7,1055	-7,0818	-7,0674	-7,1095	-7,1095
ISEQ	-6,3235	-6,3426	-6,3433	-6,3178	-6,3376	-6,3391	-6,3433
ASE	-7,0731	-7,1048	-7,1065	-7,0802	-7,1079	-7,1099	-7,1099
German 2y	-7,1449	-7,1648	-7,1654	-7,1492	-7,1663	-7,1677	-7,1677
German 10y	-6,6531	-6,6824	-6,6844	-6,6530	-6,6819	-6,6839	-6,6844
French 2y	-7,1370	-7,1549	-7,1550	-7,1417	-7,1567	-7,1576	-7,1576
French 10y	-6,6519	-6,6844	-6,6871	-6,6525	-6,6840	-6,6869	-6,6871
Italian 2y	-7,1415	-7,1597	-7,1620	-7,1441	-7,1608	-7,1634	-7,1634
Italian 10y	-6,7309	-6,7610	-6,7628	-6,7323	-6,7616	-6,7631	-6,7631
Spanish 2y	-7,1283	-7,1468	-7,1497	-7,1311	-7,1485	-7,1513	-7,1513
Spanish 10y	-6,7266	-6,7585	-6,7601	-6,7302	-6,7607	-6,7619	-6,7619
Portuguese 2y	-7,0421	-7,0586	-7,0615	-7,0429	-7,0580	-7,0614	-7,0615
Portuguese 10y	-6,6978	-6,7428	-6,7447	-6,7044	-6,7449	-6,7473	-6,7473
Irish 2y	-6,0027	-6,0840	-6,0781	-6,0027	-6,0833	-6,0778	-6,0840
Irish 10y	-6,7854	-6,8093	-6,8103	-6,7870	-6,8078	-6,8095	-6,8103
Greek 2y	-7,2384	-7,2556	-7,2501	-7,2447	-7,2618	-7,2555	-7,2618
Greek 10y	-6,7415	-6,7804	-6,7791	-6,7430	-6,7831	-6,7815	-6,7831

Table 39 – Subsample 2: Output of the BIC regarding the Quantile Regression residuals. The GARCH specification in which the BIC is minimised and better fits the model is in green.

GARCH spec	EGARCH			GJR-GARCH			
Distribution	Normal	Student-t	GED	Normal	Student-t	GED	Min
Information Criteria	AIC						
EuroStoxx600	-6,2552	-6,2852	-6,2860	-6,2520	-6,2824	-6,2837	-6,2860
EuroStoxx Banks	-6,2689	-6,2897	-6,2923	-6,2652	-6,2875	-6,2904	-6,2923
DAX30	-5,9883	-6,0641	-6,0570	-5,9833	-6,0612	-6,0540	-6,0641
CAC40	-6,2448	-6,2734	-6,2746	-6,2446	-6,2722	-6,2742	-6,2746
FTSEMIB	-6,3003	-6,3254	-6,3225	-6,2806	-6,3082	-6,3107	-6,3254
IBEX35	-6,2665	-6,2934	-6,2930	-6,2642	-6,2915	-6,2915	-6,2934
PSI20	-6,1632	-6,2397	-6,2290	-6,1630	-6,2381	-6,2282	-6,2397
ISEQ	-5,8746	-5,9453	-5,9411	-5,8650	-5,9437	-5,9373	-5,9453
ASE	-6,2700	-6,2871	-6,2881	-6,2700	-6,2860	-6,2876	-6,2881
German 2y	-5,9607	-6,0368	-6,0300	-5,9601	-6,0351	-6,0289	-6,0368
German 10y	-5,9166	-5,8057	-6,0016	-5,9092	-6,0103	-6,0011	-6,0103
French 2y	-5,9511	-6,0285	-6,0238	-5,9517	-6,0282	-6,0238	-6,0285
French 10y	-5,9177	-6,0132	-6,0073	-5,9121	-6,0149	-6,0072	-6,0149
Italian 2y	-5,9016	-5,9821	-5,9750	-5,9027	-5,9821	-5,9753	-5,9821
Italian 10y	-6,0545	-6,1379	-6,1296	-6,0482	-6,1353	-6,1263	-6,1379
Spanish 2y	-5,9407	-6,0256	-6,0203	-5,9416	-6,0248	-6,0201	-6,0256
Spanish 10y	-6,0311	-6,1276	-6,1176	-6,0261	-6,1252	-6,1149	-6,1276
Portuguese 2y	-5,9863	-6,0705	-6,0613	-5,9840	-6,0687	-6,0598	-6,0705
Portuguese 10y	-6,0284	-6,1016	-6,0919	-6,0206	-6,0999	-6,0887	-6,1016
Irish 2y	-6,1662	-6,2169	-6,2139	-6,1662	-6,2177	-6,2144	-6,2177
Irish 10y	-6,0290	-6,1191	-6,1126	-6,0334	-6,1189	-6,1137	-6,1191
Greek 10y	-6,0139	-6,0792	-6,0739	-6,0111	-6,0793	-6,0731	-6,0793

Table 40 – Subsample 3: Output of the AIC regarding the Quantile Regression residuals. The GARCH specification in which the AIC is minimised and better fits the model is in green.

GARCH spec		EGARCH			GJR-GARCH		
Distribution	Normal	Student-t	GED	Normal	Student-t	GED	Min
Information Criteria			BIC				
EuroStoxx600	-6,2321	-6,2564	-6,2571	-6,2290	-6,2536	-6,2548	-6,2571
EuroStoxx Banks	-6,2458	-6,2608	-6,2635	-6,2421	-6,2586	-6,2615	-6,2635
DAX30	-5,9718	-6,0435	-6,0363	-5,9668	-6,0406	-6,0334	-6,0435
CAC40	-6,2217	-6,2445	-6,2457	-6,2215	-6,2434	-6,2453	-6,2457
FTSEMIB	-6,2772	-6,2965	-6,2937	-6,2575	-6,2793	-6,2818	-6,2965
IBEX35	-6,2435	-6,2646	-6,2641	-6,2411	-6,2626	-6,2626	-6,2646
PSI20	-6,1401	-6,2109	-6,2001	-6,1399	-6,2093	-6,1994	-6,2109
ISEQ	-5,8527	-5,9179	-5,9137	-5,8431	-5,9163	-5,9099	-5,9179
ASE	-6,2469	-6,2582	-6,2593	-6,2469	-6,2572	-6,2588	-6,2593
German 2y	-5,9376	-6,0079	-6,0012	-5,9671	-6,0062	-6,0000	-6,0079
German 10y	-5,8935	-5,7769	-5,9727	-5,8861	-5,9814	-5,9723	-5,9814
French 2y	-5,9280	-5,9997	-5,9949	-5,9286	-5,9994	-5,9949	-5,9997
French 10y	-5,8946	-5,9843	-5,9785	-5,8890	-5,9860	-5,9783	-5,9860
Italian 2y	-5,8785	-5,9533	-5,9461	-5,8796	-5,9533	-5,9465	-5,9533
Italian 10y	-6,0349	-6,1134	-6,1051	-6,0286	-5,1108	-6,1019	-6,1134
Spanish 2y	-5,9177	-5,9967	-5,9914	-5,9185	-5,9960	-5,9913	-5,9967
Spanish 10y	-6,0106	-6,1020	-6,0920	-6,0056	-6,0996	-6,0893	-6,1020
Portuguese 2y	-5,9692	-6,0492	-6,0399	-5,9669	-6,0474	-6,0384	-6,0492
Portuguese 10y	-6,0068	-6,0746	-6,0648	-5,9989	-6,0729	-6,0616	-6,0746
Irish 2y	-6,1379	-6,1816	-6,1786	-6,1379	-6,1824	-6,1791	-6,1824
Irish 10y	-6,0059	-6,0903	-6,0837	-6,0103	-6,0900	-6,0848	-6,0903
Greek 10y	-5,9908	-6,0504	-6,0450	-5,9880	-6,0505	-6,0442	-6,0505

Table 41 – Subsample 3: Output of the BIC regarding the Quantile Regression residuals. The GARCH specification in which the BIC is minimised and better fits the model is in green.

GARCH spec		EGARCH			GJR-GARCH		
Distribution	Normal	Student-t	GED	Normal	Student-t	GED	Min
Information Criteria			AIC				
EuroStoxx600	-6,0569	-6,1339	-6,1295	-6,0523	-6,1326	-6,1274	-6,1339
EuroStoxx Banks	-5,8724	-5,9530	-5,9451	-5,8690	-5,9556	-5,9457	-5,9556
DAX30	-6,2857	-6,3295	-6,3305	-6,2732	-6,3194	-6,3213	-6,3305
CAC40	-6,0454	-6,1416	-6,1359	-6,0435	-6,1423	-6,1356	-6,1423
FTSEMIB	-5,8670	-5,9491	-5,9404	-5,8550	-5,9487	-5,9371	-5,9491
IBEX35	-5,9010	-5,9491	-5,9497	-5,8933	-5,9465	-5,9459	-5,9497
PSI20	-5,9216	-5,9696	-5,9704	-5,9153	-5,9681	-5,9677	-5,9704
ISEQ	-6,4322	-6,5152	-6,5120	-6,4237	-6,5039	-6,5033	-6,5152
ASE	-5,8874	-5,9390	-5,9378	-5,8771	-5,9360	-5,9329	-5,9390
German 2y	-6,0856	-6,1405	-6,1367	-6,0875	-6,1433	-6,1367	-6,1433
German 10y	-6,4737	-6,5660	-6,5598	-6,4607	-6,5456	-6,5427	-6,5660
French 2y	-5,9413	-6,1011	-6,0983	-6,0377	-6,1008	-6,0964	-6,1011
French 10y	-6,4292	-6,5168	-6,5070	-6,4128	-6,5031	-6,4944	-6,5168
Italian 2y	-6,1758	-6,2708	-6,2640	-6,1725	-6,2699	-6,2626	-6,2708
Italian 10y	-6,2284	-6,2975	-6,2967	-6,2219	-6,2924	-6,2925	-6,2975
Spanish 2y	-6,1464	-6,2314	-6,2237	-6,1420	-6,2303	-6,2219	-6,2314
Spanish 10y	-6,2067	-6,2770	-6,2784	-6,2014	-6,2741	-6,2752	-6,2784
Portuguese 2y	-6,2265	-6,2868	-6,2879	-6,2176	-6,2832	-6,2833	-6,2879
Portuguese 10y	-6,2249	-6,2879	-6,2885	-6,2144	-6,2830	-6,2828	-6,2885
Irish 2y	-6,3596	-6,4313	-6,4287	-6,3481	-6,4188	-6,4186	-6,4313
Irish 10y	-6,2728	-6,3198	-6,3162	-6,2715	-6,3215	-6,3167	-6,3215
Greek 10y	-6,1977	-6,2901	-6,2778	-6,1857	-6,2853	-6,2716	-6,2901

Table 42 – Subsample 4: Output of the AIC regarding the Quantile Regression residuals. The GARCH specification in which the AIC is minimised and better fits the model is in green.

GARCH spec	EGARCH			GJR-GARCH			
Distribution	Normal	Student-t	GED	Normal	Student-t	GED	Min
Information Criteria	BIC						
EuroStoxx600	-6,0403	-6,1132	-6,1087	-6,0358	-6,1119	-6,1066	-6,1132
EuroStoxx Banks	-5,8493	-5,9241	-5,9163	-5,8459	-5,9267	-5,9169	-5,9267
DAX30	-6,2626	-6,3006	-6,3016	-6,2501	-6,2905	-6,2925	-6,3016
CAC40	-6,0289	-6,1210	-6,1153	-6,0271	-6,1217	-6,1150	-6,1217
FTSEMIB	-5,8439	-5,9202	-5,9115	-5,8319	-5,9198	-5,9082	-5,9202
IBEX35	-5,8779	-5,9203	-5,9208	-5,8702	-5,9176	-5,9170	-5,9208
PSI20	-5,8985	-5,9407	-5,9416	-5,8922	-5,9392	-5,9389	-5,9416
ISEQ	-6,4091	-5,4864	-6,4832	-6,4006	-6,4750	-6,4745	-6,4832
ASE	-5,8643	-5,9102	-5,9090	-5,8540	-5,9071	-5,9041	-5,9102
German 2y	-6,0625	-6,1116	-6,1079	-6,0644	-6,1145	-6,1079	-6,1145
German 10y	-6,4506	-6,5372	-6,5309	-6,4376	-6,5167	-6,5139	-6,5372
French 2y	-5,9182	-6,0722	-6,0694	-6,0146	-6,0720	-6,0676	-6,0722
French 10y	-6,4061	-6,4880	-6,4781	-6,3897	-6,4743	-6,4655	-6,4880
Italian 2y	-6,1591	-6,2499	-6,2431	-6,1558	-6,2490	-6,2417	-6,2499
Italian 10y	-6,2053	-6,2687	-6,2679	-6,1988	-6,2636	-6,2637	-6,2687
Spanish 2y	-6,1294	-6,2102	-6,2025	-6,1250	-6,2092	-6,2007	-6,2102
Spanish 10y	-6,1836	-6,2481	-6,2495	-6,1783	-6,2453	-5,2464	-6,2495
Portuguese 2y	-6,2034	-6,2579	-6,2590	-6,1945	-6,2544	-6,2545	-6,2590
Portuguese 10y	-6,2018	-6,2590	-6,2597	-6,1914	-6,2542	-6,2539	-6,2597
Irish 2y	-6,3314	-6,3960	-6,3933	-6,3198	-6,3835	-6,3832	-6,3960
Irish 10y	-6,2497	-6,2909	-6,2873	-6,2484	-6,2926	-6,2878	-6,2926
Greek 10y	-6,1746	-6,2612	-6,2490	-6,1626	-6,2564	-6,2427	-6,2612

Table 43 – Subsample 4: Output of the BIC regarding the Quantile Regression residuals. The GARCH specification in which the BIC is minimised and better fits the model is in green.

GARCH spec	EGARCH			GJR-GARCH			
Distribution	Normal	Student-t	GED	Normal	Student-t	GED	Min
Information Criteria	AIC						
EuroStoxx600	-6,5143	-6,5940	-6,5845	-6,5096	-6,5872	-6,5781	-6,5940
EuroStoxx Banks	-6,4572	-6,5315	-6,5251	-6,4526	-6,5241	-6,5196	-6,5315
DAX30	-6,5372	-6,6182	-6,6047	-6,5319	-6,6103	-6,5978	-6,6182
CAC40	-6,5424	-6,6282	-6,6149	-6,5335	-6,6217	-6,6085	-6,6282
FTSEMIB	-6,4407	-6,5362	-6,5280	-6,4318	-6,5229	-6,5172	-6,5362
IBEX35	-6,4328	-6,5205	-6,5162	-6,4234	-6,5101	-6,5078	-6,5205
PSI20	-6,4511	-6,5328	-6,5284	-6,4426	-6,5240	-6,5203	-6,5328
ISEQ	-7,0080	-6,9252	-7,0711	-6,9995	-7,0823	-7,0633	-7,0823
ASE	-6,4392	-6,5204	-6,5170	-6,4316	-6,5103	-6,5093	-6,5204
German 2y	-6,5052	-6,5907	-6,5899	-6,4963	-6,5795	-6,5813	-6,5907
German 10y	-7,0626	-7,1431	-7,1234	-7,0526	-7,1387	-7,1176	-7,1431
French 2y	-6,4793	-6,5502	-6,5513	-6,4690	-6,5371	-6,5409	-6,5513
French 10y	-7,0116	-7,0958	-7,0732	-6,9974	-7,0892	-7,0650	-7,0958
Italian 2y	-6,8993	-6,9792	-6,9645	-6,8870	-6,9722	-6,9571	-6,9792
Italian 10y	-6,9271	-7,0109	-6,9943	-6,9144	-7,0043	-6,9869	-7,0109
Spanish 2y	-6,5246	-6,6219	-6,6060	-6,5142	-6,6134	-6,5982	-6,6219
Spanish 10y	-6,5923	-6,6918	-6,6690	-6,5829	-6,6835	-6,6603	-6,6918
Portuguese 2y	-6,5964	-6,6860	-6,6631	-6,5943	-6,6799	-6,6577	-6,6860
Portuguese 10y	-6,6071	-6,6925	-6,6760	-6,5971	-6,6849	-6,6687	-6,6925
Irish 2y	-7,0120	-7,0951	-7,0771	-7,0018	-7,0890	-7,0701	-7,0951
Irish 10y	-6,3754	-6,4445	-6,4387	-6,3703	-6,4344	-6,4320	-6,4445
Greek 10y	-6,5515	-6,6550	-6,6402	-6,5409	-6,6457	-6,6323	-6,6550

Table 44 – Subsample 5: Output of the AIC regarding the Quantile Regression residuals. The GARCH specification in which the AIC is minimised and better fits the model is in green.

GARCH spec		EGARCH			GJR-GARCH		
Distribution	Normal	Student-t	GED	Normal	Student-t	GED	Min
Information Criteria			BIC				
EuroStoxx600	-6,4926	-6,5669	-6,5574	-6,4879	-6,5601	-6,5510	-6,5669
EuroStoxx Banks	-6,4387	-6,5083	-6,5019	-6,4340	-6,5009	-6,4964	-6,5083
DAX30	-6,5141	-6,5894	-6,5758	-6,5088	-6,5814	-6,5689	-6,5894
CAC40	-6,5212	-6,6016	-6,5883	-6,5122	-6,5951	-6,5819	-6,6016
FTSEMIB	-6,4178	-6,5075	-6,4993	-6,4089	-6,4943	-6,4886	-6,5075
IBEX35	-6,4097	-6,4916	-6,4874	-6,4003	-6,4812	-6,4790	-6,4916
PSI20	-6,4305	-6,5070	-6,5026	-6,4219	-6,4982	-6,4945	-6,5070
ISEQ	-6,9924	-6,9057	-7,0516	-6,9839	-7,0628	-7,0438	-7,0628
ASE	-6,4165	-6,4921	-6,4887	-6,4089	-6,4820	-6,4809	-6,4921
German 2y	-6,4843	-6,5647	-6,5638	-6,4755	-6,5535	-6,5552	-6,5647
German 10y	-7,0476	-7,1243	-7,1045	-7,0376	-7,1199	-7,0988	-7,1243
French 2y	-6,4562	-6,5213	-6,5225	-6,4459	-6,5082	-6,5120	-6,5225
French 10y	-6,9966	-7,0771	-7,0546	-6,9824	-7,0706	-7,0463	-7,0771
Italian 2y	-6,8862	-6,9628	-6,9481	-6,8738	-6,9558	-6,9407	-6,9628
Italian 10y	-6,9135	-6,9939	-6,9773	-6,9008	-6,9873	-6,9698	-6,9939
Spanish 2y	-6,5015	-6,5930	-6,5772	-6,4911	-6,5846	-6,5693	-6,5930
Spanish 10y	-6,5692	-6,6630	-6,6402	-6,5598	-6,6546	-6,6315	-6,6630
Portuguese 2y	-6,5733	-6,6571	-6,6342	-6,5712	-6,6510	-6,6289	-6,6571
Portuguese 10y	-6,5840	-6,6637	-6,6472	-6,5741	-6,6561	-6,6399	-6,6637
Irish 2y	-6,9961	-7,0753	-7,0572	-6,9859	-7,0691	-7,0502	-7,0753
Irish 10y	-6,3523	-6,4156	-6,4098	-6,3472	-6,4055	-6,4031	-6,4156
Greek 10y	-6,5300	-6,6282	-6,6133	-6,5194	-6,6188	-6,6054	-6,6282

Table 45 – Subsample 5: Output of the BIC regarding the Quantile Regression residuals. The GARCH specification in which the BIC is minimised and better fits the model is in green.

GARCH spec		EGARCH			GJR-GARCH		
Distribution	Normal	Student-t	GED	Normal	Student-t	GED	Min
Information Criteria			AIC				
EuroStoxx600	-7,2917	-7,3173	-7,3164	-7,2945	-7,3162	-7,3165	-7,3173
EuroStoxx Banks	-7,1527	-7,2303	-7,2129	-7,1501	-7,2264	-7,2098	-7,2303
DAX30	-7,3026	-7,3210	-7,3186	-7,3048	-7,3200	-7,3189	-7,3210
CAC40	-7,2938	-7,3158	-7,3139	-7,2989	-7,3179	-7,3167	-7,3179
FTSEMIB	-6,9960	-7,0700	-7,0548	-6,9863	-7,0651	-7,0492	-7,0700
IBEX35	-7,0053	-7,0809	-7,0641	-6,9966	-7,0747	-7,0576	-7,0809
PSI20	-7,0580	-7,1409	-7,1225	-7,0557	-7,1335	-7,1176	-7,1409
ASE	-7,0091	-7,0892	-7,0713	-6,9986	-7,0817	-7,0634	-7,0892
German 2y	-7,1723	-7,2309	-7,2139	-7,1697	-7,2273	-7,2108	-7,2309
French 2y	-7,0839	-7,1701	-7,1481	-7,0707	-7,1628	-7,1397	-7,1701
Spanish 2y	-7,2929	-7,3216	-7,3206	-7,2980	-7,3234	-7,3229	-7,3234
Spanish 10y	-7,3090	-7,3347	-7,3333	-7,3139	-7,3392	-7,3370	-7,3392
Portuguese 2y	-7,2933	-7,3148	-7,3137	-7,2945	-7,3153	-7,3139	-7,3153
Portuguese 10y	-7,2763	-7,2993	-7,2969	-7,2772	-7,2992	-7,2969	-7,2993
Irish 10y	-7,1986	-7,2906	-7,2700	-7,1956	-7,2854	-7,2650	-7,2906
Greek 10y	-7,2729	-7,2971	-7,2962	-7,2779	-7,2998	-7,2990	-7,2998

Table 46 – Subsample 6: Output of the AIC regarding the Quantile Regression residuals. The GARCH specification in which the AIC is minimised and better fits the model is in green.

GARCH spec	EGARCH			GJR-GARCH			Min
Distribution	Normal	Student-t	GED	Normal	Student-t	GED	
Information Criteria	BIC						
EuroStoxx600	-7,2693	-7,2893	-7,2884	-7,2721	-7,2882	-7,2885	-7,2893
EuroStoxx Banks	-7,1345	-7,2075	-7,1901	-7,1319	-7,2036	-7,1870	-7,2075
DAX30	-7,2805	-7,2934	-7,2910	-7,2827	-7,2923	-7,2913	-7,2934
CAC40	-7,2707	-7,2870	-7,2851	-7,2758	-7,2890	-7,2878	-7,2890
FTSEMIB	-6,9805	-7,0508	-7,0356	-6,9708	-7,0458	-7,0299	-7,0508
IBEX35	-6,9898	-7,0614	-7,0446	-6,9811	-7,0552	-7,0382	-7,0614
PSI20	-7,0410	-7,1197	-7,1013	-7,0387	-7,1123	-7,0963	-7,1197
ASE	-6,9933	-7,0695	-7,0516	-6,9828	-7,0620	-7,0437	-7,0695
German 2y	-7,1548	-7,2090	-7,1920	-7,1522	-7,2054	-7,1889	-7,2090
French 2y	-7,0677	-7,1498	-7,1278	-7,0544	-7,1425	-7,1193	-7,1498
Spanish 2y	-7,2710	-7,2942	-7,2932	-7,2760	-7,2959	-7,2955	-7,2959
Spanish 10y	-7,2859	-7,3059	-7,3044	-7,2908	-7,3103	-7,3082	-7,3103
Portuguese 2y	-7,2703	-7,2860	-7,2849	-7,2715	-7,2865	-7,2852	-7,2865
Portuguese 10y	-7,2532	-7,2705	-7,2681	-7,2542	-7,2704	-7,2680	-7,2705
Irish 10y	-7,1797	-7,2670	-7,2463	-7,1767	-7,2617	-7,2414	-7,2670
Greek 10y	-7,2498	-7,2682	-7,2673	-7,2548	-7,2709	-7,2701	-7,2709

Table 47 – Subsample 6: Output of the BIC regarding the Quantile Regression residuals. The GARCH specification in which the BIC is minimised and better fits the model is in green.

Annex D – Selection of the GARCH model that better fits the volatility of the GSFCIEA.

In Annex D, we present the results for the AIC and BIC that support our choice of the GARCH model that better fits the volatility of the GSFCIEA. The selection of the better model is made equally to previous annexes.

GARCH spec	EGARCH			GJR-GARCH			Min
Distribution	Normal	Student-t	GED	Normal	Student-t	GED	
Information Criteria	AIC						
GS_FCI_EA	-12,87	-12,94	-12,93	-12,85	-12,92	-12,88	-12,94

Table 48 – GSFCIEA volatility: Output of the AIC. The GARCH specification in which the AIC is minimised and better fits the model is in green.

GARCH spec	EGARCH			GJR-GARCH			Min
Distribution	Normal	Student-t	GED	Normal	Student-t	GED	
Information Criteria	BIC						
GS_FCI_EA	-12,86	-12,93	-12,92	-12,84	-12,91	-12,88	-12,93

Table 49 – GSFCIEA volatility: Output of the BIC. The GARCH specification in which the BIC is minimised and better fits the model is in green.

Annex E – Structural Breaks definition

In Annex E, we show the results of the Bai and Perron (2003) algorithm computation, namely the number of structural breaks computed, as well as the BIC output that sustains our structural breaks definitions. Furthermore, we present the length and the dates interval of each of the subsamples.

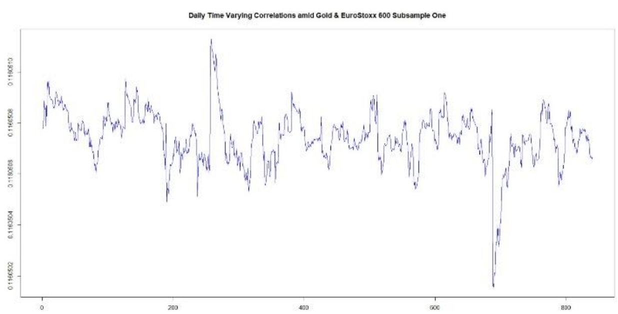
Asset	Number of Breaks						Subsamples			
	0	1	2	3	4	5	Subsample 1		Subsample 2	
	BIC						Date Interval	Length	Date Interval	Length
EuroStoxx 600	60186	57669	56550	55549	53017	52585	04/01/1999 23/04/2002	841	24/04/2002 05/07/2005	815
EuroStoxx Banks	66107	59172	56270	55104	54331	54173	04/01/1999 25/03/2002	822	26/03/2002 08/06/2005	815
DAX	102000	94100	92670	91260	89330	88900	04/01/1999 29/05/2002	866	30/05/2002 02/09/2005	833
CAC 40	89510	88580	87180	86560	83820	82830	04/01/1999 24/04/2002	842	25/04/2002 06/07/2005	815
FTSEMIB	114200	108000	106800	104500	104200	104000	04/01/1999 19/03/2002	818	20/03/2002 02/06/2005	815
IBEX 35	97820	97060	94290	93180	93060	92940	04/01/1999 14/03/2002	815	15/03/2002 29/06/2005	837
PSI 20	99890	96370	95440	93390	92070	91850	04/01/1999 14/03/2002	815	15/03/2002 19/07/2005	851
ISEQ	96100	95290	91490	87570	86950	97080	04/01/1999 21/04/2005	1603	22/04/2005 01/07/2008	815
ASE	94350	88450	87330	85390	83910	83850	04/01/1999 14/03/2002	815	15/03/2002 05/07/2005	841
German 2-years	22155	12861	10587	9117	7273	6225	04/01/1999 26/07/2002	908	29/07/2002 06/10/2005	815
German 10-years	21753	12,307,6	9726	6862	5430	5988	04/01/1999 06/12/2002	1003	09/12/2002 24/06/2008	1410
French 2-years	21936	13155	10725	9192	7167	6087	04/01/1999 30/07/2002	910	31/07/2002 10/10/2005	815
French 10-years	20977	12397	9345	6588	6268	6346	04/01/1999 06/12/2002	1003	09/12/2002 05/06/2008	1397
Italian 2-years	20844	14636	13308	12721	11485	11488	04/01/1999 30/08/2002	933	02/09/2002 10/11/2005	815
Italian 10-years	18713	11061	10034	9089	8915	9424	04/01/1999 06/12/2002	1003	09/12/2002 04/01/2007	1038
Spanish 2-years	21259	13813	12348	11957	10821	10573	04/01/1999 12/08/2002	919	13/08/2002 21/10/2005	815
Spanish 10-years	20405	11851	10964	8971	8765	8583	04/01/1999 05/12/2002	1002	06/12/2002 08/01/2007	1041
Portuguese 2-years	28142	25931	23530	23342	23301	23269	04/01/1999 17/09/2002	945	18/09/2002 18/01/2006	851
Portuguese 10-years	25034	22769	18282	17825	17413	17317	04/01/1999 05/12/2002	1002	06/12/2002 02/04/2007	1101
Irish 2-years	20468	17463	15862	15617	15476	15489	06/11/2003 25/04/2006	629	25/04/2006 23/04/2010	1014
Irish 10-years	24548	18979	17036	16269	15910	15795	05/01/1999 05/12/2002	1002	09/12/2002 21/08/2006	943
Greek 2-years	7677	6538	5805	5591	5432	5395	07/07/2014 02/10/2017	831	03/10/2017 30/04/2020	654
Greek 10-years	34165	32974	29164	28375	28295	28260	04/01/1999 05/08/2002	914	06/08/2002 26/03/2007	1184

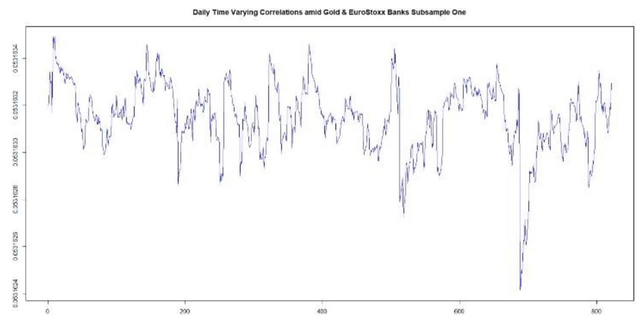
Subsamples							
Subsample 3		Subsample 4		Subsample 5		Subsample 6	
Date Interval	Length	Date Interval	Length	Date Interval	Length	Date Interval	Length
06/07/2005 12/09/2008	815	15/09/2008 17/07/2013	1234	18/07/2013 02/01/2017	884	03/01/2017 30/04/2020	846
09/06/2005 18/08/2008	815	19/08/2008 27/10/2011	815	28/10/2011 13/01/2016	1072	14/01/2016 30/04/2020	1096
05/09/2005 26/07/2010	1244	27/07/2010 30/09/2013	815	01/10/2013 08/12/2016	815	09/12/2016 30/04/2020	862
07/07/2005 15/09/2008	815	16/09/2008 31/07/2013	1243	01/08/2013 14/02/2017	905	15/02/2017 30/04/2020	815
03/06/2005 12/08/2008	815	13/08/2008 21/10/2011	815	24/10/2011 15/01/2015	822	16/01/2015 30/04/2020	1350
30/06/2005 08/09/2008	815	09/09/2008 17/11/2011	815	18/11/2011 02/02/2015	815	03/02/2015 30/04/2020	1338
20/07/2005 26/09/2008	815	29/09/2008 07/12/2011	815	08/12/2011 19/08/2015	940	20/08/2015 30/04/2020	1199
02/07/2008 25/11/2011	870	28/11/2011 10/02/2015	815	11/02/2015 30/04/2020	1332	---	---
06/07/2005 12/09/2008	815	15/09/2008 23/11/2011	815	24/11/2011 06/03/2015	835	09/03/2015 30/04/2020	1314
07/10/2005 16/12/2008	815	17/12/2008 27/02/2012	815	28/02/2012 21/10/2015	928	22/10/2015 30/04/2020	1154
25/06/2008 02/09/2011	815	05/09/2011 12/11/2014	815	13/11/2014 30/04/2020	1392	---	---
11/10/2005 18/12/2008	815	19/12/2008 29/02/2012	815	01/03/2012 19/05/2015	815	20/05/2015 30/04/2020	1265
06/06/2008 16/08/2011	815	17/08/2011 24/10/2014	815	27/10/2014 30/04/2020	1405	---	---
11/11/2005 27/01/2009	815	28/01/2009 06/11/2013	1222	07/11/2013 30/04/2020	1650	---	---
05/01/2007 16/12/2010	1005	17/12/2010 26/02/2014	815	27/02/2014 30/04/2020	1574	---	---
24/10/2005 07/01/2009	815	08/01/2009 19/09/2013	1202	20/09/2013 29/11/2016	815	30/11/2016 30/04/2020	869
09/01/2007 29/09/2010	947	30/09/2010 04/12/2013	815	05/12/2013 14/02/2017	815	15/02/2017 30/04/2020	815
19/01/2006 24/09/2010	1191	27/09/2010 29/11/2013	815	02/12/2013 09/02/2017	815	10/02/2017 30/04/2020	818
03/04/2007 27/09/2010	885	28/09/2010 02/12/2013	815	03/12/2013 14/02/2017	817	15/02/2017 30/04/2020	815
26/04/2010 02/10/2012	629	03/10/2012 26/03/2015	629	27/03/2015 30/04/2020	1301	---	---
22/08/2006 03/11/2009	814	04/11/2009 10/01/2013	814	11/01/2013 22/03/2016	814	23/03/2016 30/04/2020	1047
---	---	---	---	---	---	---	---
27/03/2007 14/06/2010	815	15/06/2010 19/08/2013	815	20/08/2013 14/02/2017	892	15/02/2017 30/04/2020	815

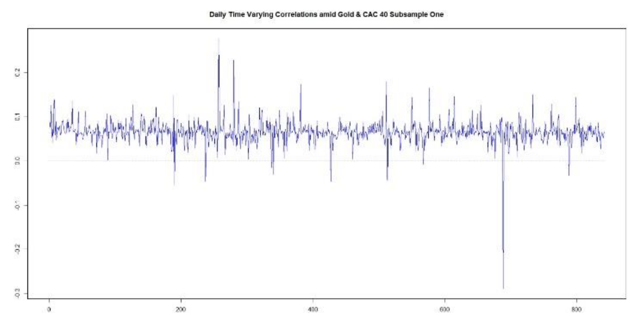
Table 50 – Structural Breaks computation. On the left side it is the number of breaks and the BIC value, on the right side it is the length and the period of each of the subsamples.

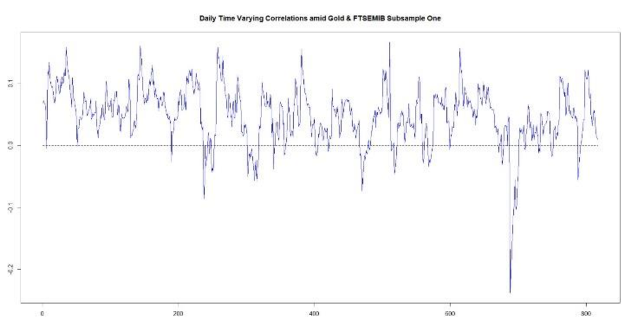
Annex F – Daily time-varying correlations for subsamples

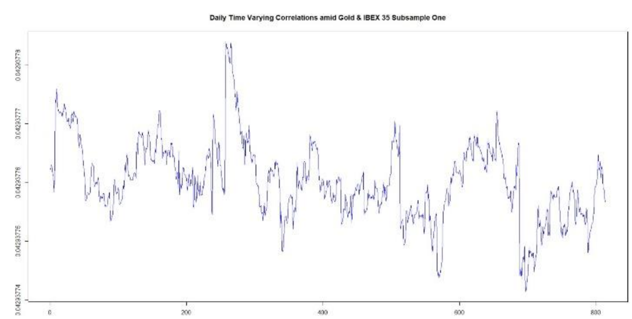
In Annex F, we display the figures of each of the subsamples daily time-varying correlations. This data is the one we introduce in our subsample t-tests and consequently are the base of our analysis regarding Gold's Hedge ability, in terms of subsamples.

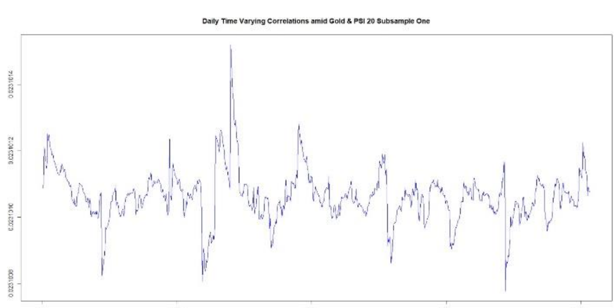


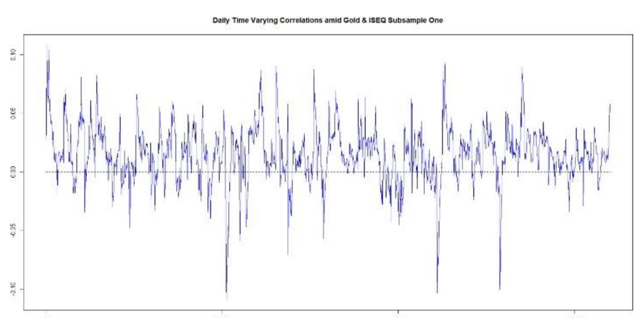




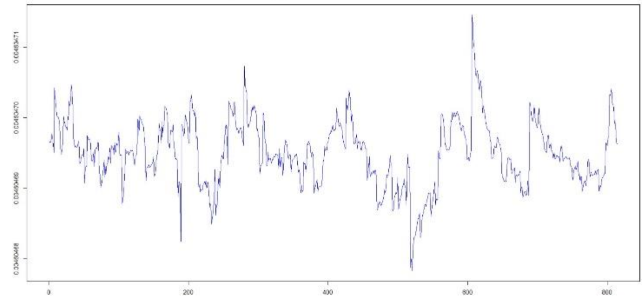




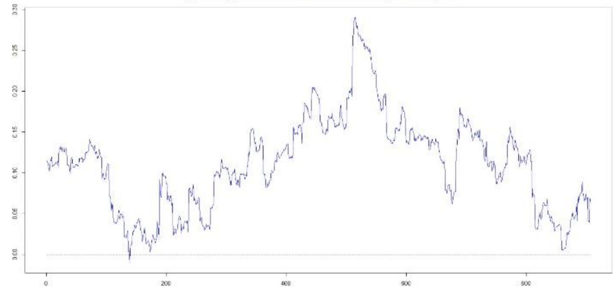




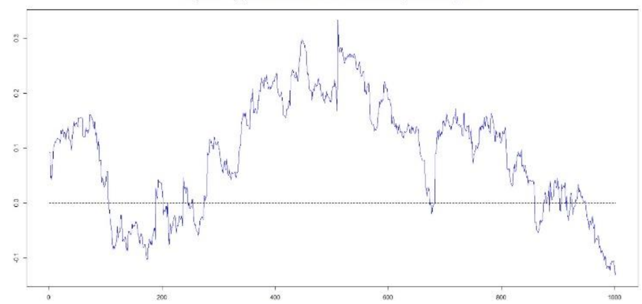
Daily Time Varying Correlations amid Gold & ASE Subsample One



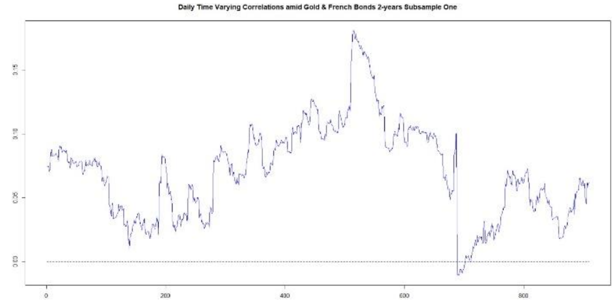
Daily Time Varying Correlations amid Gold & German Bonds 2-years Subsample One



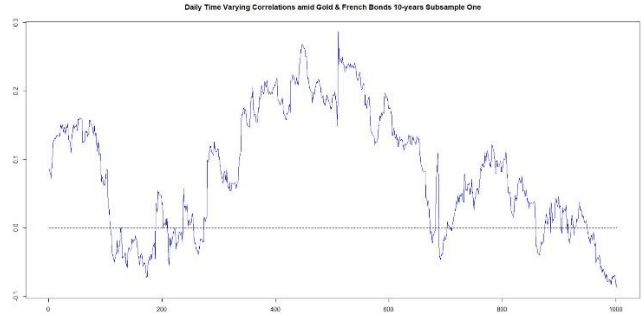
Daily Time Varying Correlations amid Gold & German Bonds 10-years Subsample One



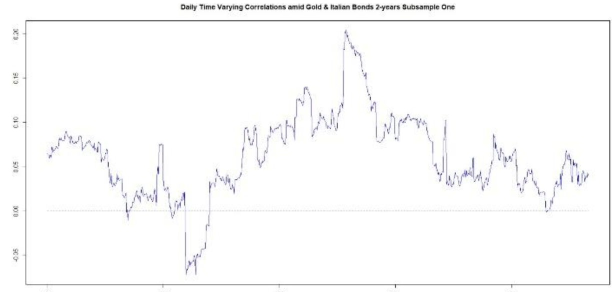
Daily Time Varying Correlations amid Gold & French Bonds 2-years Subsample One



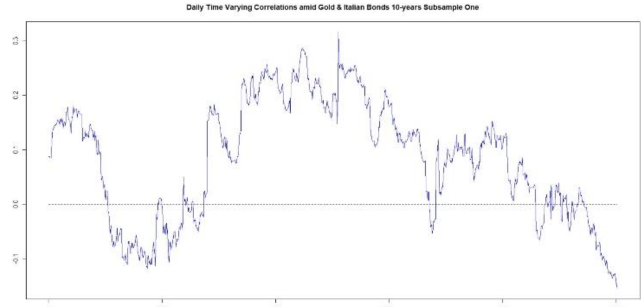
Daily Time Varying Correlations amid Gold & French Bonds 10-years Subsample One



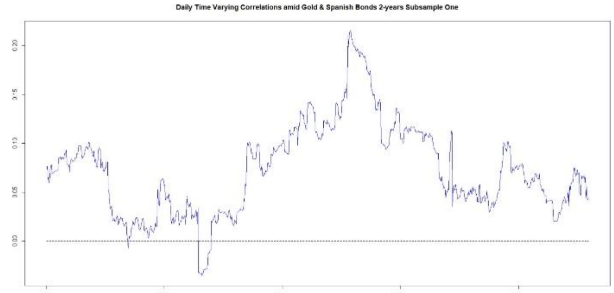
Daily Time Varying Correlations amid Gold & Italian Bonds 2-years Subsample One



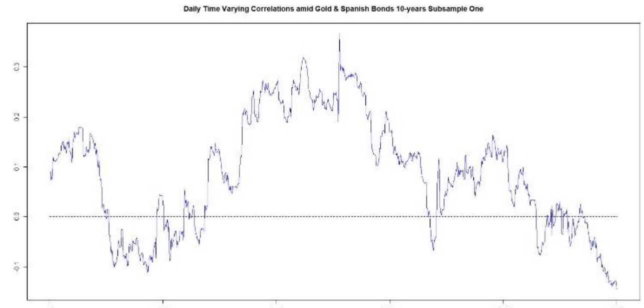
Daily Time Varying Correlations amid Gold & Italian Bonds 10-years Subsample One



Daily Time Varying Correlations amid Gold & Spanish Bonds 2-years Subsample One



Daily Time Varying Correlations amid Gold & Spanish Bonds 10-years Subsample One



Daily Time Varying Correlations amid Gold & Portuguese Bonds 2-years Subsample One

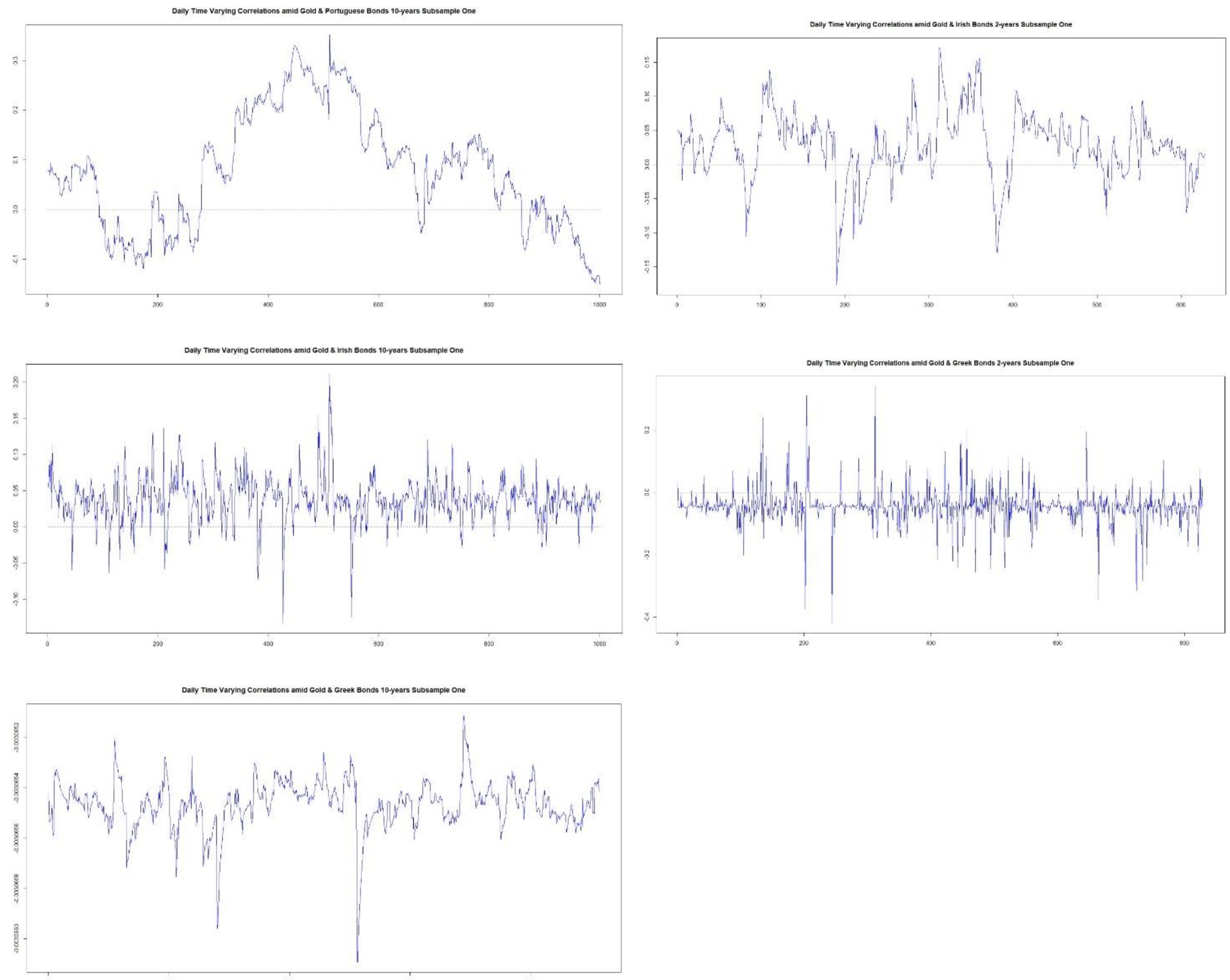
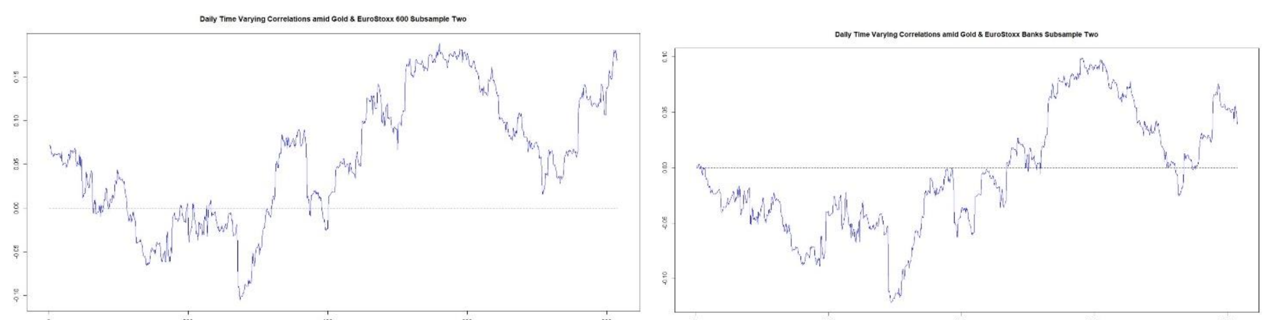
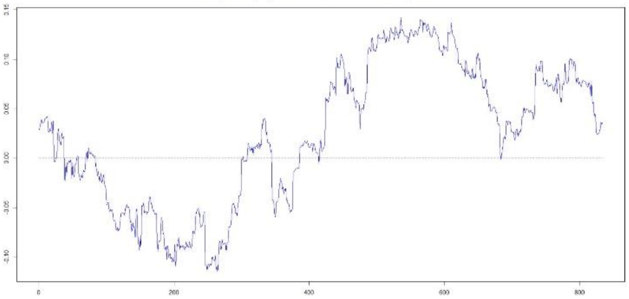


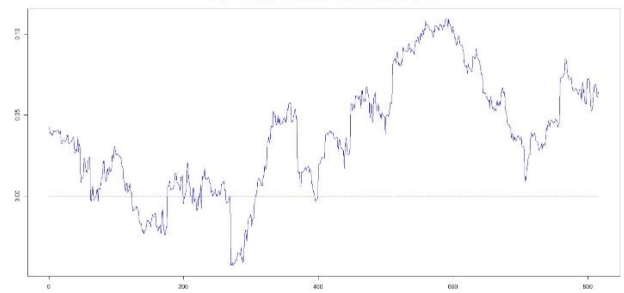
Figure 2 – Subsample 1: Daily Time Varying Correlations between Gold and each asset. From the left to the right and from the top to the bottom, we present: EuroStoxx 600, EuroStoxx Banks, DAX, CAC 40, FTSEMIB, IBEX 35, PSI 20, ISEQ, ASE, German Bonds 2 years, German Bonds 10 years, French Bonds 2 years, French Bonds 10 years, Italian Bonds 2 years, Italian Bonds 10 years, Spanish Bonds 2 years, Spanish Bonds 10 years, Portuguese Bonds 2 years, Portuguese Bonds 10 years, Irish Bonds 2 years, Irish Bonds 10 years, Greek Bonds 2 years and Greek Bonds 10 years.



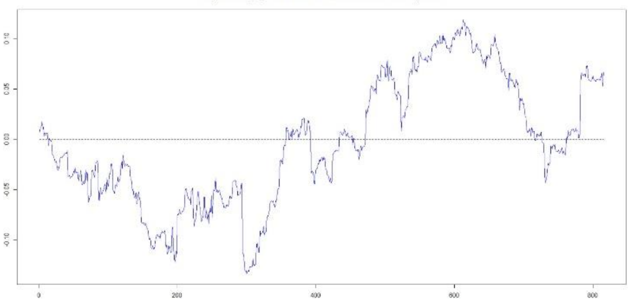
Daily Time Varying Correlations amid Gold & DAX Subsample Two



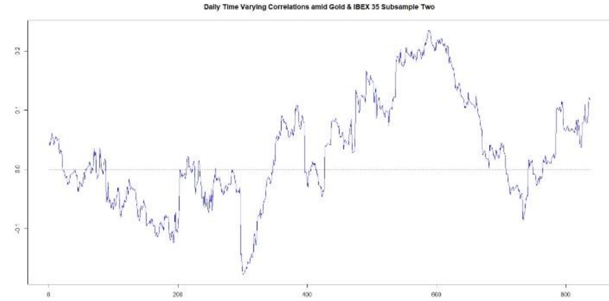
Daily Time Varying Correlations amid Gold & CAC 40 Subsample Two



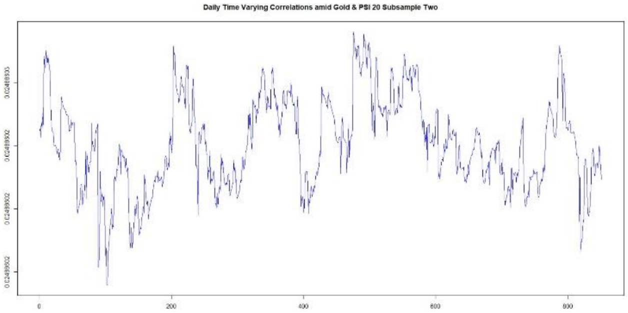
Daily Time Varying Correlations amid Gold & FTSEMIB Subsample Two



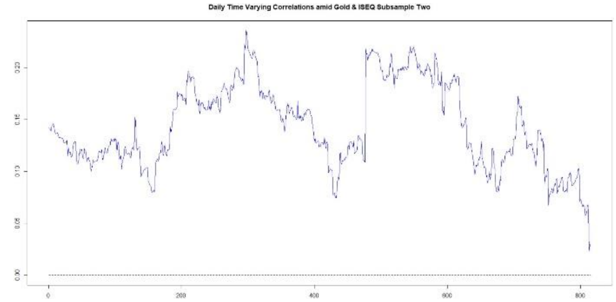
Daily Time Varying Correlations amid Gold & IBEX 35 Subsample Two



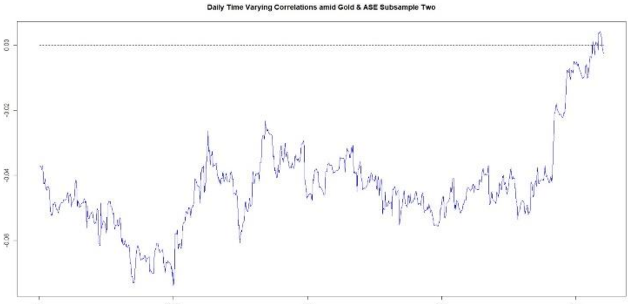
Daily Time Varying Correlations amid Gold & PSI 20 Subsample Two



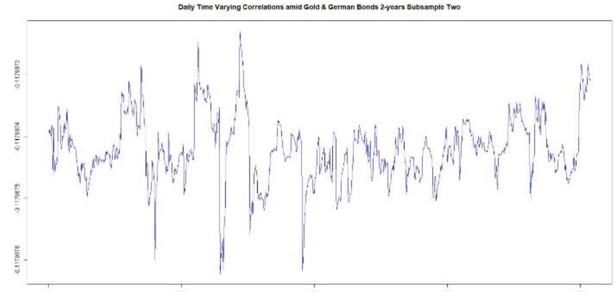
Daily Time Varying Correlations amid Gold & ISEQ Subsample Two



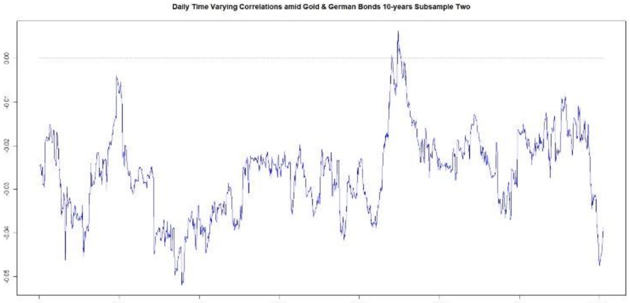
Daily Time Varying Correlations amid Gold & ASE Subsample Two



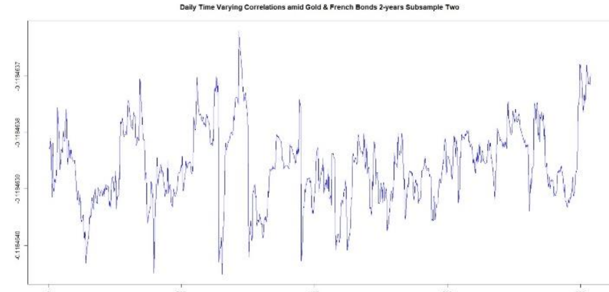
Daily Time Varying Correlations amid Gold & German Bonds 2-years Subsample Two

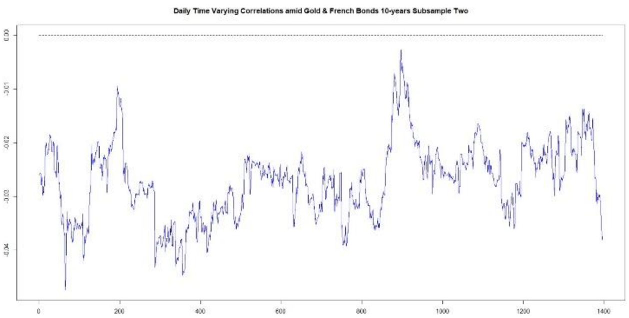


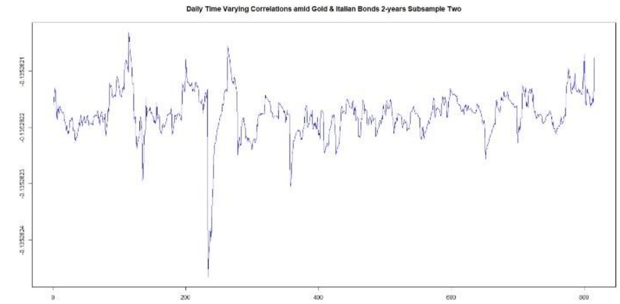
Daily Time Varying Correlations amid Gold & German Bonds 10-years Subsample Two

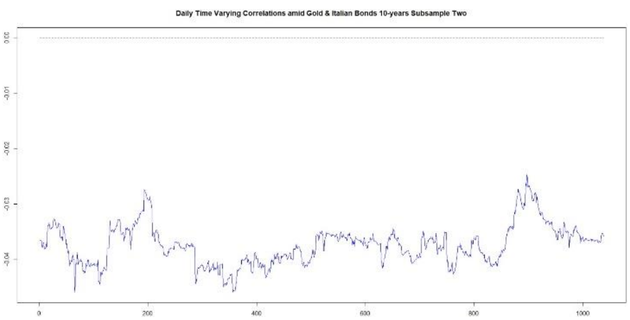


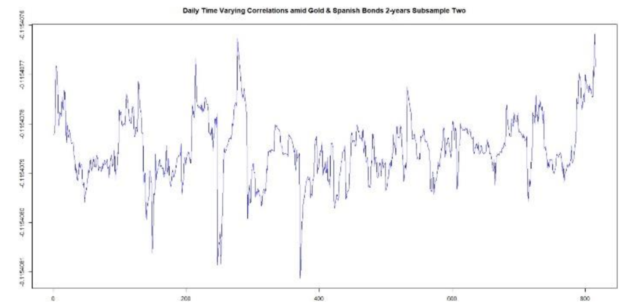
Daily Time Varying Correlations amid Gold & French Bonds 2-years Subsample Two

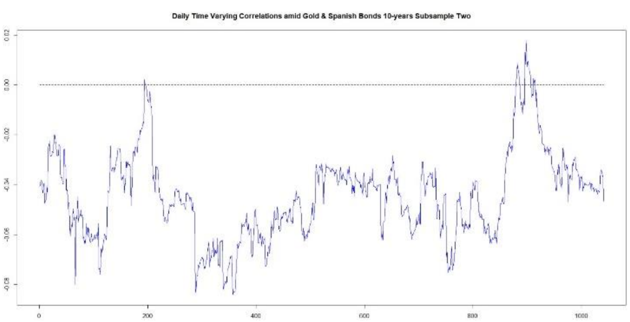


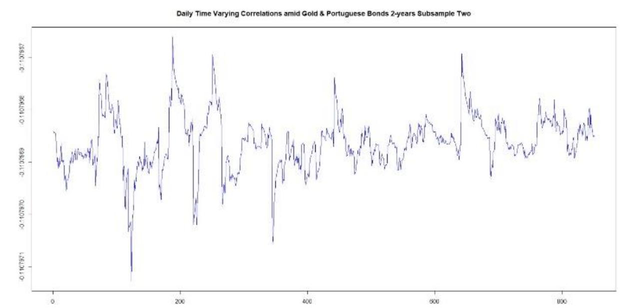

Daily Time Varying Correlations amid Gold & French Bonds 10-years Subsample Two

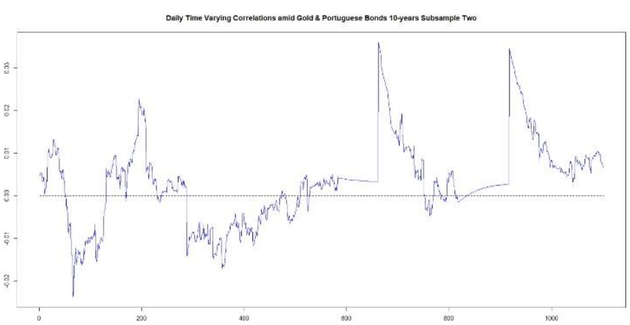

Daily Time Varying Correlations amid Gold & Italian Bonds 2-years Subsample Two

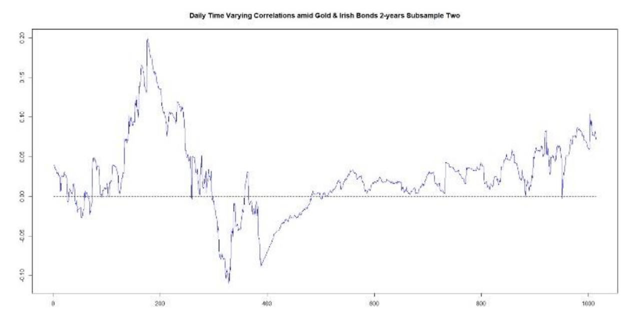

Daily Time Varying Correlations amid Gold & Italian Bonds 10-years Subsample Two

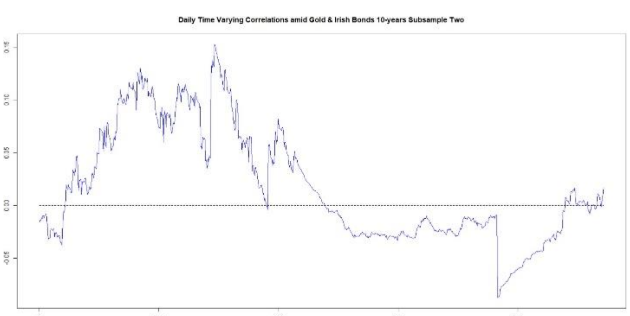

Daily Time Varying Correlations amid Gold & Spanish Bonds 2-years Subsample Two

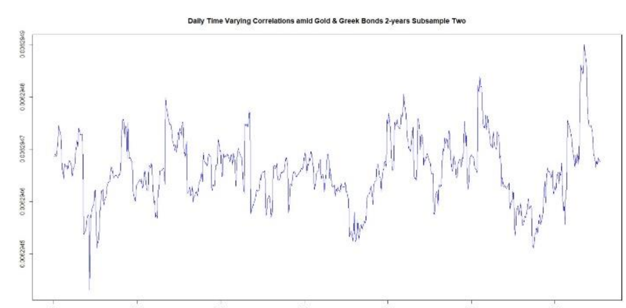

Daily Time Varying Correlations amid Gold & Spanish Bonds 10-years Subsample Two


Daily Time Varying Correlations amid Gold & Portuguese Bonds 2-years Subsample Two


Daily Time Varying Correlations amid Gold & Portuguese Bonds 10-years Subsample Two


Daily Time Varying Correlations amid Gold & Irish Bonds 2-years Subsample Two


Daily Time Varying Correlations amid Gold & Irish Bonds 10-years Subsample Two


Daily Time Varying Correlations amid Gold & Greek Bonds 2-years Subsample Two

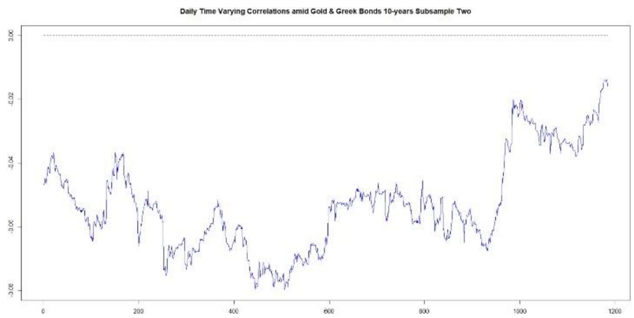
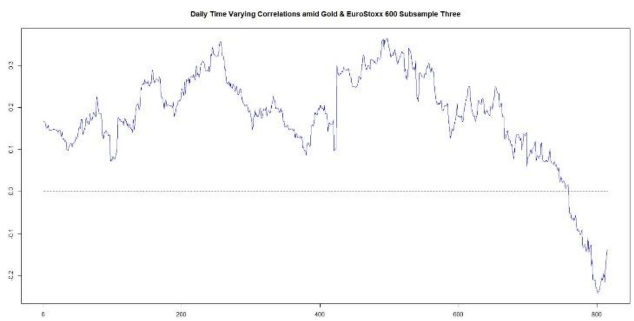
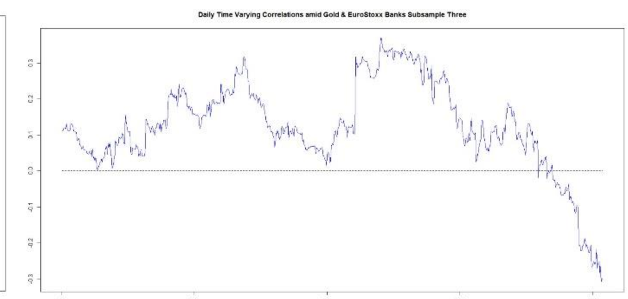
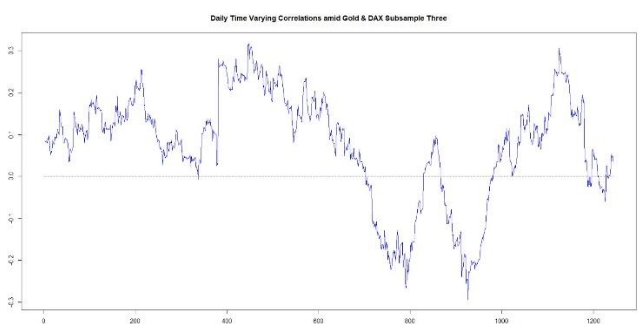
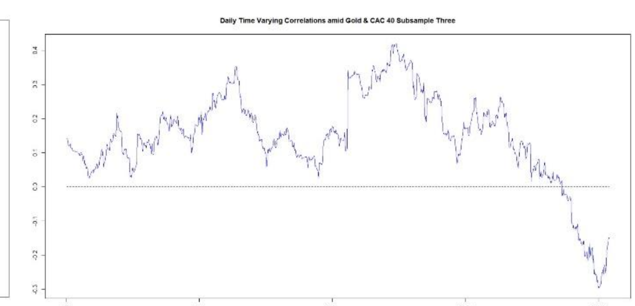


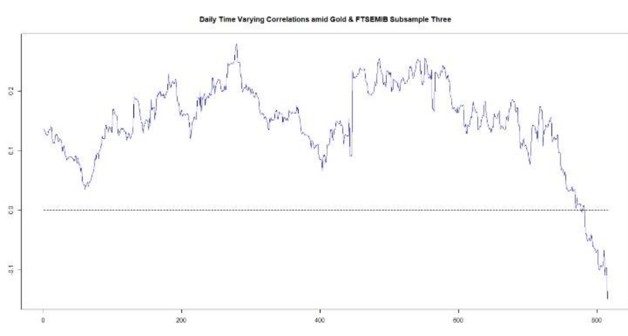
Figure 3 – Subsample 2: Daily Time Varying Correlations between Gold and each asset. From the left to the right and from the top to the bottom, we present: EuroStoxx 600, EuroStoxx Banks, DAX, CAC 40, FTSEMIB, IBEX 35, PSI 20, ISEQ, ASE, German Bonds 2 years, German Bonds 10 years, French Bonds 2 years, French Bonds 10 years, Italian Bonds 2 years, Italian Bonds 10 years, Spanish Bonds 2 years, Spanish Bonds 10 years, Portuguese Bonds 2 years, Portuguese Bonds 10 years, Irish Bonds 2 years, Irish Bonds 10 years, Greek Bonds 2 years and Greek Bonds 10 years.

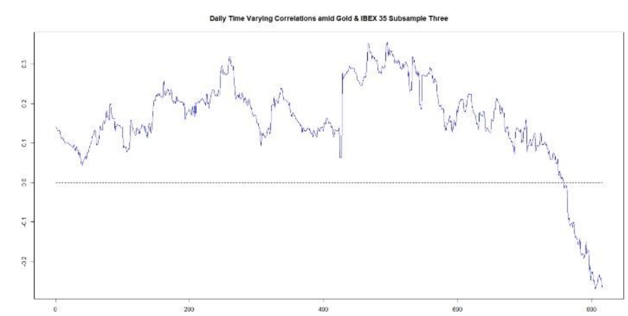


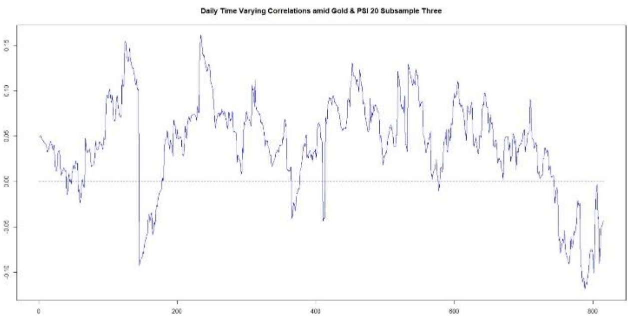


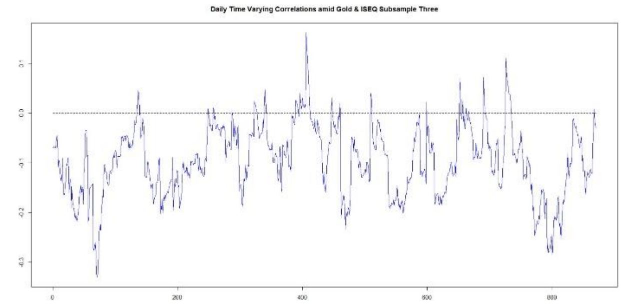


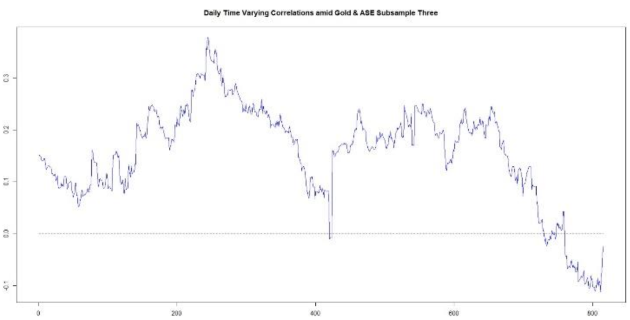


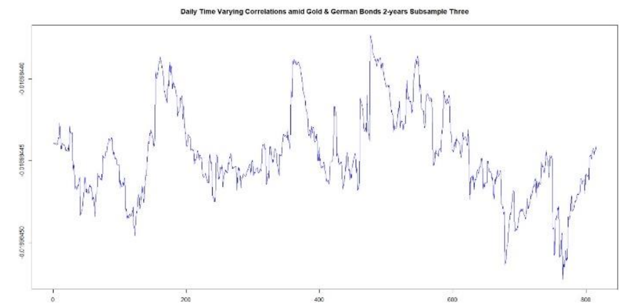


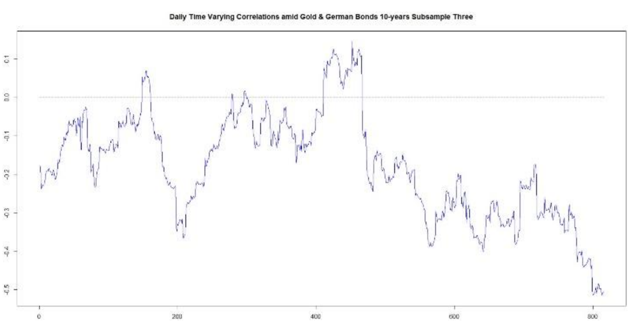


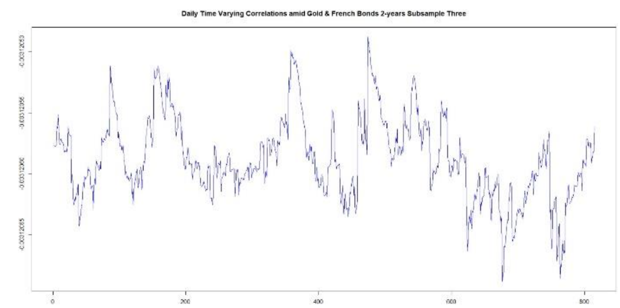

Daily Time Varying Correlations amid Gold & PSI 20 Subsample Three

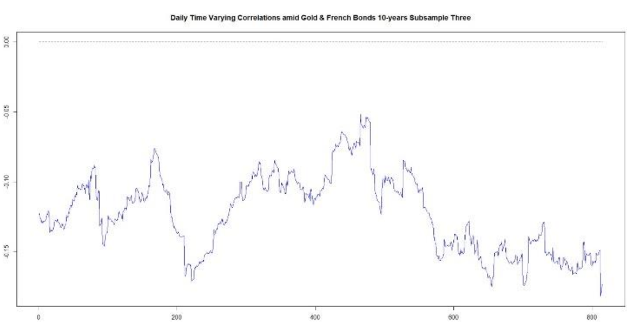

Daily Time Varying Correlations amid Gold & ISEQ Subsample Three

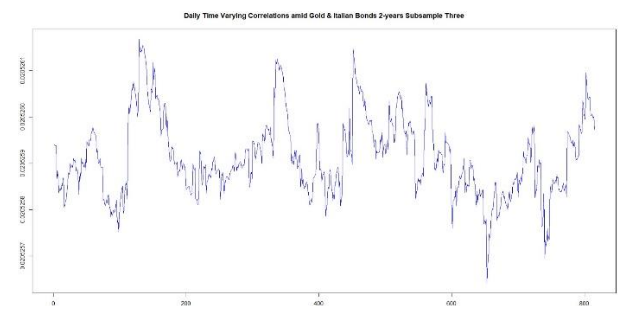

Daily Time Varying Correlations amid Gold & ASE Subsample Three

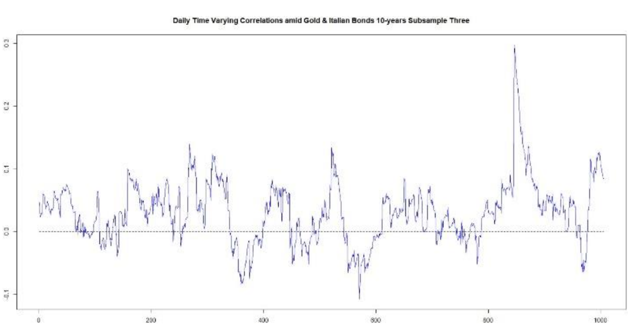

Daily Time Varying Correlations amid Gold & German Bonds 2-years Subsample Three

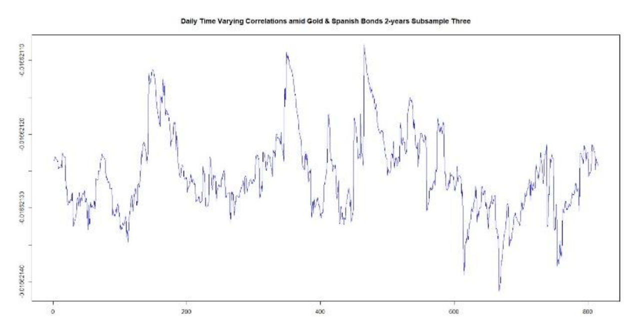

Daily Time Varying Correlations amid Gold & German Bonds 10-years Subsample Three


Daily Time Varying Correlations amid Gold & French Bonds 2-years Subsample Three


Daily Time Varying Correlations amid Gold & French Bonds 10-years Subsample Three


Daily Time Varying Correlations amid Gold & Italian Bonds 2-years Subsample Three


Daily Time Varying Correlations amid Gold & Italian Bonds 10-years Subsample Three


Daily Time Varying Correlations amid Gold & Spanish Bonds 2-years Subsample Three

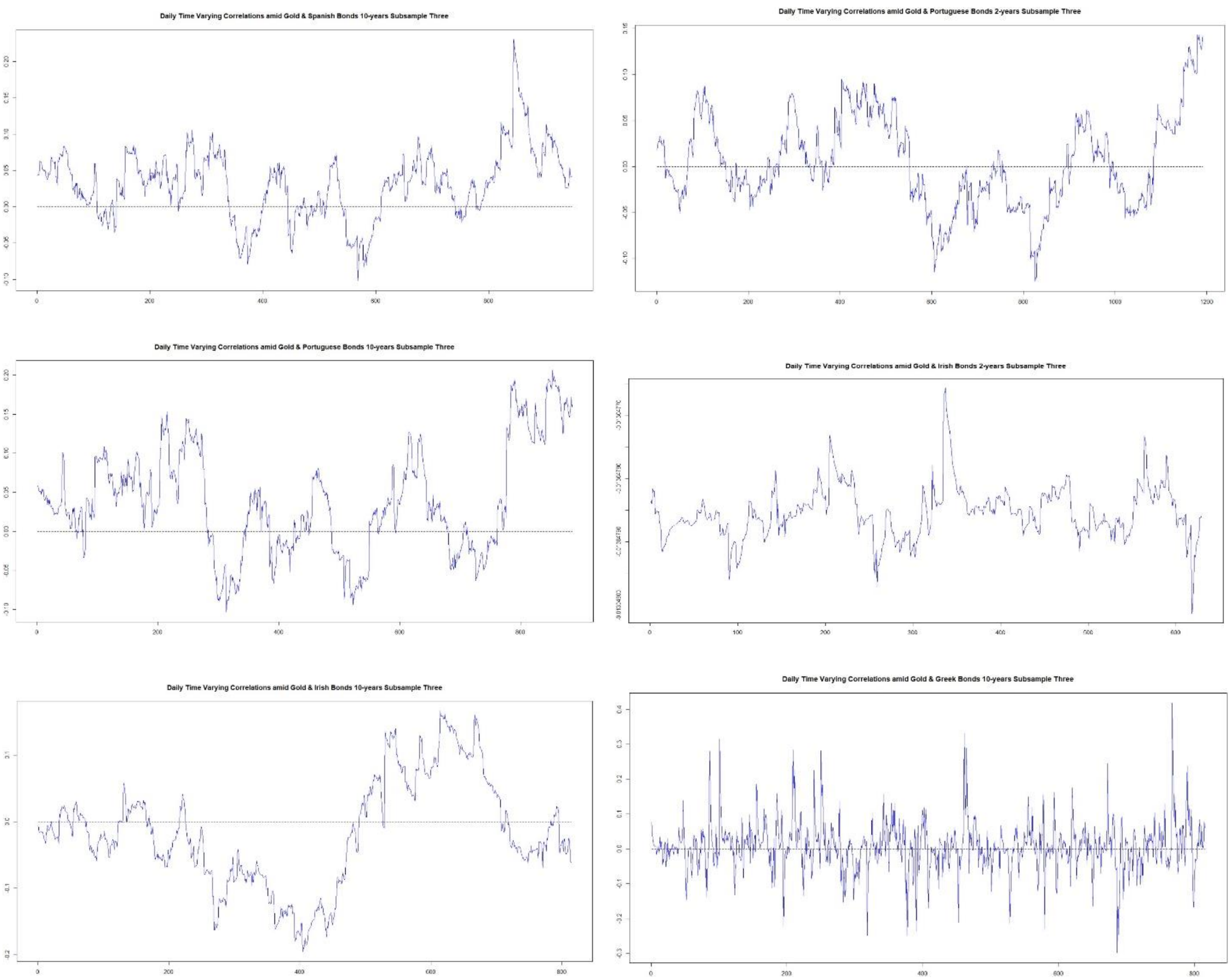
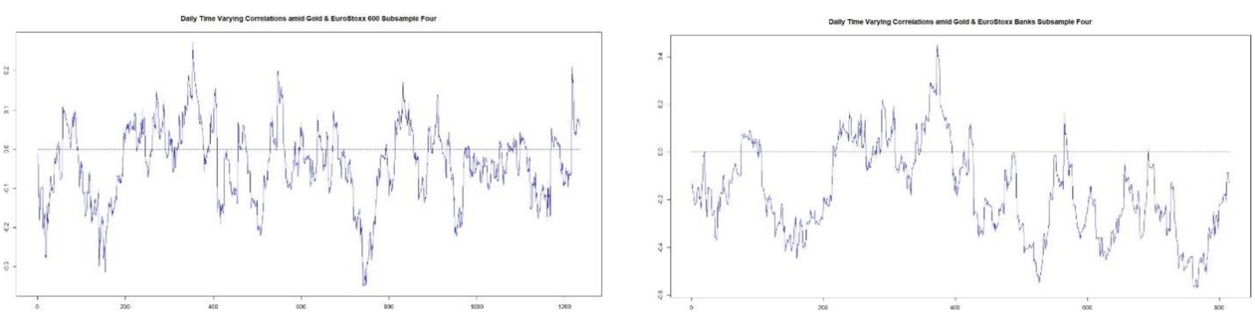
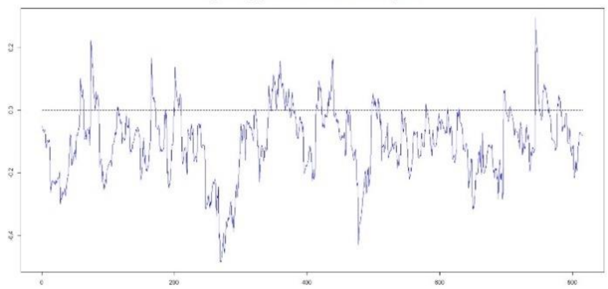


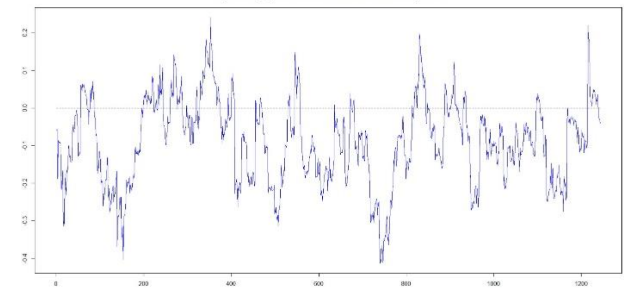
Figure 4 – Subsample 3: Daily Time Varying Correlations between Gold and each asset. From the left to the right and from the top to the bottom, we present: EuroStoxx 600, EuroStoxx Banks, DAX, CAC 40, FTSEMIB, IBEX 35, PSI 20, ISEQ, ASE, German Bonds 2 years, German Bonds 10 years, French Bonds 2 years, French Bonds 10 years, Italian Bonds 2 years, Italian Bonds 10 years, Spanish Bonds 2 years, Spanish Bonds 10 years, Portuguese Bonds 2 years, Portuguese Bonds 10 years, Irish Bonds 2 years, Irish Bonds 10 years and Greek Bonds 10 years.



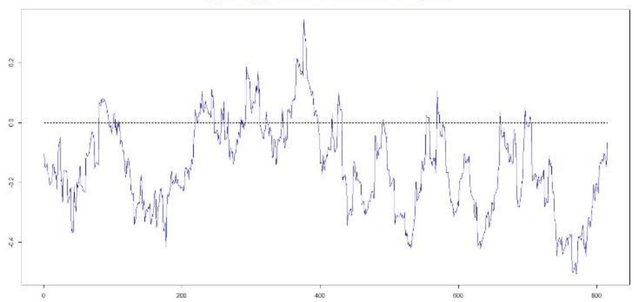
Daily Time Varying Correlations amid Gold & DAX Subsample Four



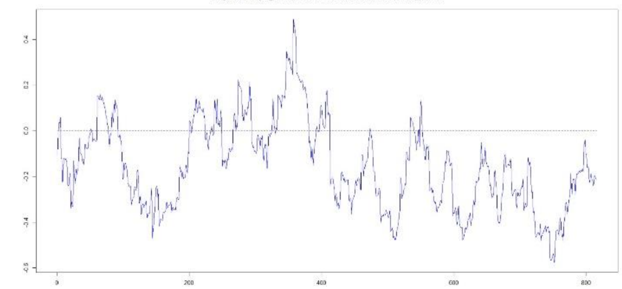
Daily Time Varying Correlations amid Gold & CAC 40 Subsample Four



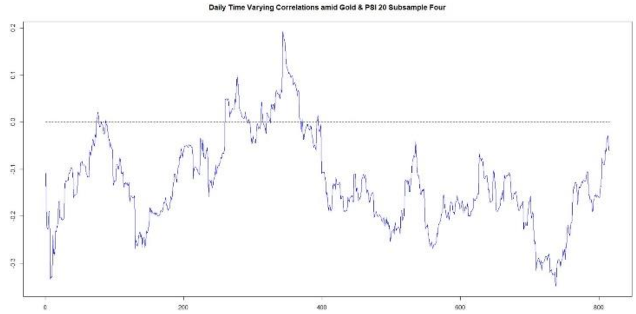
Daily Time Varying Correlations amid Gold & FTSEMIB Subsample Four



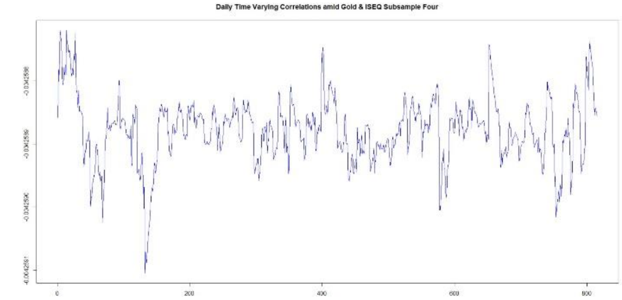
Daily Time Varying Correlations amid Gold & IBEX 35 Subsample Four



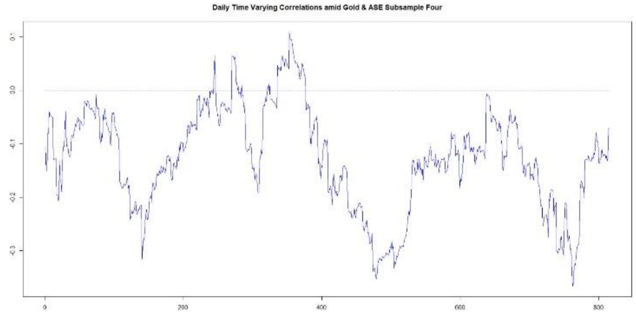
Daily Time Varying Correlations amid Gold & PSI 20 Subsample Four



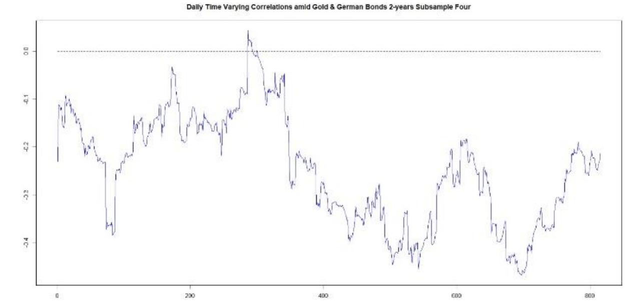
Daily Time Varying Correlations amid Gold & ISEQ Subsample Four



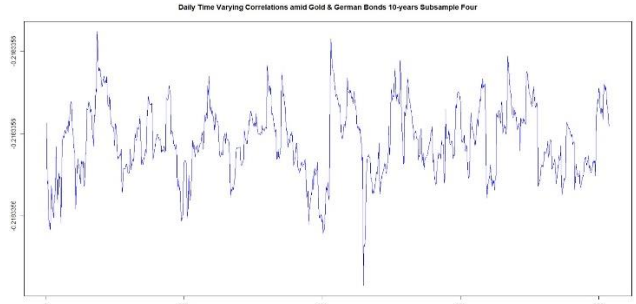
Daily Time Varying Correlations amid Gold & ASE Subsample Four



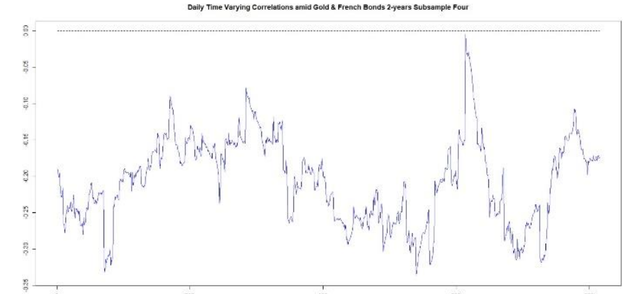
Daily Time Varying Correlations amid Gold & German Bonds 2-years Subsample Four



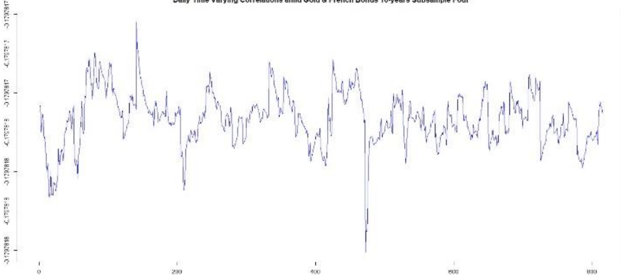
Daily Time Varying Correlations amid Gold & German Bonds 10-years Subsample Four



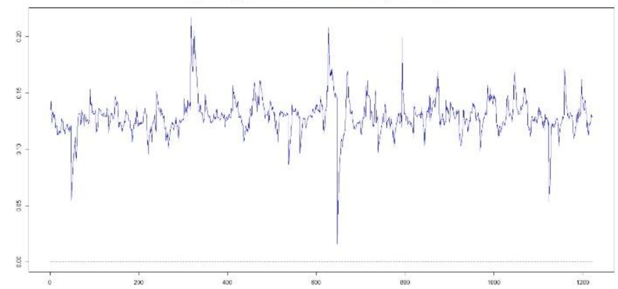
Daily Time Varying Correlations amid Gold & French Bonds 2-years Subsample Four



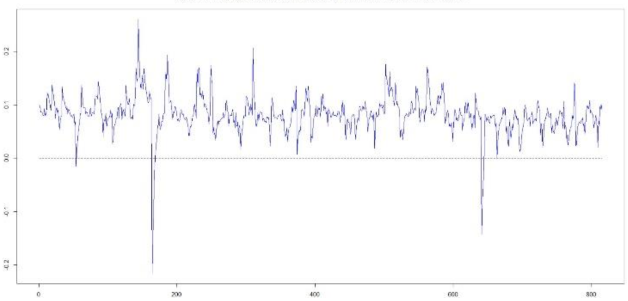
Daily Time Varying Correlations amid Gold & French Bonds 10-years Subsample Four



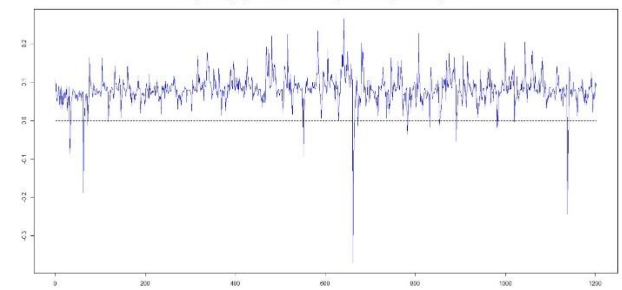
Daily Time Varying Correlations amid Gold & Italian Bonds 2-years Subsample Four



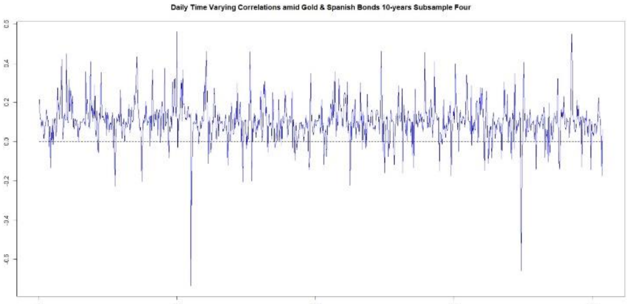
Daily Time Varying Correlations amid Gold & Italian Bonds 10-years Subsample Four



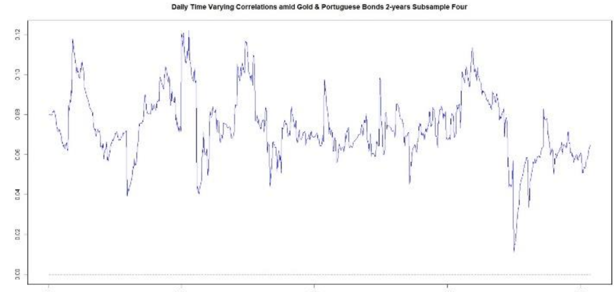
Daily Time Varying Correlations amid Gold & Spanish Bonds 2-years Subsample Four



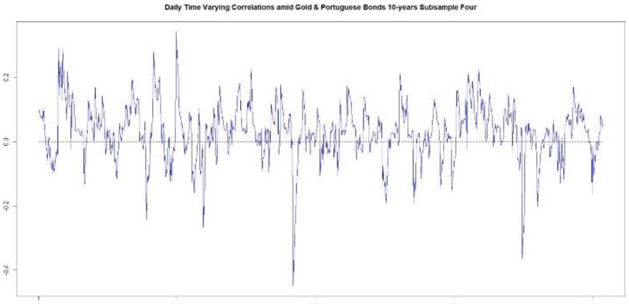
Daily Time Varying Correlations amid Gold & Spanish Bonds 10-years Subsample Four



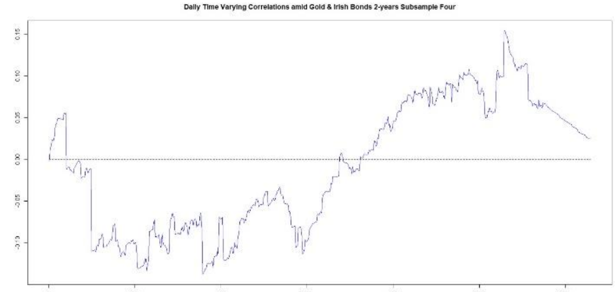
Daily Time Varying Correlations amid Gold & Portuguese Bonds 2-years Subsample Four



Daily Time Varying Correlations amid Gold & Portuguese Bonds 10-years Subsample Four



Daily Time Varying Correlations amid Gold & Irish Bonds 2-years Subsample Four



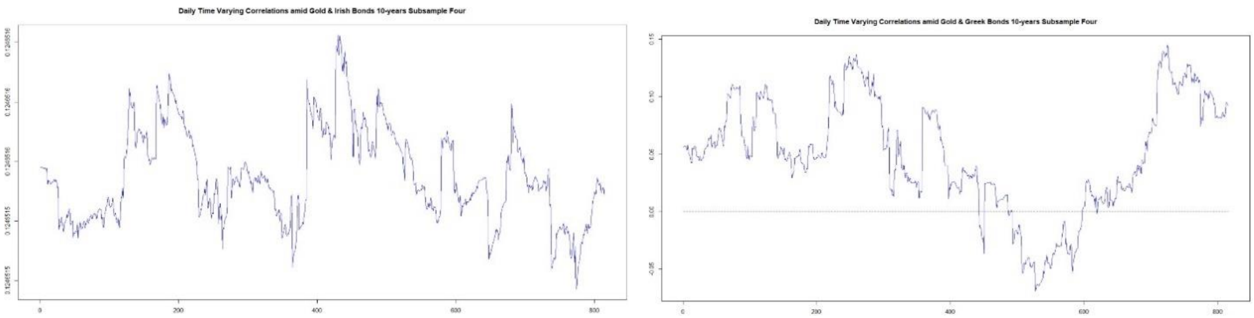
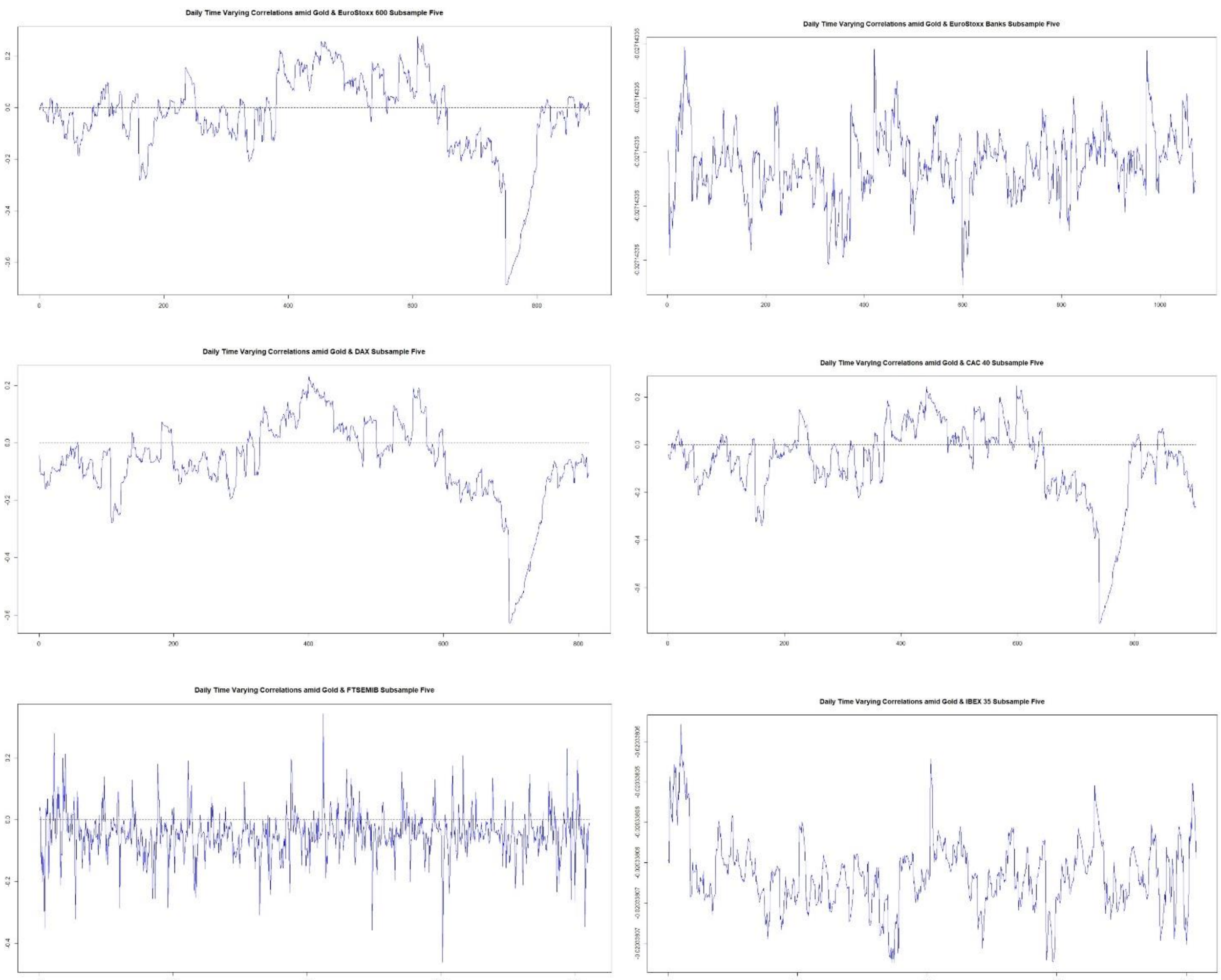
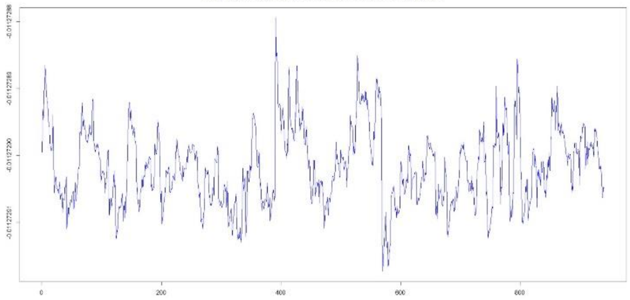


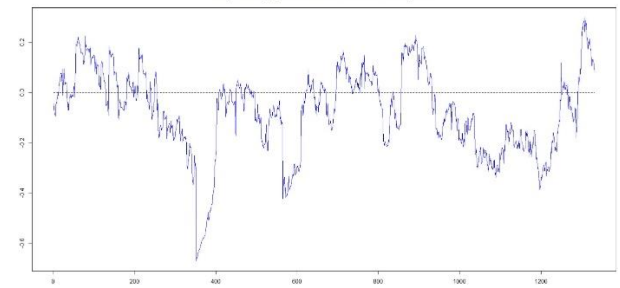
Figure 5 – Subsample 4: Daily Time Varying Correlations between Gold and each asset. From the left to the right and from the top to the bottom, we present: EuroStoxx 600, EuroStoxx Banks, DAX, CAC 40, FTSEMIB, IBEX 35, PSI 20, ISEQ, ASE, German Bonds 2 years, German Bonds 10 years, French Bonds 2 years, French Bonds 10 years, Italian Bonds 2 years, Italian Bonds 10 years, Spanish Bonds 2 years, Spanish Bonds 10 years, Portuguese Bonds 2 years, Portuguese Bonds 10 years, Irish Bonds 2 years, Irish Bonds 10 years, Greek Bonds 2 years and Greek Bonds 10 years.



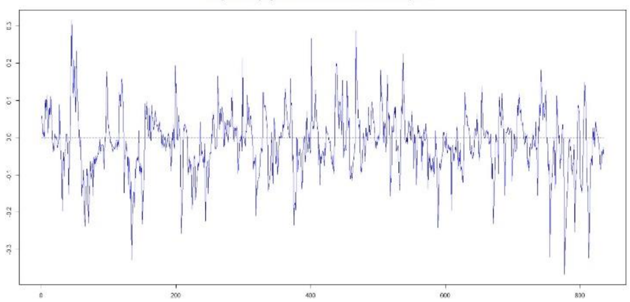
Daily Time Varying Correlations amid Gold & PSI 20 Subsample Five



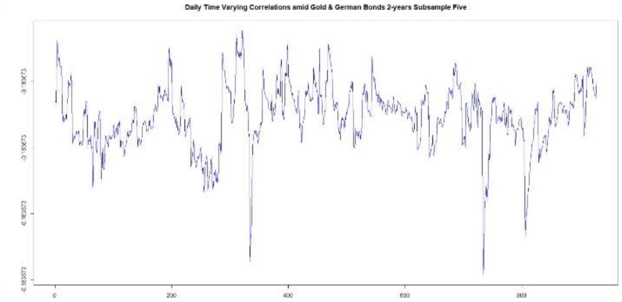
Daily Time Varying Correlations amid Gold & ISEQ Subsample Five



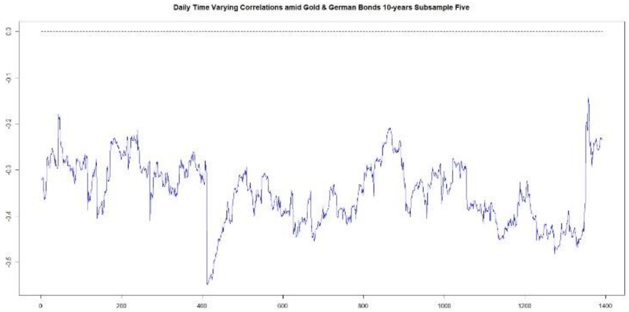
Daily Time Varying Correlations amid Gold & ASE Subsample Five



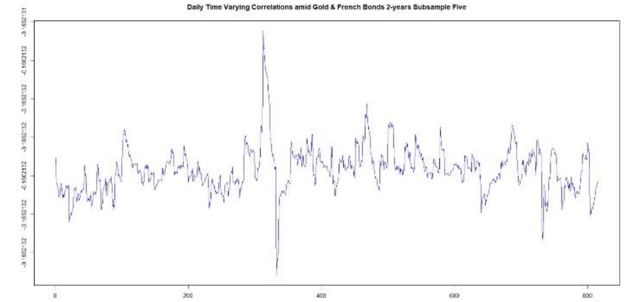
Daily Time Varying Correlations amid Gold & German Bonds 2-years Subsample Five



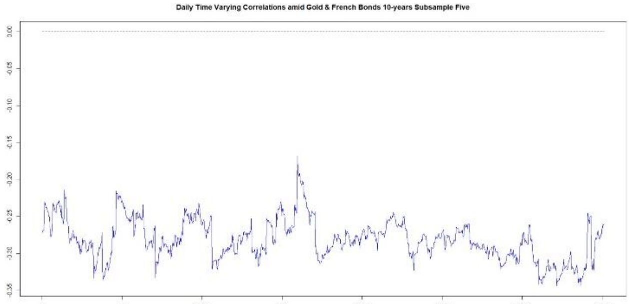
Daily Time Varying Correlations amid Gold & German Bonds 10-years Subsample Five



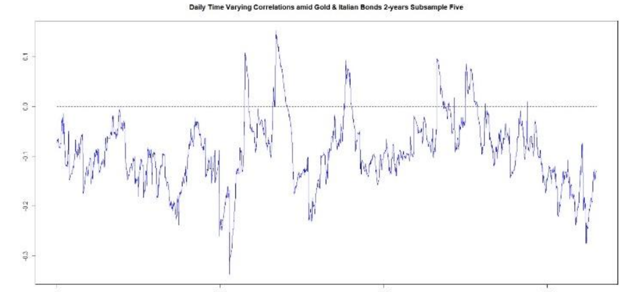
Daily Time Varying Correlations amid Gold & French Bonds 2-years Subsample Five



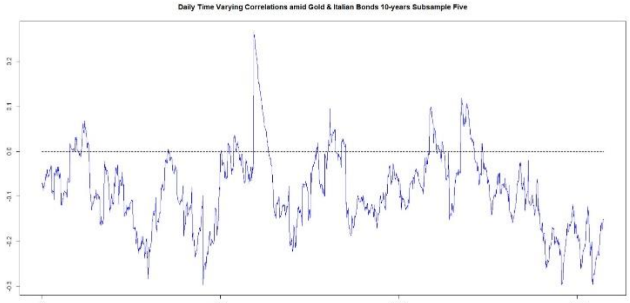
Daily Time Varying Correlations amid Gold & French Bonds 10-years Subsample Five



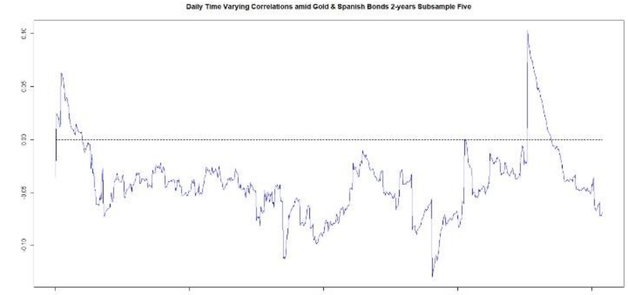
Daily Time Varying Correlations amid Gold & Italian Bonds 2-years Subsample Five



Daily Time Varying Correlations amid Gold & Italian Bonds 10-years Subsample Five



Daily Time Varying Correlations amid Gold & Spanish Bonds 2-years Subsample Five



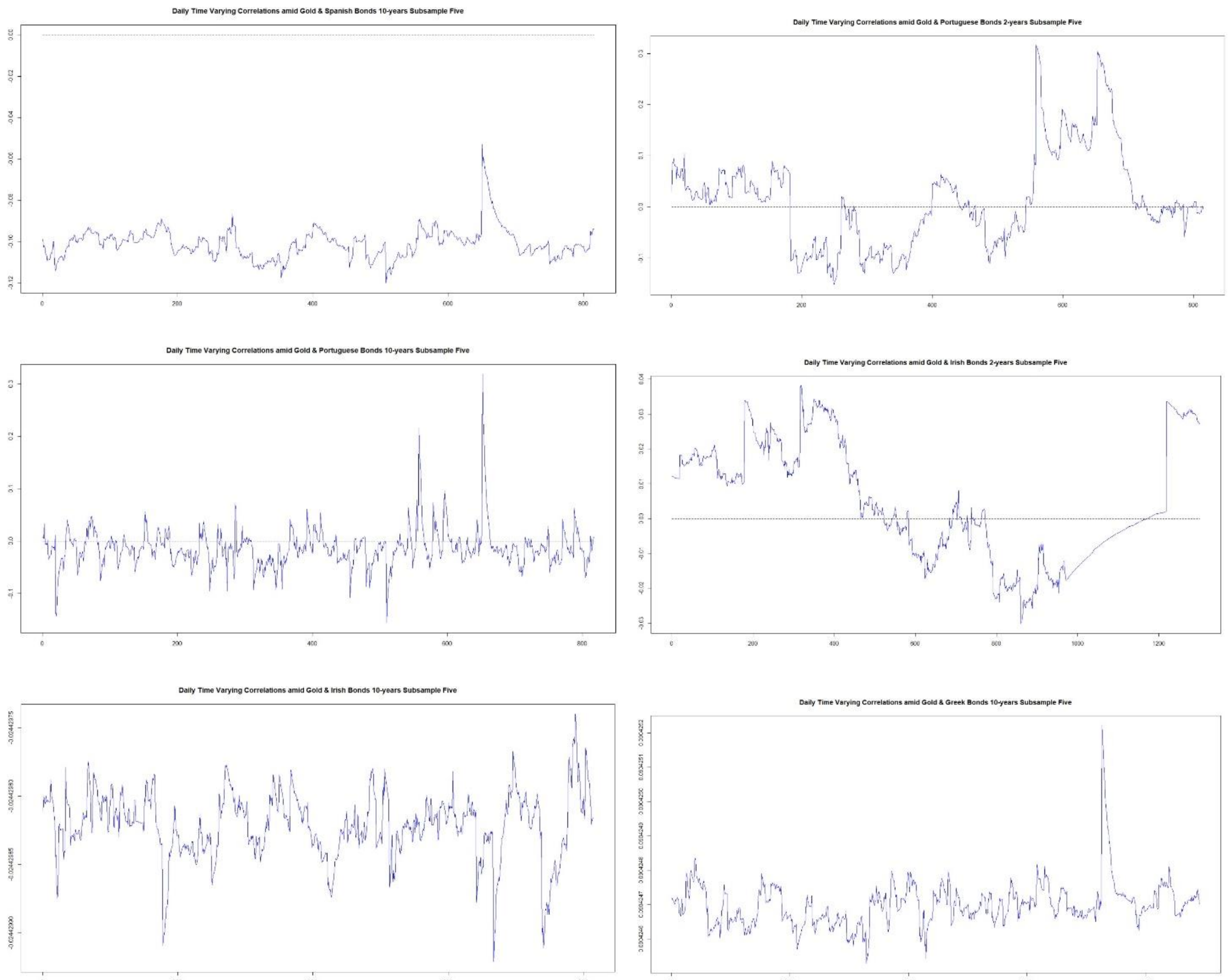
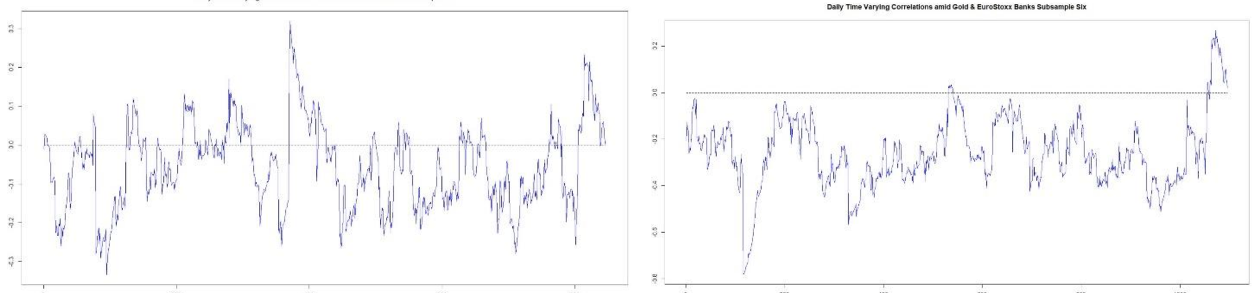
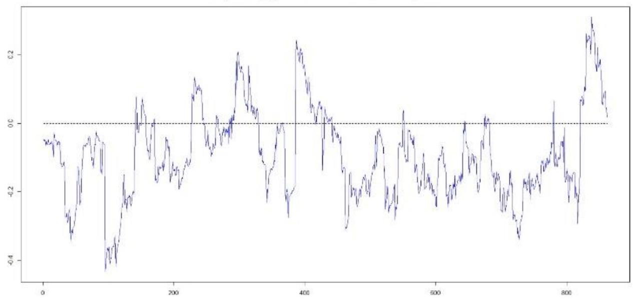


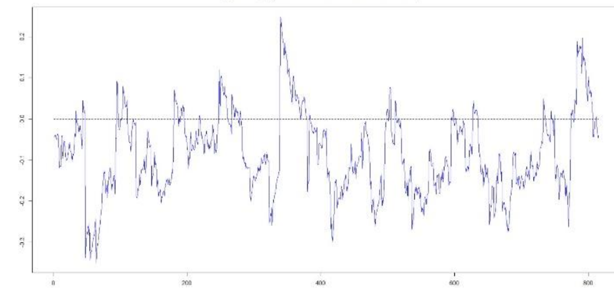
Figure 6 – Subsample 5: Daily Time Varying Correlations between Gold and each asset. From the left to the right and from the top to the bottom, we present: EuroStoxx 600, EuroStoxx Banks, DAX, CAC 40, FTSEMIB, IBEX 35, PSI 20, ISEQ, ASE, German Bonds 2 years, German Bonds 10 years, French Bonds 2 years, French Bonds 10 years, Italian Bonds 2 years, Italian Bonds 10 years, Spanish Bonds 2 years, Spanish Bonds 10 years, Portuguese Bonds 2 years, Portuguese Bonds 10 years, Irish Bonds 2 years, Irish Bonds 10 years, Greek Bonds 2 years and Greek Bonds 10 years.



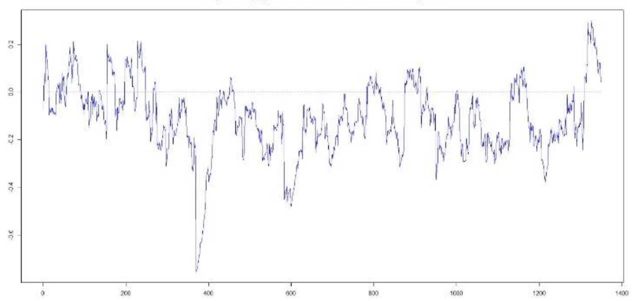
Daily Time Varying Correlations amid Gold & DAX Subsample Six



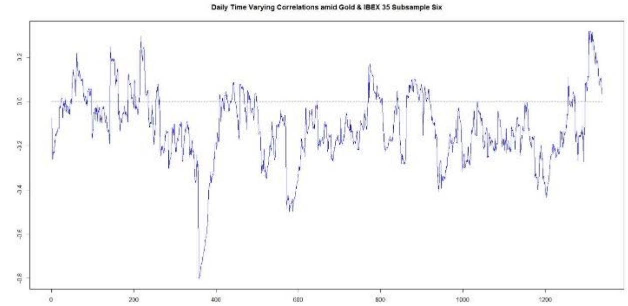
Daily Time Varying Correlations amid Gold & CAC 40 Subsample Six



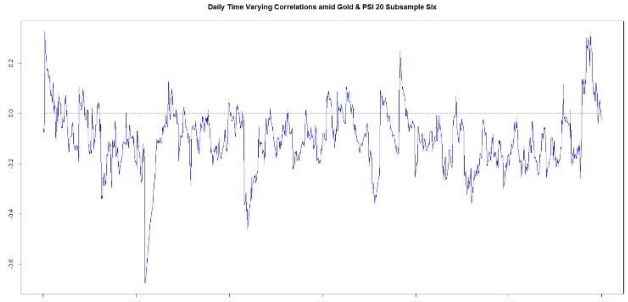
Daily Time Varying Correlations amid Gold & FTSEMIB Subsample Six



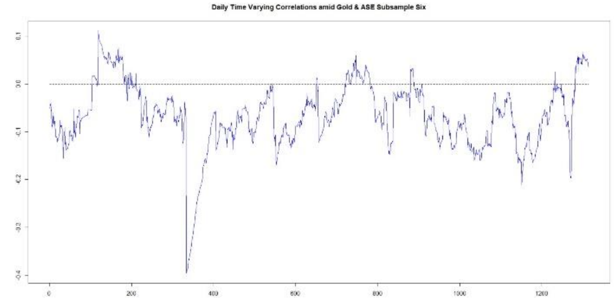
Daily Time Varying Correlations amid Gold & IBEX 35 Subsample Six



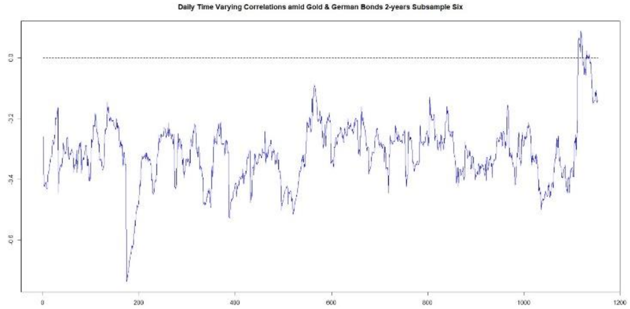
Daily Time Varying Correlations amid Gold & PSI 20 Subsample Six



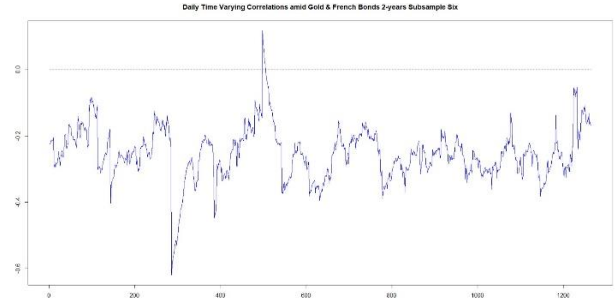
Daily Time Varying Correlations amid Gold & ASE Subsample Six



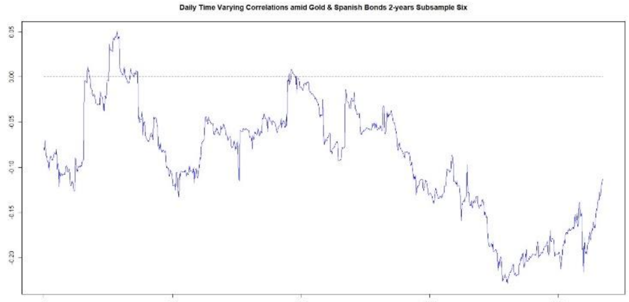
Daily Time Varying Correlations amid Gold & German Bonds 2-years Subsample Six



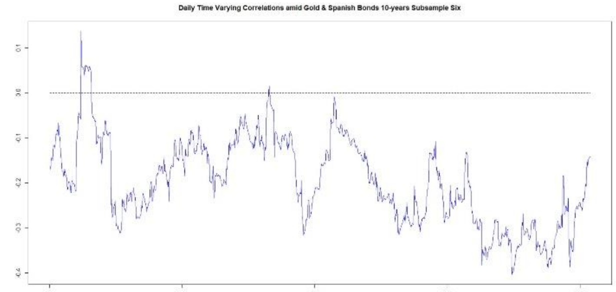
Daily Time Varying Correlations amid Gold & French Bonds 2-years Subsample Six



Daily Time Varying Correlations amid Gold & Spanish Bonds 2-years Subsample Six



Daily Time Varying Correlations amid Gold & Spanish Bonds 10-years Subsample Six



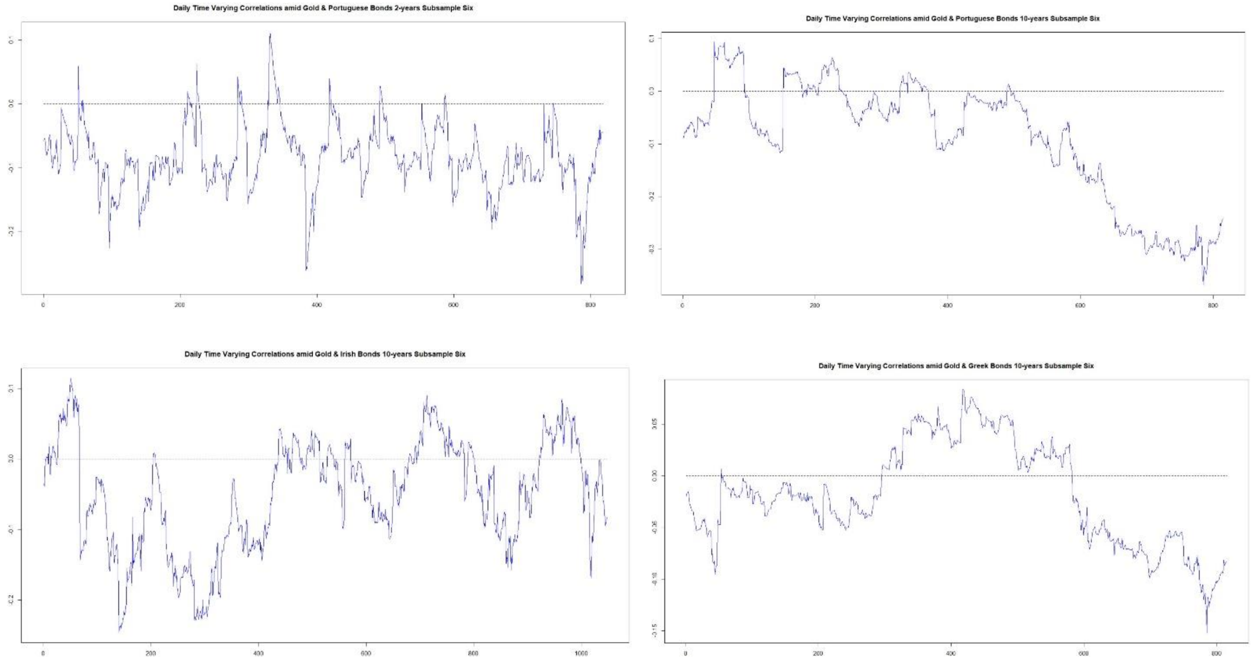


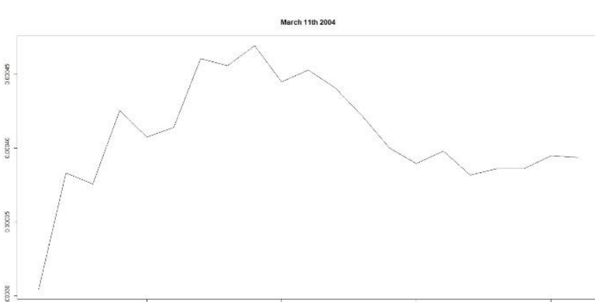
Figure 7 – Subsample 6: Daily Time Varying Correlations between Gold and each asset. From the left to the right and from the top to the bottom, we present: EuroStoxx 600, EuroStoxx Banks, DAX, CAC 40, FTSEMIB, IBEX 35, PSI 20, ASE, German Bonds 2 years, French Bonds 2 years, Spanish Bonds 2 years, Spanish Bonds 10 years, Portuguese Bonds 2 years, Portuguese Bonds 10 years, Irish Bonds 10 years, Greek Bonds 2 years and Greek Bonds 10 years.

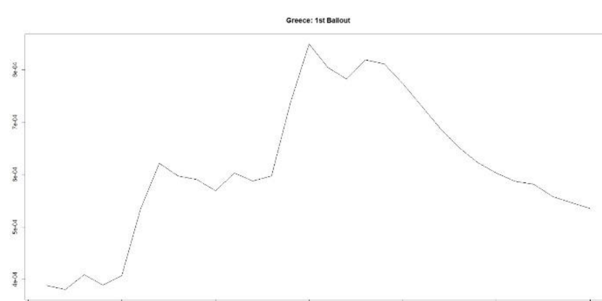
Annex G – Events candidate to be included in Specific Periods' Regression

In Annex G, we present the events candidate to be included in Specific Periods' Regression, its beginning and ending dates, as well as the justification to be considered as a candidate.

Event	Beginning Date	Justification	Ending Date	Justification
September 11th 2011	11/09/2001	Terrorist	31/10/2001	Precedent from Baur and McDermott (2016)
March 11th 2004	11/03/2004	Terrorist	08/04/2004	Based on the decrease of the proxied volatility
Lehman Brothers collapse	15/09/2008	Financial	31/10/2008	Precedent from Baur and McDermott (2016)
1st Bail Out - Greece	03/05/2010	Financial	11/06/2010	Based on the decrease of the proxied volatility
Bail Out Ireland	28/11/2010	Financial	07/01/2011	Based on the decrease of the proxied volatility
Bail Out Portugal	07/04/2011	Financial	31/05/2011	Based on the decrease of the proxied volatility
2nd Bail Out - Greece (asking)	21/07/2011	Financial	19/08/2011	Proxied volatility does not decrease and a Safe Haven has limited time period (defined arbitrarily)
Political Turbulence September to October 2012	28/09/2011	Financial/Political/Economic: Political declaration	27/10/2011	Agreement between European leaders to a debt deal
2nd Bail Out - Greece (approval)	21/02/2012	Financial	30/03/2012	Proxied volatility had a first low decrease and was increasing and due to Safe Haven's definition we defined arbitrarily the date
Greek Elections 2012	07/05/2012	Political	22/06/2012	Based on the decrease of the proxied volatility
Spanish Banks Bail Out	09/06/2012	Financial	13/07/2012	Based on the decrease of the proxied volatility
3rd Bail Out - Greece (asking)	08/07/2015	Financial	19/08/2015	ESM board of governors approve the Memorandum of Understanding
Brexit Referendum	24/06/2016	Political	22/07/2016	Based on the decrease of the proxied volatility
COVID-19 outbreak	24/02/2020	Sanitary	09/04/2020	Based on the decrease of the proxied volatility

Table 51 – Events candidate to Safe Haven





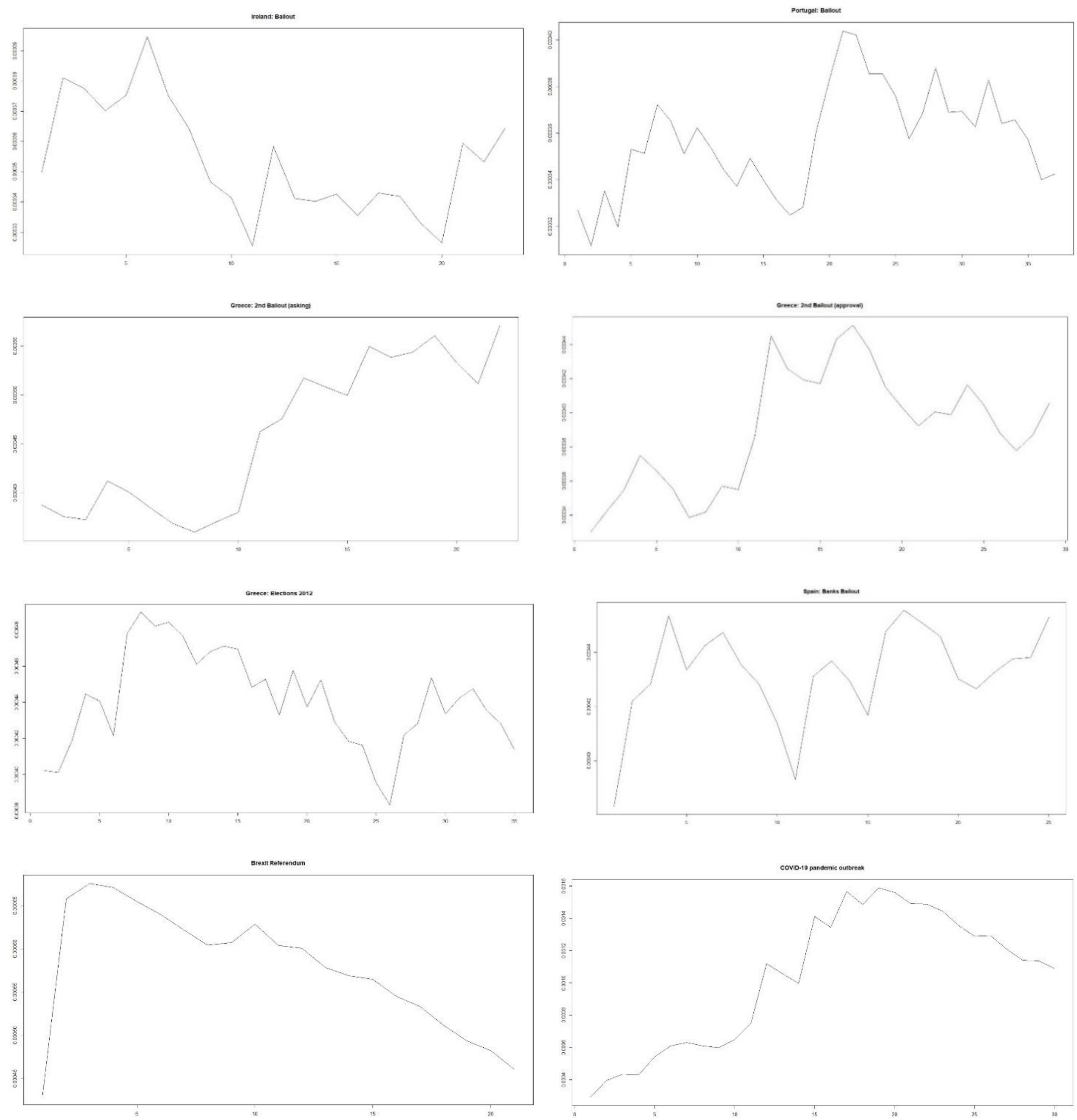


Figure 8 – GSFCIEA volatility by an EGARCH with Student's T distribution. We use this proxy to define the end period in Specific Periods' Regression, for the period in which there are not any precedent in literature. From the left to the right and the top to the bottom the periods are the following: March 11th 2004, first Bailout to Greece, Irish Bailout, Portuguese Bailout, asking for second Bailout by Greece, approval of second Bailout to Greece, Greek elections 2012, Spanish Banks Bailout, Brexit Referendum, COVID-19 pandemic outbreak.