UNIVERSITAT JAUME I
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ON THE RELATIONSHIP BETWEEN ECONOMIC POLICY UNCERTAINTY AND VOLATILITY: INTERNACIONAL EVIDENCE

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INTRODUCTION

During the financial crisis started in 2007 due to the fall of Lehman Brothers Bank, the volatility in the markets and the uncertainty of the investors, increased in an abrupt manner. The investors and with they the markets enter in a period (from 2007 since 2013 approximately) of financial instability where the value of the assets change quickly from one day to another by the adverse situation that the states were passing, with their sovereign debt and the probability of enter in a great bankruptcy.

By one hand the uncertainty that creates the situation since the crisis makes its entry, the investors decide to wait to make their decisions of investments because the great level that the volatility can reach in the markets cannot be quantify and be higher than the day before creating a great level of uncertainty. So to quantify the measure of uncertainty of a country was created an index called the Economics Policy Uncertainty (EPU) (**Ross Baker, et al., 2016**) that measures the uncertainty of the countries. How uncertainty is obtain it is explained later in the chapter of Economics Policy Uncertainty.

By the other hand the European Central Bank like others central banks in the world decides to avoid troubles like this in the future and use an indicator that helps to prevent the periods of high volatility in the financial systems of the countries and measures the increment of systematic risk that the set of the markets suffer due to the reaction to some act or new unexpected that are capable to make the systematic risk increase. That is the principal purpose of the Country Level Index Financial Stress (CLIFS) **(Duprey, et al., 2015**) that it is explain in a more detailed manner in the chapter Country Level Index Financial Stress.

Aside for a creation of the financial stress index the regulation that affects the banking system was remodelled to prevent the same situation that produced the crisis creating the stress testing for the banks to guarantee the solvency in case of future impact situations.

The principal objective of this paper it is know if the variations that suffers the uncertainty measures with the EPU can be explain with the variations of the volatility in the financial system of Spain using the CLIFS. And compares it with others countries of Europe (Germany, France and Italy in this case) to know if that relationship between volatility and uncertainty can be used only for Spain or can be used for the rest of the countries of the sample.

Using for that purpose a linear regression model that helps to explain in a specific way the value of the variaitons of the CLIFS that explain the variations of the EPU for the sample.

The content of this paper is distributed in the next way:

- In the conceptual framework are explained the concepts of Uncertainty, risk and volatility in the first chapter. In the second and the third Chapter are explained accordingly the EPU and CLIFS. Finally in the four chapter we find an explanation of what is a linear regression model.
- In the methodology are realised the correlation analysis of Spain, Germany, France and Italy.
- And in the third part are explained the results for the group of analysed countries and the conclusions arrived following the results.

CONCEPTUAL FRAMEWORK

UNCERTAINTY, RISK AND VOLATILITY.

The uncertainty can be define according to Business Dictionary, like a situation when the actual state of knowledge is such that the consequences, extent or magnitude of circumstances or facts are unpredictable. This unpredictability is the difference between a good and a bad decision. This definition has two important implicit terms, risk and volatility. Both will be explained now.

By one hand, the risk may be explained as a possibility of loss caused by external agents (Business Dictionary, n.d.). In finances exists two kind of risks (Non-systematic and systemic) and inside this two groups exists other groups of risk: (Investopedia, n.d.)

Non systemic risk. This risk is a risk that affect a particular market, enterprise or asset. This kind of risk can be reduced using the technique of the diversification and reduced the negative effect of its variation. Like it is said before in this risk exists a group of sub risk which are explicated now:

- **Business risk.** This risk includes the possibility of obtain a lower profit of a business or having a loss instead a profit. For this sub risk exist four categories:
- ***Strategic risk***. It is occurs when the way that takes the business it is not the way that has been proposed in the plan. If a company change the plans established in a bad way, the strategy it is not all the effective that it is has to be and the business can reach the objectives.
- ***Compliance risk*.** This risk it is particulary strong in sectors with very restrictive laws.
- ***Operational risk***. This risk it is related with the daily routine of the firm. This appears with the firm fails n that operations.
- **Liquidity risk.** This risk implies the possibility of that an asset can be sold in a quickly way in the market. In other words, the firm or the financial institution can turn its assets into cash due to lack of buyers or a market that is not big enough. This risk affects specially the short term debt. There are some differences between the liquidity risk in the companies and the liquidity risk in financial institutions.
    - Companies. The level of this risk it is decide using ratios. A watching the levels of liabilities and the assets in the short term to keep it in a desired level.
    - Financial institutions. It is important for that kind of institutions has a cert level of financial stability in case a period of shortage came. Their stability it is observed with attention. To maintain that level of stability, they are submit to stress test and compliance requirements.
- **Financial risk**. Can be expressed at the risk that in the corporation or a country in the case of bonds does not attend its obligation and enter in default. The changes in the price as of the assets due to political changes, foreign conflicts, natural calamities of differences in the market can increase the volatility in the foreign investment and create a retire of funds that create a bankruptcy in the system.
- **Political risk**. In this category it can be find that risk that affects in a negative way the investors due changes in the laws and the politics of the country. This kind of risk it is difficult of measured.

- **Sovereign risk**. This risk it is related with a change in the rules that makes a central banks. This risk can make a forex contract loss in a full or partial way its value.

- **Tax risk**. This risk implies that a change in the taxation make it by the government can reduce the value of the investment.

- **Credit risk**. It is the risk that the lender cannot attend tis obligations of payments.

- **Call risk**. This is the risk that a holder confront of a callable bond that a bond issuer will take a favourable position of the callable bond feature and pay off the issue before the end of its maturity. This mean the investor will reinvested the bond in a less favourable scenario.

Systemic risk. This risk is implicit in the markets and in the financial system and cannot be diversified like the non-systematic risk. This risk cannot be mitigate, it is always exist and, so, in this risk is higher, the volatility is higher and with more volatility in the markets more uncertain it is the future of that market and less interested is the investor to make its invest. In this case the sub risk are:

- **Purchasing power risk**. This sub risk it is related with the loss of value in the investment by the level of the inflation.

- **Interest risk rate.** This kind of risk affects the investment due to the change of the interest rate can reduce or increase the final value of the investment. This risk has a great directly effect to the bond, because when the interest grows the value of the bond decease and vice versa. This relation between the interest rate and the bonds that makes that the cost of opportunity of maintain the bond decease and the investors changes their investments into other products or market with a major interest rate. Price sensitive it is created when the process of security with some term of maturity are more sensible to increment of the market interest rates and giving as a results a deceiver decline in the value of securities . The long term securities has more interest rate than the short term and though leads to a more sensitivity of its prices and taking more risk. To compensate that excess of risk the expected return on securities with long term includes a risk premium, which is the extra rate return for the extra risk taken.

- **Exchange rate risk.** It is the risk of the change in the value of a foreign coin.

- **Reinvestment risk.** In this type of sub risk is related with the interest rate that the inversion will be reinvested can be reduced and decease the value of a coupon too. Explained in another manner this risk happens when the investor cannot invest the return of the investment at the same rate that as the rate that was invested. This risk can be reduced investing in zero-coupon bonds because this bonds are free of risk.

By another hand volatility it's defined in Investopedia such as a statically measure of the dispersion of returns for a given market index (Investopedia, n.d.). To more volatility more risky is the investment, due to the fact of the fluctuations of the value of an asset, if this fluctuation is bigger, exists a high probability of get more dispersion and therefore more risk of obtaining a bad outcome. Exists three types of volatility (Radtke, 2014)

- **Historical volatility:** To measure this type of volatility it is based in the past movements of the prices or the value of an index.
- **Relative volatility.** It is the correlation coefficient between two price series of a security or an index. In this correlation coefficient know as beta is greater than 1, indicate that the stock moves in a greater way than the market. The contrary happens when the beta has a value of -1
- **Implied volatility**. It is the expected volatility for the future between the present price and the expectations of the investors in the options.

ECONOMIC POLICY UNCERTAINTY (EPU)[1]

To measure the uncertainty in this paper, the set of data used for the calculations will be taken from the Economic Policy Uncertainty index, which calculation is explained in the next paragraph.

The Economic Policy Uncertainty **(Ross Baker, et al., 2016)** is an index that measures the uncertainty related with the policy economics. This index has three components:

- **Newspaper reports.** An index is created due to the examination of the most important newspapers in every country. In the research of every article that contains

[1] Data obtained from : http://www.policyuncertainty.com/

the key words economic policy uncertainty. The key words are uncertainty or uncertain, economic or economy, congress deficit legislation or regulation among others that enters in the categories of policy uncertainty and economic. .The intention of knowing how many articles has the key words is known about the how many interest has a country, for example, about the uncertainty in the economy. In a more specific way, to make the index, they focus they search in this parameters:

- The person or group of person that make the decision that lead to that uncertainty.
- The actions that would be taken under that policy.
- When the policy will be execute.
- The consequences of the past, present and future of the actions that the policy carry.
- The result of no make any action and creates uncertainty.

After the research of the words in the newspapers articles they create a range counting the total numbers of article in the same month and in the same newspaper. Thanks to that process it is possible to generate an EPU series from month to month of every newspapers, for later normalized that series using the standard deviations.

- **Tax code provisions**. Based on the announcement by the Congressional Budget Office (CBO) that gather lists of the temporary federal tax code provisions. Thanks to that provisions a list of annual dollar weighted numbers can be created. In that list are included the dollar weighted numbers that are expected to finish over the next 10 years. This list allows the opportunity to know the level of unpredictability that can take the tax code in a future. Usually the CBO hold to the last moment before take any decisions about the taxes whether to continue with the actions that they are doing, undercutting stability and making the path that will take the taxes less certain. To calculate the EPU it is necessary know the absolute dollar value of the expiring tax provisions of every year inside a period of 10 years. After that, a discount of the 50% is applied to the future expirations and then, we sum the discounted dollar weighted tax code expirations. Thanks to that calculation process, we obtain an index amount in January that will be constant during a period that comprise a year. Then an annual discount rate it is apply the tax provisions due to some provisions are established to expire in the next years.

- **Division between forecasters.** This component uses the dispersion between the forecast of the members of the Federal Reserve Banks of Philadelphia's Survey of Professionals Forecasters, this forecast it is create for each quarter of a year. Specifically in this component it used the individuals predictions of the future levels of: Consume Price Index (Inflation), Federal Expenditures, State and Local Expenditures. These variables were choose due to the strong relation that exists between the monetary and fiscal policy and these variables.

After knowing the predictions, they take the cross-sectional dispersion of every single prediction as a representative measure of the evolution of the future outcome. For calculation of the elements mentioned before, it uses the same procedure:

  - Inflation. Individual predictions of the CPI inflation rate of every quarter of the year. Four periods every year. For the measure of the dispersion of this parameter it is necessary the calculation of the interquartile range of inflation rate of the predictions.

  - For the federal, local and state expenditures they follow the same method. This methodology consists in divide the interquartile range of four-quarter-ahead predictions by the average four-quarter-ahead prediction and multiply by a 5-year retrospective moving mean for the ratio of the nominal federal purchases to nominal GDP. After that calculations for three parameters, we make the sum to know a global amount of forecaster difference about future expenditures.

For Europe in this case for Spain, Germany, France and Italy the measure of the EPU differ of the used for U.S. In that case the authors Ross Baker, et al. use the 50% of the index, is constructed with the news-based and the other 50% comes from the differences between the predictions of the forecasters. The newspapers from Spain are El Pais and El Mundo looking for the key words in Spanish and the authors clear the range using the word today and we rescale to group standard deviation before 2011 and then aggregate across papers monthly. For the differences between predictions of the forecasters we trust in individuals predictions of the CPI inflation and the federal government budget balance variables given by the Consensus Economics. We calculate the basic IQR of the inflation by country and month for our inflation disagreement amount and the IQR of the budget balance predictions of Spain using as scale the GDP for the fiscal disagreement measure. It is necessary deseasonalize the IQR of the predictions resulting amount. The next graphic represents the evolution of the EPU index for the case of Spain.

COUNTRY LEVEL INDEX FINANCIAL STRESS (CLIFS)[2]

A financial stress index is a measure for express the situation of the systematic risk in a country, in order to advice in this risk increase due to a stress event. All the elements selected in this indexes are chosen because they reflect in a proper manner the behaviour of the markets. This kind of indexes help the policy makers to take actions to prevent the consequences of the increments of stress. The systemic risk are related with this factors (**Estévez Cerqueira & Cambón Murcia, 2015)**:

- magnitude
- interconnectedness
- lack of substitutes and concentration
- lack of clearness
- weight
- behaviour of the participants in the markets
- moral threat
- Information asymmetry.

Systemic financial stress event can be define as a period of financial market stress related with a negative and lengthened shock in the economy, or, episodes of stress in the real economic, that cannot be classified as recessions but are related with a high level of financial stress. For this paper the measure of the volatility in the financial markets will be taken from the Country-Level Index of Financial Stress **(Duprey, et al., 2015**), which is explained in the next paragraph.

To compute the CLIFS, they extract the data of 3 financial markets: equity, bonds and foreign exchange markets.

- **Equity markets**: To measure the stress in the equity markets exists two variables. The monthly realised volatility and the cumulative maximum loss. This variables creates two sub index or subgroups in this market and in the others.

[2] Data obtained from: https://sdw.ecb.europa.eu

- **Bond markets**: To calculate the stress in this markets it is necessary the use of two variables, the monthly realised volatility and the cumulative difference of the maximum increase of the real government bond spread with respect to Germany over a two year rolling window.
- **Foreign exchange markets:** To compute the stress in the foreign exchange markets exists two variables: the realised volatility and second the longing lasting changes in the real effective exchange rate

After the extraction of the data, the next step is convert the indicators mentioned above in one.

For that purpose **Duprey, et al** used the cumulative density function. The CDF make the transformation of every variable into percentiles. After obtaining the percentiles, the next phase it's aggregate every market using the average. The average can be used because for every single market they have calculate the same which is the volatility and the maximum losses of every market.

Once the sub index are aggregate, the next step is to know the cross -correlation of the sub-indexes doing this the index will show us the augment or diminution of the risk because the link between the co movements in the overall financial system stress.

FSI can be calculated using the next expression: $FSIt = \mathbf{I}t \cdot Ct \cdot \mathbf{I}t,$

It is the standardised index

Ct is the time varying cross correlation. This correlation is calculated using the exponentially weighted Moving Average with 0,85 as the value of the smoothing parameter.

To identify a financial stress event it is necessary follow the next steps (Duprey, et al., 2015):

- The periods stress events can be identify using :
    - The production growth. If there exist at least six consecutive month with a decrease of the annual production growth.
    - Overlay at least a part with a fall in real GDP during at least two quarters.
- Establish the start period of the next period of the financial stress.
- Figured it out and end date for the financial stress.

- If the financial stress happens during a period of lengthened of economic stress since the past period of financial stress linked the period of financial stress with the preceding period of systemic financial stress.
- A systemic financial stress can be define as a period of 6 months in a consecutive way of real economic stress or during one year following the opening of the financial stress period, or, during the full financial stress period if it not finishes in one year
- A financial stress period cannot be considered systemic when:
    - If another financial period ended less than two quarters before the presently established start date.
    - The period has been continued by incorporating two adjacent financial stress episodes
    - If no exists any other financial stress episode in the previous six months.

LINEAR REGRESSION MODEL

To study the relation between the EPU index with the CLIFS, it will be used the simple linear regression model. A linear regression model enables to have a view of a relation between two variables. There are two types of variables, the independent (x), which are under control and dependent (y), which doesn't have any control over it. The word linear, comes from the results are around of a straight line. This model can be expressed by the equation: $y=\alpha+\beta x+\varepsilon$ (**Columbia Business School and Columbia University Digital Knowledge, n.d.)**Where:

- **Y** is the dependent variable. It is the variable that we are going to study
- **X** is the independent variable. It's the variable, in which the data is known
- β is the slope of the line. If this parameter equal to zero then no exists any relationship and more than zero then exists some relationship whether positive or negative
- α is the intercept This parameter gives the value of y when x is 0

- ε. Is the irreducible error. The relation between the variables are not accurate because exists some factors which cannot be controlled. That has to be considered when the variables are analysed. His term includes all that parameters.

Once the model is made it, it is necessary to know how many precision has.

To measure this accuracy we need the following stats.

  - E (residual error).Is the difference between the actual and the predicted. In order that the model has a good accuracy this error has to take the little value possible.
  - Coefficient of determination. The value of this parameter is between 0 and 100. The model will be more precise when the value is closer to 100.

LEAST SQUARES METHOD

This method is normally used to obtain the best line that better adjusts to the data proposed and get the minimum error possible with he given data **(Abdi, n.d**.)

That error can be expressed like the sum of $(y_a-(ax_a+b))^2$. To get the lower levels of this quadratic expression it is necessary set the derivative of a and b and make it equal to zero, in the two cases the derivatives are (Abdi, n.d.):

- For the case of a : $\partial E/\partial a=2Na+2b\Sigma x_a-2\Sigma Y_a= 0$
- For the case of b: $2b\Sigma X^2_a+2a\Sigma X_a-2\Sigma Y_aX_a= 0$

Solving this equations find the next results:

- a = My-bMx. Where M is equal to the mean
- b is equal to the sum of $(Y_a – My)(X_a-Mx)/(X_a-Mx)^2$

This least squares have the next statically properties:

- The group of data that is obtain using this method is a random sample from a population.
- The model that follows the population is linear
- The error has a predicted value equal to zero

- The independent variables are linear independents
- The error follows a normal distribution and does not have any correlation with wit the independent variables.

METHODOLOGY

Once the variables are known and the method is clear, is time to run the correlation and regression analysis for the four countries that composed the sample. The order of the analysis is first Spain, Germany, France and finally Italy.

The procedure of the analysis will be the next one:

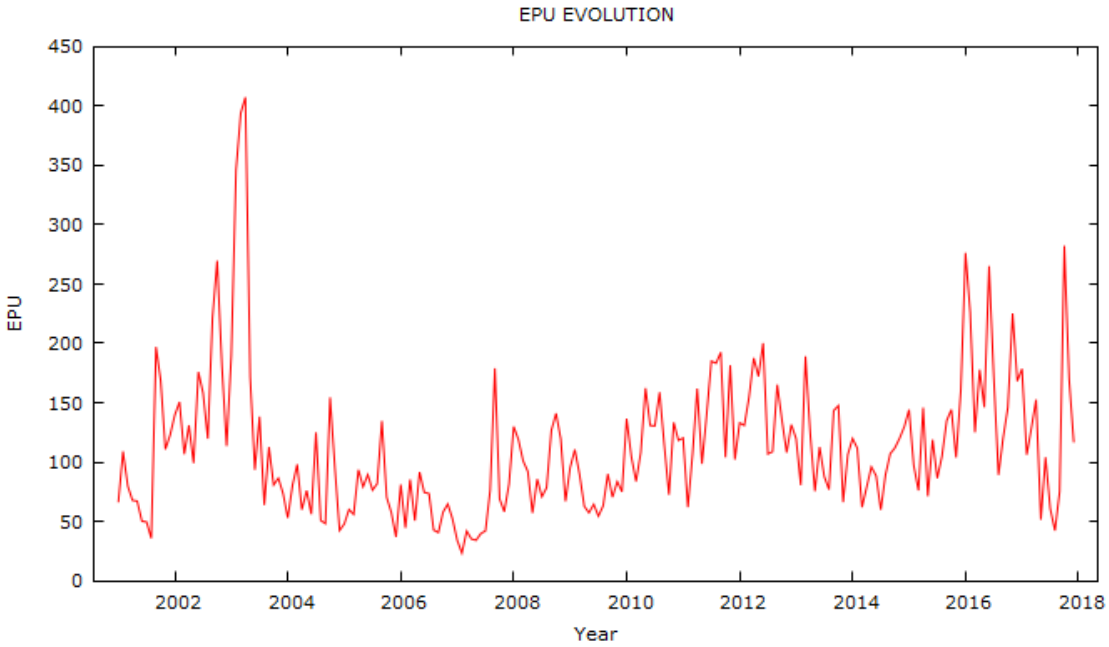
- A study of the EPU evolution of every country and try to explain the most important picks of the graphical representation, to know if exists something in common in the four countries that makes the uncertainty increases. The focus will be put in the period when the crisis start until today.
- Study the CLIFS evolution, using the system describe above, this procedure will allow to know if exists any fact that affects in a common or in a specific manner the four countries and serve to describe the increase in the volatility.
- A previous view of the correlation using the graphical representation of the variations of the two indexes and using the correlation coefficient.
- A regression analysis including:
    - The test of the correlations of the populations.
    - The test of the slope of the equation using a T test.
    - A variance test using the statistic F.
    - The standard error estimated.
    - The determination coefficient or R-squared.
    - And the use of confidence intervals to know the capacity of predictions of the model.

The explanation of the expressions concepts will be only for Spain because they are the same for the rest of countries.

CORRELATION AND REGRESSION ANALYSIS SPAIN

The main purpose of this work it's make a regression study to know if the uncertainty and the volatility of the financial market, measured with EPU and CLIFS accordingly, are related. To be more specific the aim of this paper is to know if the financial stress created in periods of high volatility in the market increase the uncertainty of the investors. The size of the sample is the 204 months (equivalent to 17 years), due to the index varies monthly for the four countries.

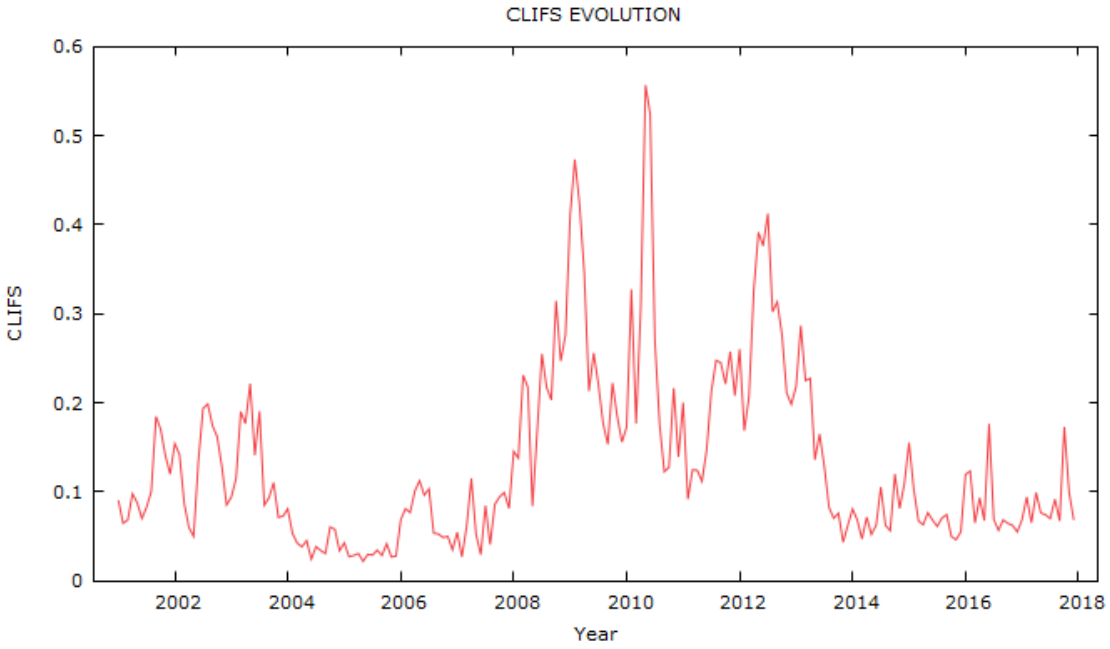
As it can be see it in the graphic, the level of uncertainty decrease from 2004 until 2007, when it reaches another pick due to the international crisis created by the bankruptcy of Lehman Brothers and the great fall of the market of dealing houses (Burubuja inmobiliaria). After that during the 2007 and 2016 the uncertainty in Spain has a similar level and



Graphic 1 EPU evolution for Spain

no exists an exceptional pick. In 2016, the graphic shows a new maximum level, the facts that make uncertainty reach this level are the elections in Spain that were celebrate with

a second round and the independence in Catalonia with the celebration of the referendum the 1 of October in the year 2017.The increment of uncertainty can be due to the Brexit and the elections in United States where Trump was elected for President of that country

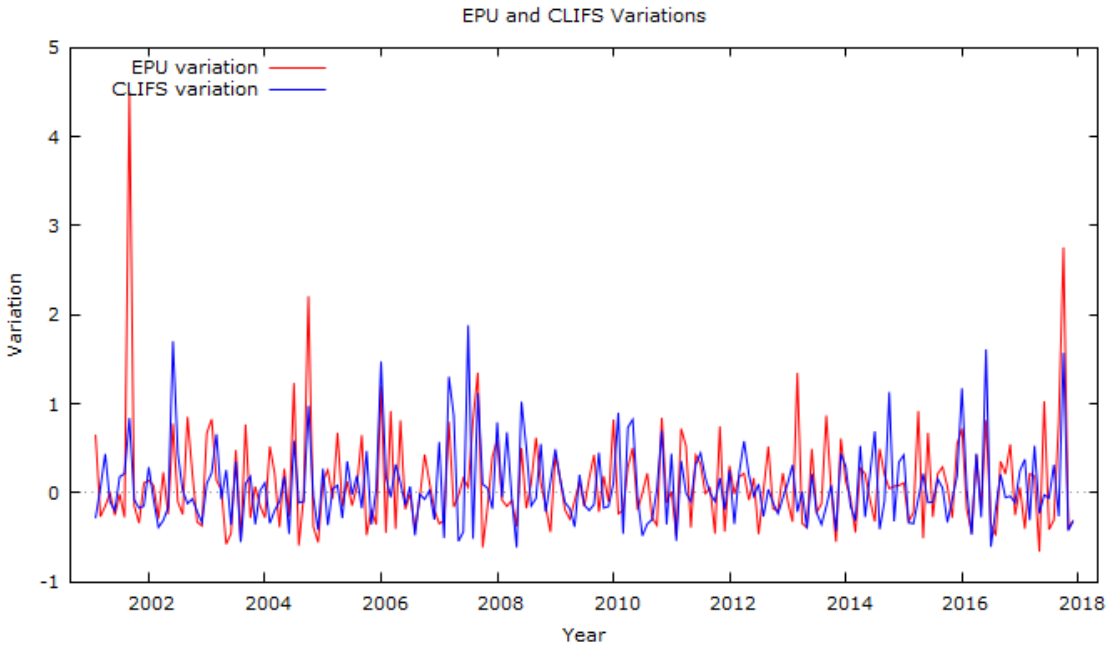


Graphic 2: CLIFS Evolution for Spain.

For the volatility, represented above can be observed that during the crisis of 2007 the Spanish markets suffered a great level of financial stress until the year 2013 and then starts to decrease. After 2014 the volatility decrease and no exists any important new pick. During the period of 2008-2014 due to the crisis the debt of Spain was downgraded, the unemployment of the young people that reach a great level and the market of jobs with very poor conditions can be the elements that makes increase the volatility. The reduced yields of the bonds the rescue that suffers the banking system, the possibility of default of Greece make that volatility reach the pick in the early 2012.After the possible situations are described with words, the next procedure it is, using numbers to see more accurately (with numbers) that relations with a regression analysis.

To start with the analysis, it is convenient have a previous view of how variate the two indexes and if their variations moves in a similar way. To do that, it is use the graphic below. As can be observed in the graphic the two indexes moves in a similar way around the sample. To calculate the variation of the indexes the expression used is:

$$\frac{(x_1 - x_0)}{x_0}$$



Graphic 3: Indexes variations for Spain.

Once can be see it that moves in a similar way, this can be appreciate in the graphic 3, it is useful to know the coefficient of correlation measure with the formula $\Sigma\, Sxy/SxSy$in this case the coefficient is 0.42, with this results, it can be say it that the indexes have some direct relation between them, but this relationship is not strong. In the next sub-section, we are going to know much better the relation between them.

To study the relation between the two indexes with in a much more detailed manner, it will used a correlation analysis. For this work, the CLIFS index is choose as the independent variable and the EPU index as the dependent variable, since it want to be known if the increase of financial stress index or in other words the volatility of the markets creates more variation of EPU or uncertainty.

The first step of this analysis, following **A. Lind, et al., 2012** is make an hypothesis testing to know if the correlation between the populations is 0. So the null hypothesis is ρ= 0 and the alternative is ρ≠0. In this case the test is of two tails. To make this test and reject or no reject the null hypothesis, it is used the next formula: $t=\frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$. To make this t test it is needed n-2 degrees of freedom. So in this case we have 201 degrees of freedom. Now it is the time to know if in the hypothesis testing can be accepted or rejected the null hypothesis. The area that comprises the decision rule is -1.972 and + 1.972 and the t value calculated with the formula above is 6.608. With this results, it is clear the rejection of the null hypothesis and the acceptation of the alternative. So exists some correlation between the populations of the variables. At this point, it is possible to focus

more in the relationship with a linear regression equation, which it is explained in the conceptual framework n the Chapter Linear Regression Model.

Once it is sure that the variables are correlated, the next phase it is to make and regression analysis to know the linear relationship of the two indexes with an equation regression (**A. Lind, et al., 2012**). In this case the equation has the next form. Y= 0.063+0.545X. This equation express in a specifically way the relation between the two variables. With say in a summarize way:

- When the volatility it's equal to zero the uncertainty has a value of 0,063.
- The slope of the regression line is equal to 0.545. In other words, when the volatility increase the uncertainty increase in 0.545.

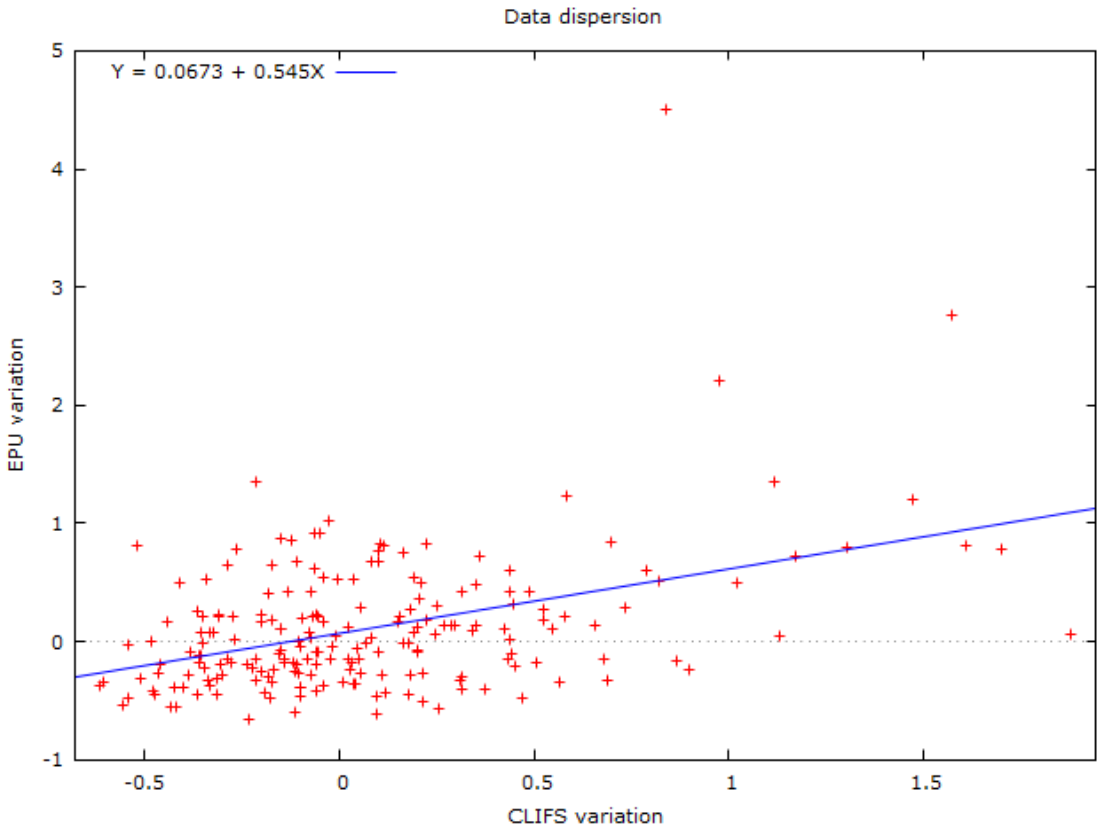
After find the equation of regression, it is useful, make a test to the slope of the equation to know is the slope is different of 0 and know if the variable it is useful to estimate the variation of the EPU in this case. To make a slope test the null hypothesis is $\beta \leq 0$ and the alternative is $\beta > 0$. The formula to measure t in this case is:

b-0/Sb with n-2 degrees of freedom this case we use one tail with a 0,05 level of significance. The critical value is in this case it is 6.608. The interval in this case is 1.653. 6.608>1.1653 so the null hypothesis is rejected and the alternative hypothesis is accepted. The conclusion is that the slope of the equation is major than 0 and the variation of CLIFS can help to predict an increase in the variations of EPU. The p-value, is a statistic parameter that confirm if the rejection of the null hypothesis is correct. The rejection is accepted if the p-value is less than 0.05 in this case is equal to 0, a little value of this parameter ensures that the rejection of the null hypothesis was the correct decision, therefore the slope of the variation of CLIFS explain the variations of EPU.

The variance analysis helps to calculate the variability explained by the regression model and helps to determinate if the model is meaningful. For make this analysis is used the F-test. In this case the numerator and the denominator have the same liberty degrees 201. The level of alpha is 0.05. And the expression to calculate the value of F is SSR/SSR(n-2) the null hypothesis in this case is the slope is equal to zero and the alternative is the slope is not equal to zero. For the case of Spain, the F is to 43.66. The critical point to make the decision is 1.2686. 43.86 is higher than 1,286. The null hypothesis is rejected and the alternative is accepted. This situation leads to the conclusion that the equation helps to predict the behaviour of the variables. For this case the p-value of the test is zero so accept the alternative hypothesis is correct.

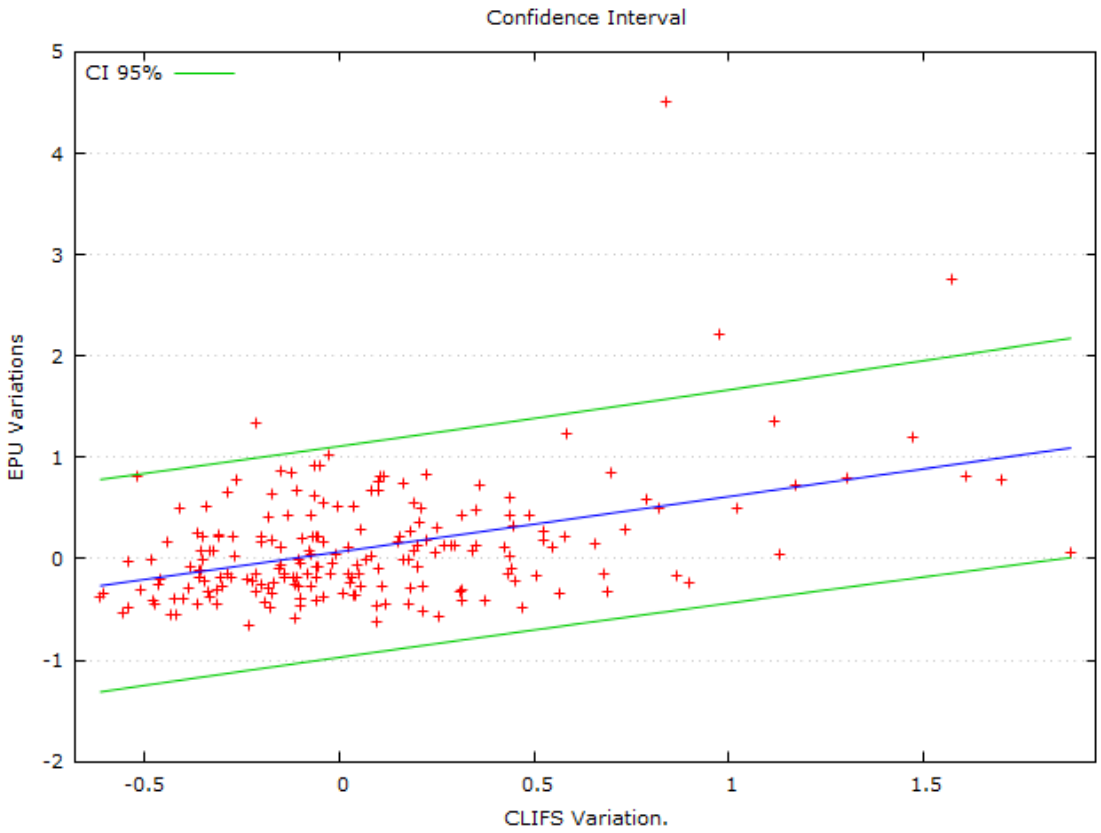
It is time of evaluating if this equation has the capacity of prediction. For that it is usually used the standard error of estimate, this statistic calculates the precision of the prediction of the EPU. To measure this statistics it is used the next formula: (∑(y-y*) ^²/n-2) ^½ (A. Lind, et al., 2012). Using the data, the result of the standard error of estimate is 0,5269. With this standard error of estimate, we can say that the point are near of the egression line and the equation Y= 0.063+0.545X can be used to predict the variation of uncertainty.

The coefficient of determination can be defined as the proportion of the total variation in the dependent variable that is explained by the variation of the independent variable. In this study the coefficient indicates that the 17.86% of the variation of the uncertainty it is explained by the variation of the volatility.



Graphic 4 Data dispersion of the fit line for Spain.

Finally it is employed the confidence interval graphic to see the capacity of prediction. In the graphic below, can be observed that with a level of confidence of 0,05 the majority of the values of the variations are inside of the interval of confidence. So the conclusion using the confidence interval is that the variations of the volatility can explain the variation of the uncertainty with an error of 5%



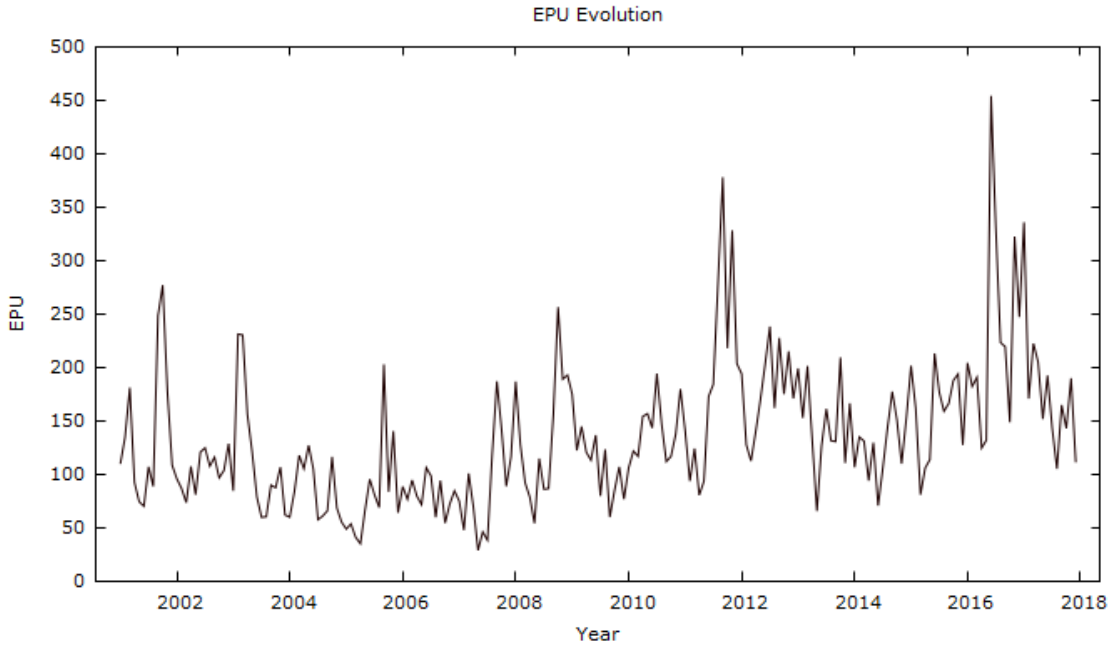
Graphic 5: Confidence Interval for Spain.

Once the analysis it is made for Spain, can be useful analysis other countries to compare results and see if that relationship can extended or not to the other countries. In this case the other countries are Germany, France and Italy. To have a sample where two countries suffer the consequences of the crises in a great manner (Spain and Italy) and two countries do not suffer the crises in a low manner.

CORRELATION AND REGRESSION ANALYSIS GERMANY

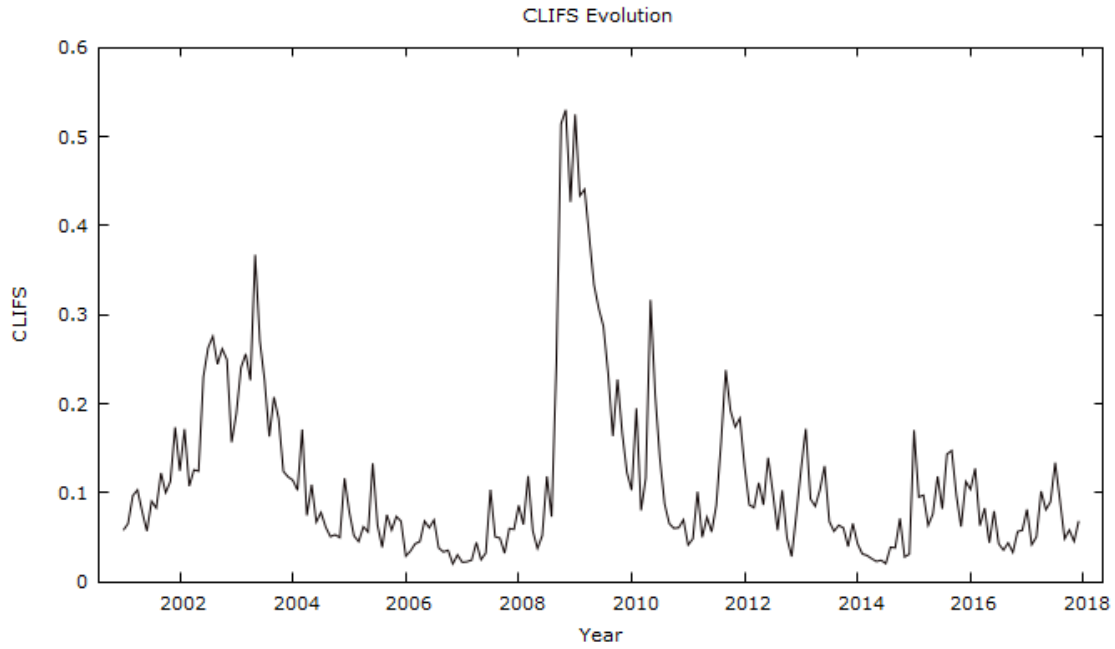
Germany has the next EPU evolution. As can be appreciate in the graphic the crisis increases the uncertainty until 2012 approximately and the elections in Germany can be the event that creates increase the uncertainty during the 2017. The increase suffer at final 2011 comes from the uncertainty in have a second period of recession and for help

to the rescue of the countries of the south. Inside the period of 2006-2017 the great increment of the uncertainty it is create by the Brexit and the elections commented earlier.



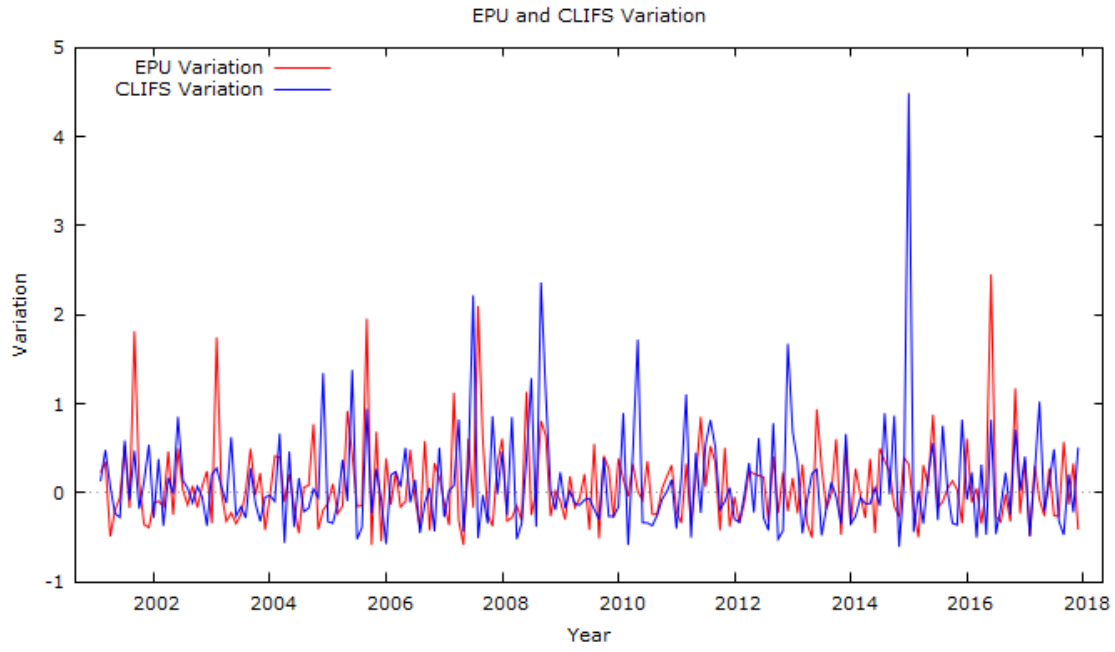
Graphic 6: EPU Evolution for Germany.

The evolution of the volatility of the financial system of Germany has the next graphical representation. The period of more stress in this country was during the economic crises during the period 2008-2010.In the middle of 2010 the announcement of a new rules for the market of the derivatives in Germany increase the volatility.



Graphic 7: CLIFS Evolution for Germany.

Once the evolution of every index, it is time to know the evolution of their variations. This graphic shows that the variation moves in the same direction but not in the same quantity. The coefficient of correlation gives a 0.2, giving a positive but weak correlation.



Graphic 8: Indexes variations for Germany

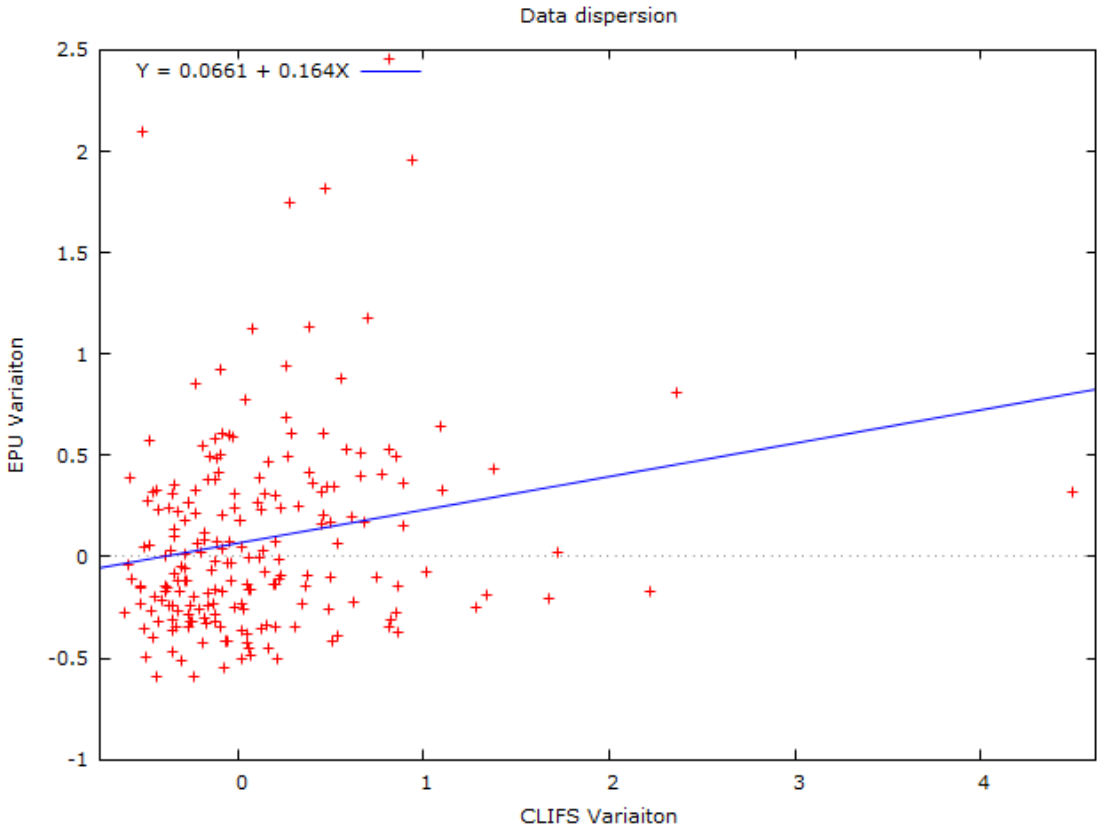
Like it is made with Spain it is necessary to make a regression analysis to put the focus in the relationship. That express the linear equation y=0,066+0,164.

It is time to see if the correlation between the populations of the indexes is equal to zero. As it is established above the null hypothesis for this it is $\rho = 0$ or ≠ 0. The test t in this case gives a result of 2.89 and the critical value to make the decision is 1.65247 which is minor than 2,89. The hypothesis null must be rejected and the conclusion is that exists correlation between the two populations.

The next step of the analysis is know if the slope of the equation is equal to zero. Like it was made it for Spain. The result of the t statistics is 2.93. And the value for the decision about the rejection or not of the null hypothesis is 1.65247. So the null hypothesis is rejected. The slope is > 0 and the variations of the CLIFS gives a good estimation for the variation of the uncertainty. For Germany the p-value is 0 so the decision of reject the null hypothesis and accept the alternative, was the right decision.

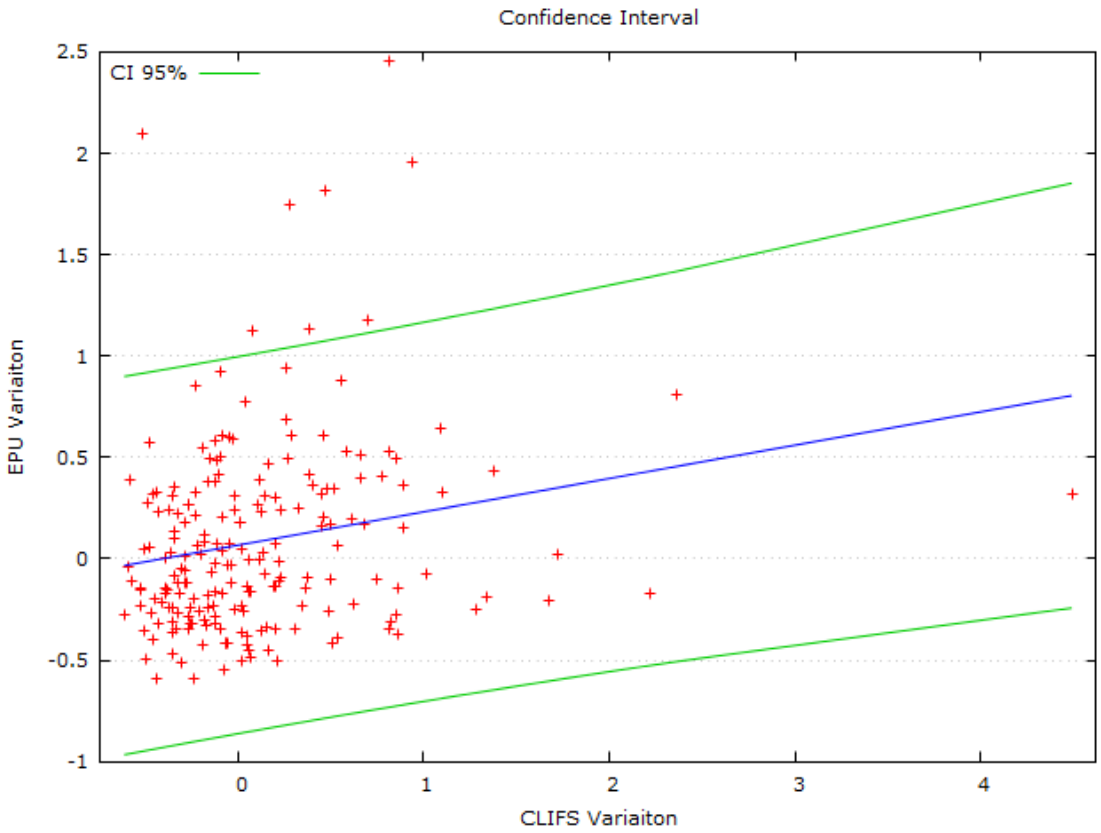
The variance analysis for the case of Germany with value of the statistic F equal to 8,63 leads to accept the alternative hypothesis and verified that the regression equation it is important to predict the variation of uncertainty in this model. In his case the p-value is 0 so the decision for the F statistic is the correct decision.

The standard estimate error for the equation is 3,137. This results gives a big value and indicates the existence of dispersion between the line and the data is high. The coefficient of determination is of 4,11% which means that the proportion of the variation of uncertainty explained by the volatility it is low. The dispersion can be observed in the next graphic.



Graphic 9 Data dispersion of the fit line for Germany.

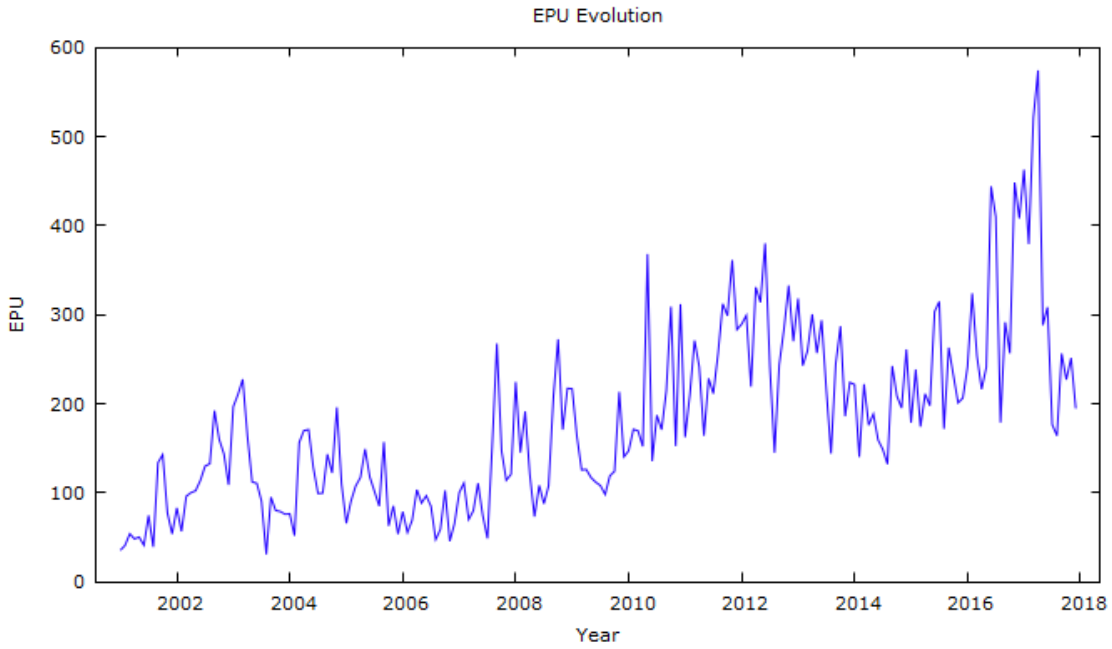
As can be appreciated in the graphic below the confidence interval for Germany not includes all the value inside the interval. The capacity of the prediction can to be adequate in this case.



Graphic 10: Confidence interval for Germany

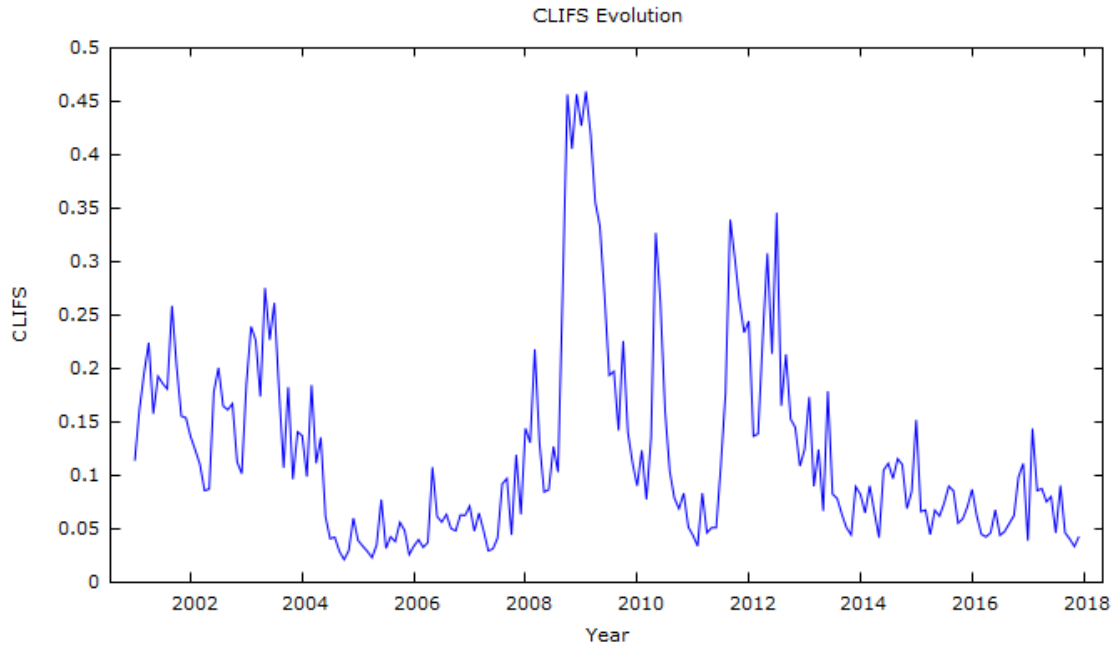
CORRELATION AND REGRESSION ANALYSIS FRANCE

In the graphic below, it is observed that the uncertainty for France it ascending during the years and has an elevate level that the rest of countries evaluated. The victory of Trump in the United States and the Brexit in the United Kingdom can be detonate of the great level suffers in the periods 2016-2017. The elections and the changes in the workers law can be the reasons of the rise of the uncertainty



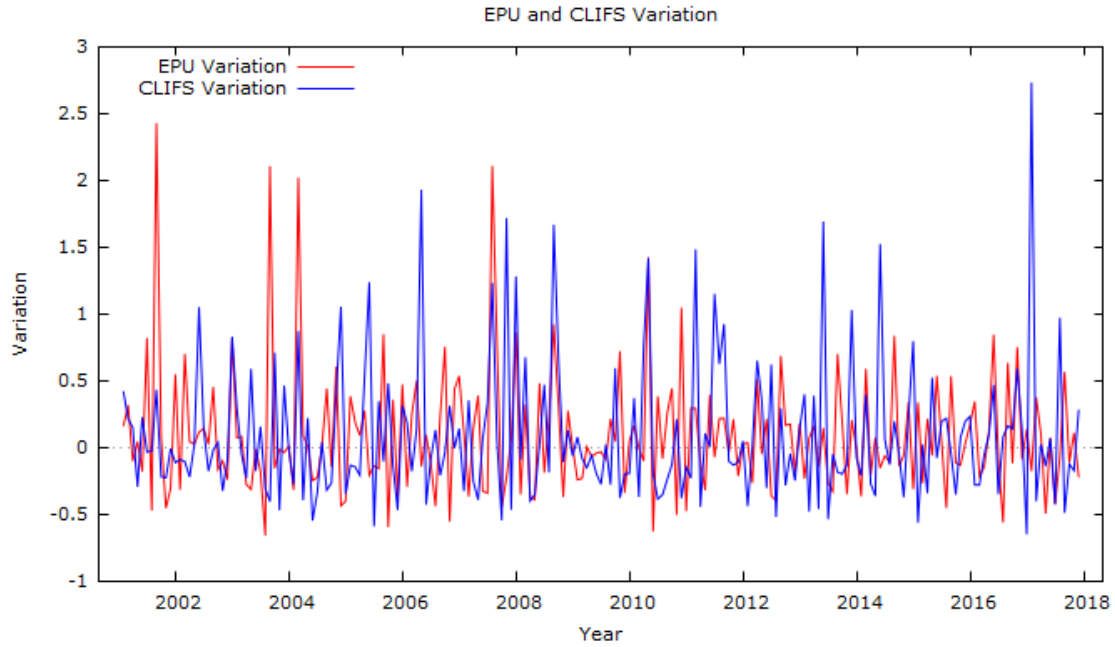
Graphic 11 EPU Evolution for France.

The evolution of volatility in France suffers abrupt changes during the crises period and then the markets in France tends to reduce their stress. During the period of 2008 and 2014 the volatility reaches important peaks in this period. In that period the markets in France as other banks in Europe had a poor regulation of financial practices, and in the case of France suffers a great volatility due to that practices. The increment of price f the basic foods in this country during the middle term of 2011 creates that volatility peak in the markets. The debt of Greece, the rescue of the banking system creates the peak obtained in early 2012.



Graphic 12CLIFS Evolution for France.

The evolution of the variations of uncertainty and volatility are draw in the next graphic. And we see the same case like Germany, a tendency of vary in the same way but no in the same quantity. In this case the coefficient of correlation has a result of 0,16 giving a positive but weak relation between variables.



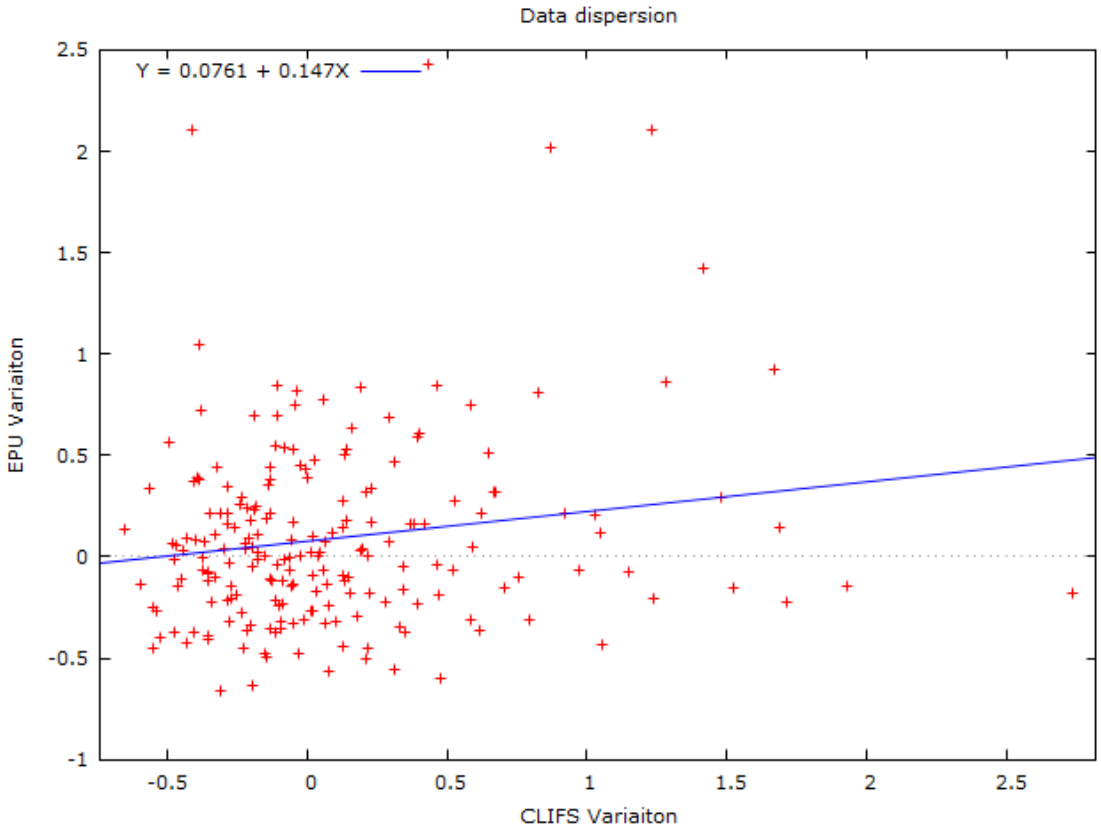
Graphic 13: EPU and CLIFS Variation for France.

Next step is regression analysis like the made with Spain and Germany before. First step is know if exists correlation between the population. The result of the t test for this county gives a result of 2,355 and the value to make the decision it is 1.65247 calculated for Spain and for Germany previously. So the hypothesis null is rejected and the alternative hypothesis is accepted and with that, the assumption of the correlation of the populations is different of zero.

After knowing the existence of correlation, to continue with the analysis, it has to be made a test to the slope of the equation. For France the equation of regression is y= 0,076+0,146x. In this case the t statistics gives a value of 2,335 and this result exceeds the value to make the decision so the slope it is higher than zero ad the slope is useful to make an estimation. The p-value is 00.02 less than 0.05. The decision is the correct.

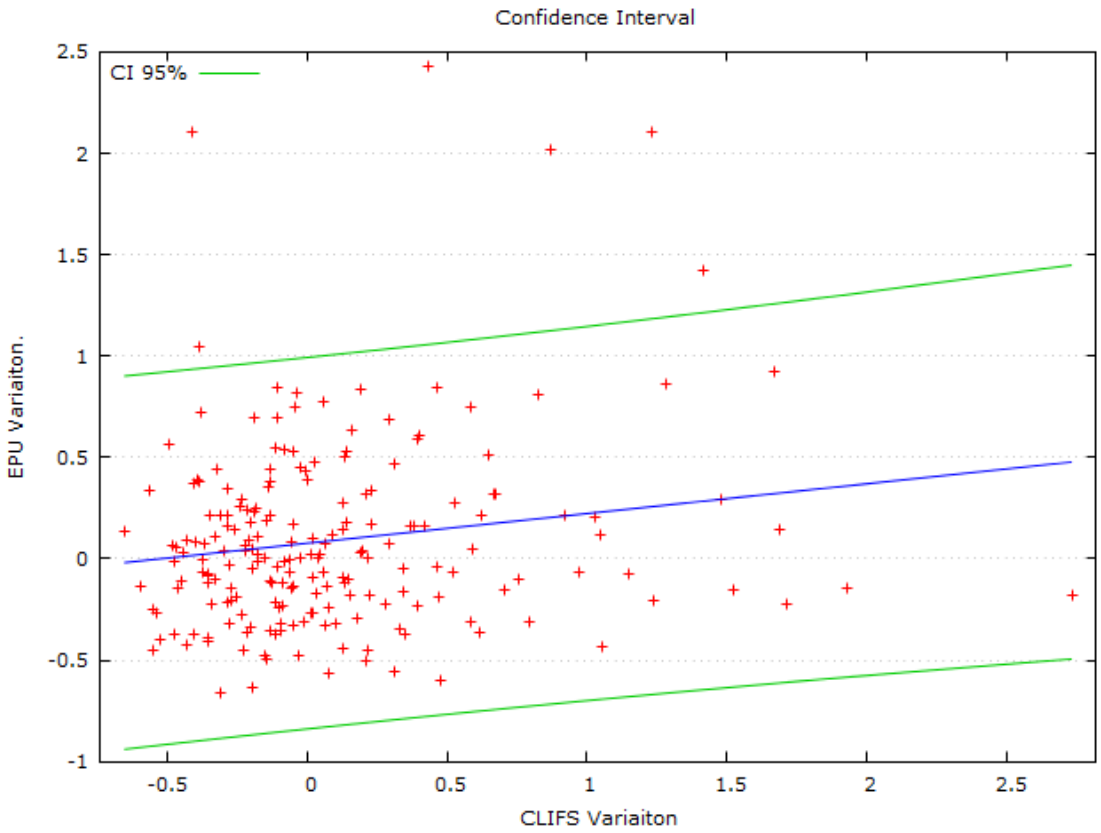
In this country the variance analysis gives an F value of 5.54. The F value to make the decision to accept of rejected the null hypothesis of the slope of the equation is equal to zero is 1.2686 which is lower than 5.54. The decision arrived is reject the null hypothesis accepting the alternative. And the conclusion it is the equation helps to predict the behaviour of the variations of the uncertainty. In this case the decision for the statistic is accepted because the p-value is equal to 0.02.

The standard error estimation in this case is 0.21. This value indicates that the data is not dispersed from the regression line in a great measure. In this case. The R squared although it is only 2% indicating that only a little proportion of the variations of the uncertainty are explained by the variations of the volatility. This is what show the next graphic



Graphic 14: Data dispersion of fit line for France

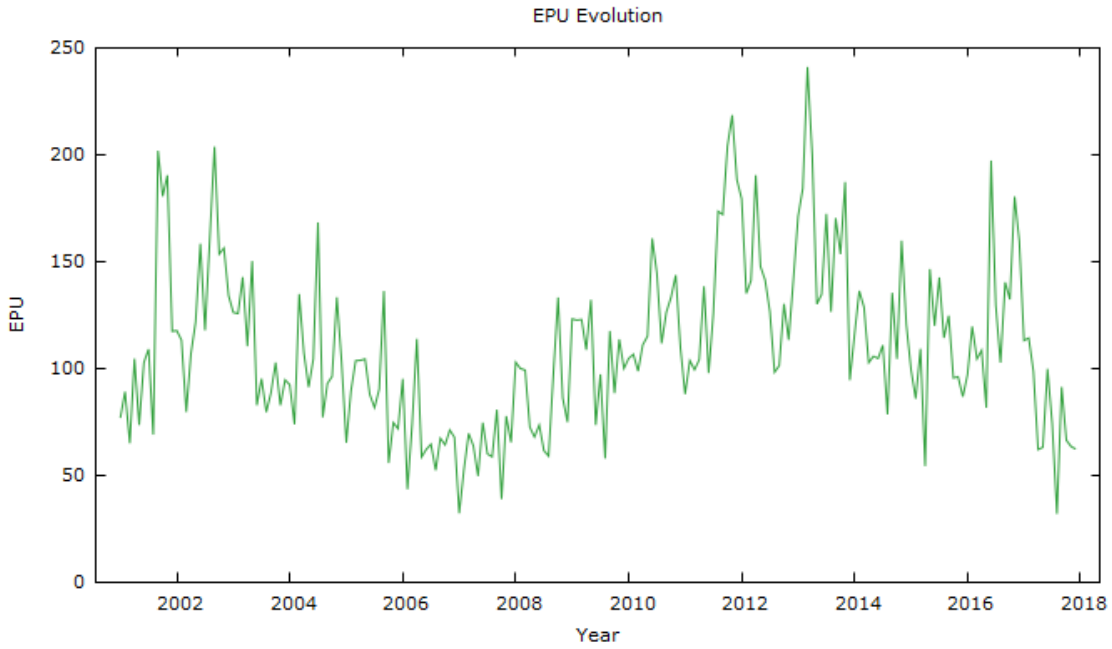
In the graphic showed down the confidence interval for France. It is similar than the other countries. The majority of the observations are inside the interval with exceptions of a limited number of observations outside of that interval. It is observed too that the confidence interval of Germany and France are bigger than the confidence interval of Spain.



Graphic 15: Confidence Interval for France

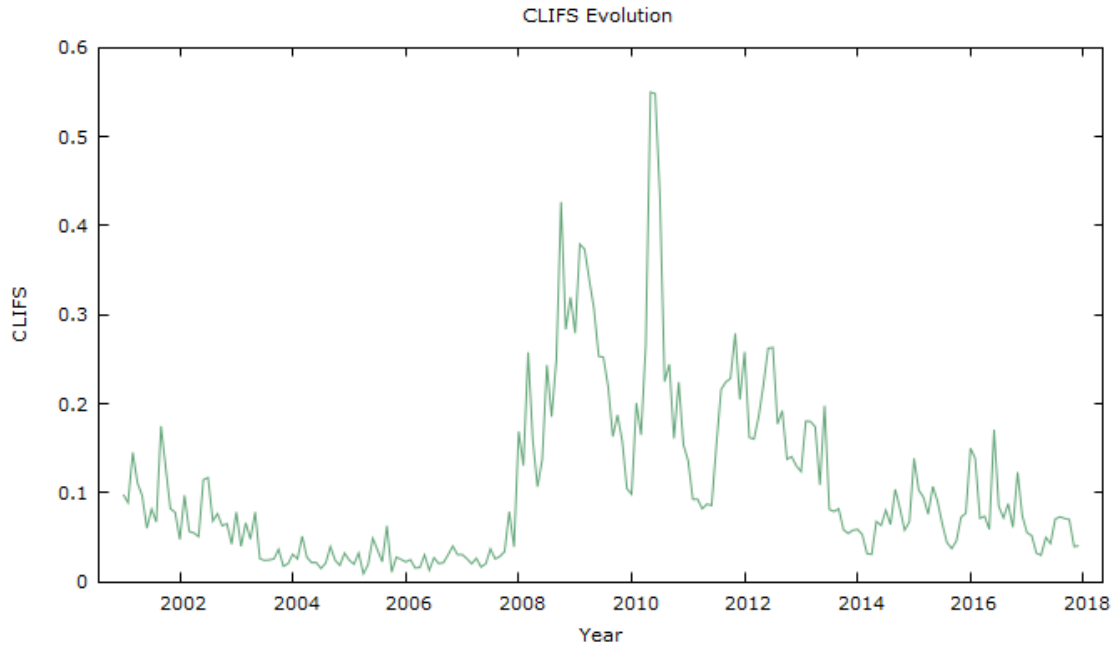
CORRELATION AND REGRESSION ANALYSIS ITALY

As can be appreciated in the graphic above the uncertainty in Italy do not permanent constant during the period of years selected. The country experiment a more level during the years of the crises like the rest of countries. In the period if 2010-2012, the fear of second recessions, the debt crisis of this country suffered and with that the rumour of a rescue. In the period of 2012-2014 the elections in Italy creates an increment in the uncertainty.



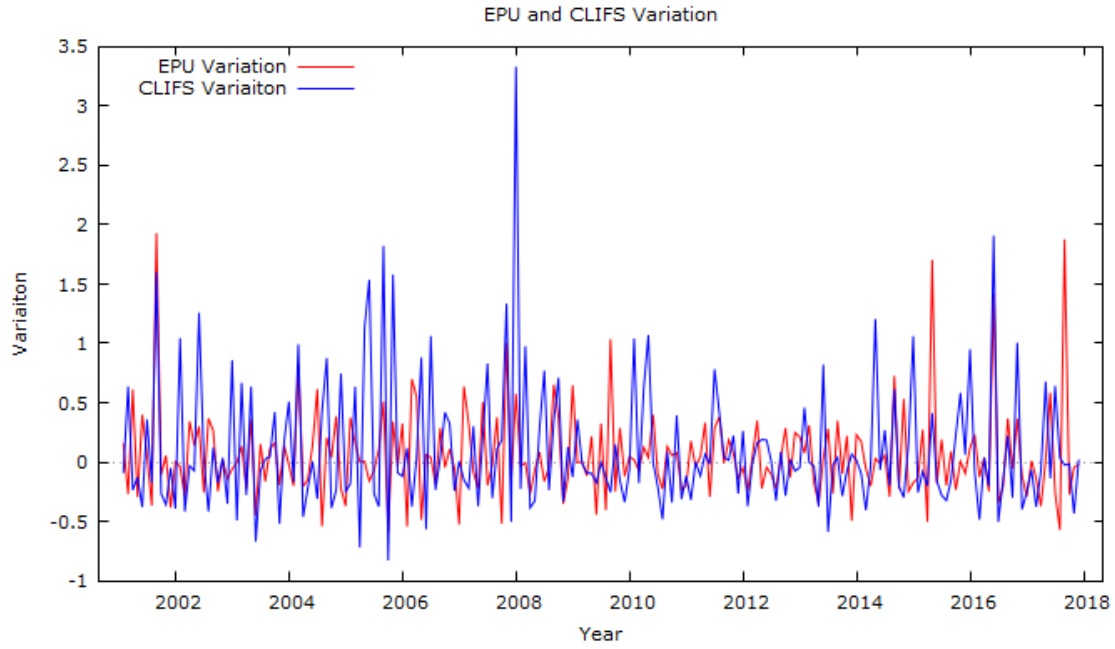
Graphic 16: EPU Evolution for Italy

The volatility of this country has a similar evolution of the CLIFS as the other. A great increased during the financial crises that has been reduced with the past of time. Thanks to the more restrictive regulations that have been merged after the crisis. The peak during the period of 2010 -2012 came from the decrement of the price of the bonds for the buying of European Central Bank. The debt crisis mentioned in the previous graphic and the uncertainty for the payment of the Greece debt creates an increase in the finally term of 2011.



Graphic 17: CLIFS Evolution for Italy

The variation of the two indexes is showed below. This country experiments the same situation as the others countries, a positive relation but weak due to they no move in the same quantity. The correlation in this country for the two variables is 0,31.



Graphic 18: EPU and CLIFS Variation for Italy

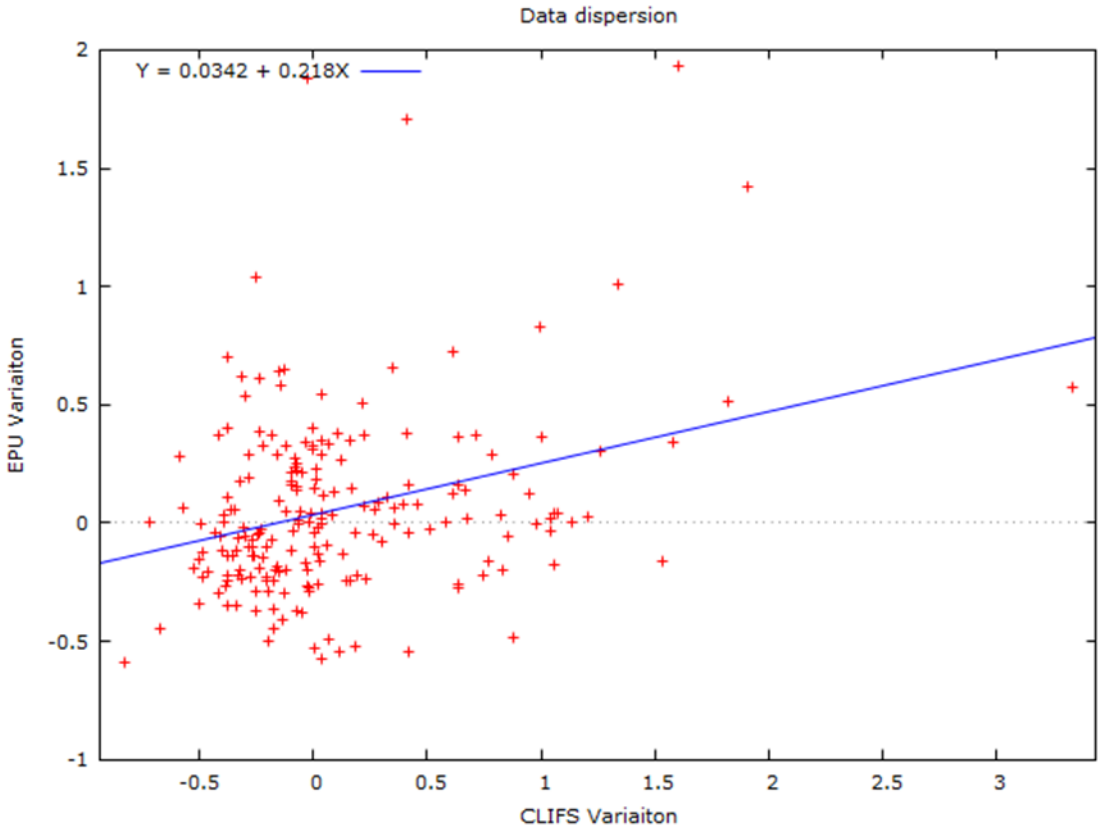
The regression analysis reflects the next observations. The t test to prove that exists correlation between the population of the two samples take the value 4,671 which it is a higher value than 1,65. The null hypothesis in this case is rejected. The populations of the variables are correlated between them.

By another hand, the test to see if the slope of the equation that for this country is the next: y=0,034+0,22x.

For the case of Italy the slope is higher than zero so the parameter β helps to explain the variations that suffer the uncertainty due to the volatility. The p-value in this case with a value of zero confirms that the decision take it before it is the correct one.

For Italy the variance analysis arrived at the same conclusion than the others countries. Accept the alternative hypothesis because the value F is higher than the critical point of decision. 21,81>1,26. The conclusion arrived is the same than the others countries, the regression equation helps to explain the behaviour of the uncertainty. For this test the p-value is equal to zero and corroborates e decision of reject the null hypothesis and accept the alternative.

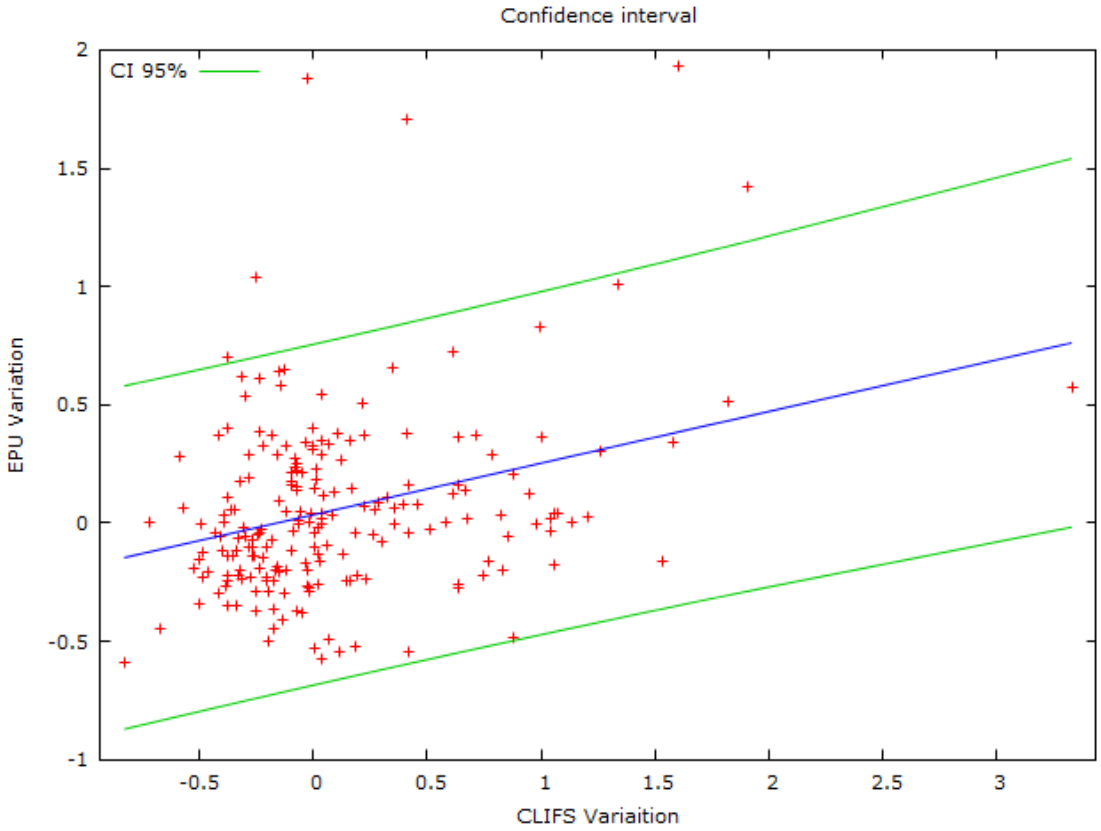
The standard error in this case is equal to 0,36, the set of data in this case is near of the regression line with only a little dispersion. The coefficient of determination says that only the 9% of the variation of the uncertainty measured by the EPU are explained by the variations of the volatility measured by the CLIFS. Situation that is reflected in the next graphic.



Graphic 19: Data dispersion of the fit line for Italy.

In the case of Italy, except for 5 points of data, the rest of values are included inside of the intervals. Giving a good predictions of the set of values.

For Italy the confidence interval is the next.



Graphic 20: Confidence interval for Italy

RESULTS AND CONCLUSION

As it is mentioned in the introduction the purpose of this work it is know if the uncertainty measured with the EPU index and the volatility measure with the CLIFS of Spain, Germany France and Italy are related for each country in a separately way. In a more specific way try to figure it out it the variations of the volatility are directly related with the variation of uncertainty. Once the analysis of regression is made it is time to take the results.

In the next table are summarized the results for the four Spain, Germany, France, Italy.

Country	***Equation***	***T statistic***	***P-value***	***F statistic***	***P-value***	***Standard error***	***R squared***
Spain	0,06+0,54 x	6,61	0	43,66	0	0,53	0,18
Germany	0,66+0,16 x	2,94	0	8,63	0	3,14	0,04
France	0,07+0,14 x	2,36	0,02	5,55	0,02	0,21	0,02
Italy	0,03+0,21 x	4,67	0	26,71	0,00	0,31	0,09

The result presented in the table compares the results for four countries of the Europe Union. The results are different for each country. The slopes of Germany and France are similar and lower than the slope of Italy and Spain. That occurs because the levels of financial stress are lower in Germany and France than in Spain and Italy. This situation can be explained due to the different force which the financial crisis affects the countries In Germany and France the markets stay more stables during that years than the markets in Spain and Italy. And that not affect in a great manner to the uncertainty of the north countries and the south countries. The events that affects in a great manner to one country affects in other manners to another. Every country has its manner of affront high stress events, which means high volatility in the financial markets, and with that the manner of affront systemic risk and finally a way of maintain the uncertainty in low level by that way.

VOLATILITY

The way the investors think and their aversion to the risk it is important too to understand the results presented in the table above. The preference to invest in short term and high term of every country, the preferences to invest in equity or in state debt, and the situation of the country sovereign debt, or the situation in the forex market, (which it is correlated with the situation of the others countries outside the Eurozone), creates that differences between the results in the volatility slope of the regression equation in every country. Other important factors to take into account are the rise or decease state debt, because

this fact allow that the volatility in the market of bond increases and if the state cannot offer a good solutions, the volatility can increment a little bit. The regulation affects to the volatility. If exists a strong and restrictive regulation that offers to the investors some security, the volatility deceases in a quite manner. If the markets are not regulated to protect the investors a simple bad notice can unleash a great pick.

UNCERTANITY

For the uncertainty, to explain the differences presented in the table, exists some elements that varies from one country to another and it is necessary to take into account to explain the variations of uncertainty. Not all the uncertainty proceeds from the financial markets. The increase or decrease of the uncertainty can be explicated by others questions that affect the economy. A great increase of the inflation, affects the purchasing power of the population, creating a sensation in the consumers that it is necessary saves the money because the uncertainty that creates the continuous increasing of the prices. An increment of unemployment that makes uncertainty increases due to the no existence of income for the workers. The inexistence of inversions by companies or by particulars, with an insufficient rent to create a stable situation among the workers, and, an elevate quantity of taxes to paid makes the uncertainty grows too. If this situations are not solved in a proper manner by the governments and the institutions the increase of uncertainty can be multiply. Not only can do that, the investment in services and goods, can be other of the options that the uncertainty increase. The lack of investment can rise the uncertainty due to the investment moves the economy, helps the companies grows and upgrade their productivity and with that in an indirectly way increase the labour force in a country and creates employment.

If the public expenditure decease or even maintain stable the uncertainty tends to grow up, if the government's does not help to create some stability in the economy, increasing the public expenditure or deceasing the taxes, the consumption deceases rising the uncertainty too.

In conclusion, an increment of the volatility itself cannot explain all the increment that suffers uncertainty, but can explain the increment related with the financial markets. This happens because the human factor and with that the decisions that takes the government and the policy makers depends of the evolution of the situations that can take the news that creates the reaction in the markets. In other words, depends on the conflicts

that creates the increment of volatility and the answer of the investors. If this conflict finds a quick and easy solution the increment of volatility is lower. If the conflict is prolonged during a great period of time or the solution choose for end the conflict is worse than the conflict itself the increase of volatility reach a great pick. And with the volatility the uncertainty.

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