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SINGLE MARKET UNCERTAINTY IN THE GLOBAL CONTEXT

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Abstract

The contribution of this paper is to estimate the single market uncertainty in the connectivity with the global financial network. This research presents the approach used in quantification of the risks based on the information derived from macro variables and standard deviation. The paper focuses on the technical fan-chart to link the data to the forecast predictions. **Keywords:** single market, uncertainty, Fan-Chart, risk distribution

Introduction

Global and regional quantitative analysis has an important bearing on the assessment of situations prospects and political decision constructions[1]. However, in time these analyses are subject to a range of variables that could influence projection of reality in decisional process. The uncertainty as an effect could represent the events with low- probability but with high-impact; these continuity of forecast errors in history of the decisional process conducts in time to volatility development on the stress points. Whenever the decisional processes are based on analytical results, it is important to exist some indications about the quality of results as error measures.

In this paper we present a *Fan-Chart* application on the EU single market in a context where the market has a "harmonized" degree with the global financial network and known sensitivity to the global fluctuations and risks. The purpose of the research is to recognize the borders of the uncertainties domain which surround the connectivity with the global

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[1] Franziska Ohnsorge et al., "Quantifying Uncertainties in Global Growth Forecasts", *World Bank, Global Economic Prospects, Special Issue,* no. 2, 2016, pp. 79-95.

network. Through this we follow to determine the degree of the forecasting distribution of variables which can influence the dynamic vector sensitivity.

The paper is structured as follows: the first section is an overview of the theoretical framework used in the application construction; the second section presents the application of the model and interpretation of the results. In the first part of this section we represent the chart of data used and their projection in a *Fan-Chart* construction. The goal of this process is to identify the links between markets patterns and global risk variables. Secondly, we will use a benchmark instrument to analyze the forecasting process and categories according to perceptions associated with links between patterns and variables. The advantages of this protocol is that it creates an imagine about the asymmetrical distributions and the effects on the performance metrics in a discrete time line. The last section is dedicated to concluding remarks.

Theoretical framework

We begin this section by defining and discussing the main theoretical concepts which will be used in the *Fan-Chart* construction. In the last part we develop research framework based on the model proposed by Blix and Sellin[2] and Kannan and Elekdag[3]. The update for this model will represent the repartition of the market risk indicators to the global variables, through this we want to correlate the dependence of this two variables class which can create uncertainties.

In the classical sense the uncertainty is correlated with the no sense action of decider to assign probabilities to the out-put or to actions[4]. In analytical research this perception is linked with the impossibility to make prediction about the situation evolution in a continuing time or to anticipate the possible effects which result from an event. In social science an equivalent concept of uncertainty is chaotic evolution which describe in simple terms the lack of patterns which define stable models of change.

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[2] Marten Blix, Peter Sellin, "Uncertainty Bands for Inflation Forecasts", *Sveriges Riksbank Working Paper Series*, no. 65, 1998, pp. 1-20.

[3] Prakash Kannan, Selim Elekdag, "Incorporating Market Information into the Construction of the Fan Chart", *IMF Working Paper*, WP/09/178, 2009.

[4] Michael D. Resnik, *Choices: An Introduction to Decision Theory*, Minneapolis: University of Minnesota Press, 1987, p. 14.

Therefore, in our research will we report to the uncertainty which exist in real situations as a result of integrating such factors as: randomness, incomplete information, fluctuations or dynamic operators.

The relevance of uncertainty in the single market analysis comes from the discussion about shocks, which can affect the economy equilibrium points. Secondary, the uncertainty is about the behavioral predictions as well as the information mechanism changing at once with the interface between actors.

Following this structure in our analysis, the uncertainty will represent a random parameter associated to the measurement results which can characterize the dispersion of probabilities given by the risk variables. The result of this interpretation will allow measurement uncertainty through the standard deviation of the *Fan-Chart.*

The second concept discussed in this part is the single market. In order to operate with this concept, we will depart from the classical view and will repot it as a formal model. Therefore, we will consider a continuous time model in a infinite horizon where the single market is a logical space $\mathcal{M}_t$, $t = 1, 2, .., T$ defined through a function $\mathcal{M}_t = \mathcal{M}_{\mathcal{R}} \, \mathbb{x} \, \mathcal{M}_{\mathcal{V}}$. In this application $\mathcal{M}_{\mathcal{R}}$ is the real dimension of the market which incorporate norms, perceptions, boundary, actions and actors. And $\mathcal{M}_{\mathcal{V}}$ is the virtual dimension of the market constituted by the interface among actors, signal information, variables and reports among other elements. The existing domain attributed for each of the dimensions are: $\mathcal{M}_{\mathcal{R}} \in [0, 1]$ which represents the logical possibility degree to compose the market with the constitutive elements. The second domain is $\mathcal{M}_{\mathcal{V}} \in [1, \omega, \omega_0, \omega_1, \dots, \omega_n]$, where ω_n is the number of reality projection in the cognitive mapping of the actors. What results from these domains is an indexes set of events such as: what is happening in $\mathcal{M}_{\mathcal{R}}$ is indexed by $m \in [0, z]$, and the events from the $\mathcal{M}_{\mathcal{V}}$ go with $m^* \in [z, 1]$, where $0 < z \leq 1$ is a measure of the single market size and actors decisions magnitude are normalized in 1. This index represents a labeling of the activity into single market through the rapport between real events and perception of these by the involved actors.

Because our space represent an interface among actors with a capacity of information and goods transfer, it is possible to be characterized through a graph $G = (V, \beta)$ where V is the set of the actor involved and β is the set of the links among them. Due to the fact that number of the implied

actors is impossible to account, to maintain the analysis tractable we relate the V set as a immeasurable size of actors from the states to stakeholders $V = \int_S^A \updownarrow$. Therefore, the structure of the market will be a probabilistic distribution of links and actors which can exist in one moment of time in the space $\mathcal{M}_t$. This relationship is expressed through mapping $G = P(2^n, \odot)_{t=1,2,\dots,i}; i = n, \dots, T$ where 2^n is the possible number of combinations between actors and links, P is the probability distribution and $\odot$ is an operator which modify the network structure.

What we want to put in evidence through this expression of the market is the stochastic character and the fact that markets have a dynamical structure. Firstly, the stochastic process describes the evolution of the market in terms of random variables $(\bar{v}; v = \{v_1, \dots, v_z\})$ which influences the evolution vector in a period of time. The second character, according to Bayoumi *et al*., defines in the single market context the law of capital motion[5], which is described as:

$$K_{t+1}(j) = (1 - \delta)K_t(j) + \Psi_t K_t(j) \; where \; 0 < \delta \leq 1 \qquad (1)$$

where: δ is depreciation rate, $\Psi_t K_t(j)$ capital accumulation, where $\Psi(.)$ a function of the investment/capital ratio $I_t(j)/K_t(j)$ such as $\Psi(\delta) = \delta$ and $\Psi(\delta) = 1$.

Under the convergence of these theoretical elements it is possible to describe the macroeconomic benefits of an increased competition under the influence of international variables. In economical terms this convergence can be interpreted as a cycle life of the actors investments on the single market where the capital is subject to the variable impact on capital motion. Therefore, the cycle of capital with different fluctuations is described as a triangular fuzzy number with the deviation limits given by the investment integration degree on the market. So, considering that the investment integration degree on the market represents the capital membership function on the market $\mu(c)$, we can define it through the next expression:

[5] Tamim Bayoumi et al., "Benefits and Spillovers of Greater Competition in Europe: A Macroeconomic Assessment", *ECB, Working Paper Series*, no. 341, April 2004, p. 16.

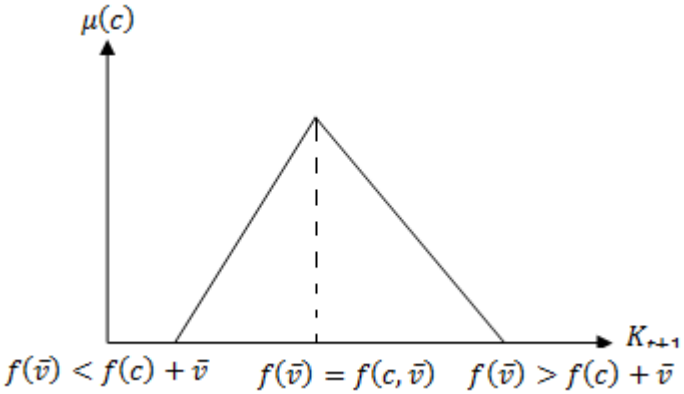


Fig. 1 Fuzzy number of capital cycle life

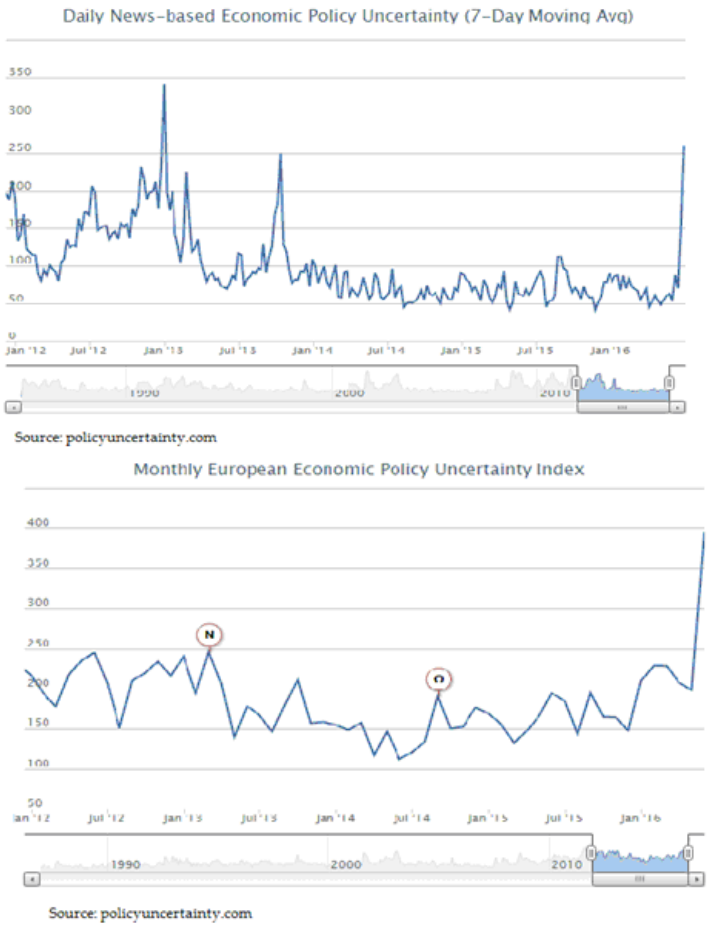
$$\mu(c) = \{\begin{matrix}((K_1(t+1) - (f(v^-) < f(c) + v^-))/((f(v^-) = f(c, v^-)) - (f(v^-) < f(c) + v^-)), if\ (f(v^-) < f(c) + v^-) \le \\ \le K_1(t+1) \le (f(v^-) = f(c, v^-))\ @((f(v^-) = f(c, v^-)) - K_1(t+1))/((f(v^-) > f(c) + v^-) - (f(v^-) = f\end{matrix}$$

where: $f(\bar{v}) < f(c) + \bar{v}$ is the investment at the beginning and describes that value of investment under a variable influence that is higher than the negative impact of variable, $f(\bar{v}) = f(c, \bar{v})$ is the investment maximum point when the value of capital flow is equal with the impact of variable, and $f(\bar{v}) > f(c) + \bar{v}$ is the situation when the investment accumulate a risk degree and becomes uncertain in time. The last element treated is the risk indicator of the single market fluctuation. In order to calculate de risk degree of the single market fluctuation and its uncertainty it is necessary to make some assumptions regarding to distribution function as well as the risk factors which influence the dynamics of the market. According to other authors[6] we can use an economic uncertainty index to make the measurements of the economic policy uncertainty and after that to compare it with the model proposed by the Cardarelli et al[7]. The last model consists from two elements which are used to characterize simultaneously the global growth forecast and an individual growth, which in our case is the single

[6] Kevin L. Kliesen, Uncertainty and the Economy, *Federal Reserve Bank of St Louis*, 2013, [https://www.stlouisfed.org/publications/regional-economist/april-2013/uncertainty-and-the-economy], 29 June 2016.

[7] Roberto Cardarelli, Financial Stress, Downturns, and Recoveries, *IMF Working Paper*, 2009.

market. The idea of this comparison is to reveal the differences between asymmetric effects created on the global level and the projection of this into single market.



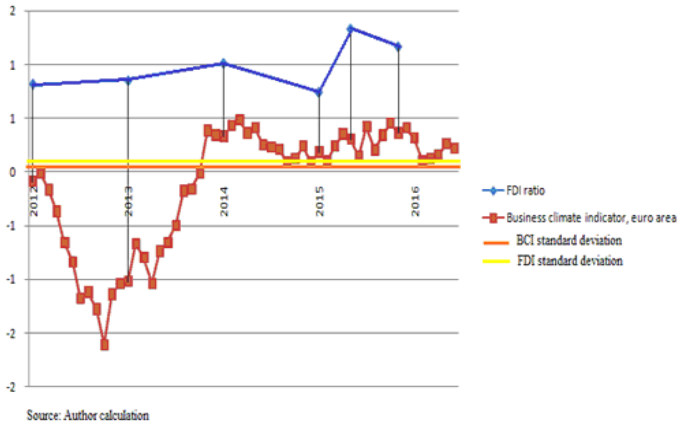
The projection of the global economic uncertainty in European economy is revealed by the fluctuations path between max and min points in European Economy policy. In contrast, the implied risk of European economy does not have a significant projection on global uncertainty modulation.

Fig. 2. Economic Uncertainty Index comparison[8]

[8] Note: in the second graphic the N point shows the Euro zone stress from February 2013, and the O point is the Greek crisis from August 2014. For more details about methodology used in index calculation see Scott R. Baker *et al*., Measuring Economic Policy Uncertainty, October 2015, [http://www.policyuncertainty.com/media/BakerBloomDavis.pdf].

Source: Author calculation

Relationship between FDI and Business climate indicator



Source: Author calculation

Despite the global uncertainty projection, the single market and business perception tend to be more closed to the prediction distribution and to reveal a robustness. This state, makes the single market to offer a stability degree to investments, with a positive dispersion of portfolios losses in risk conditions.

Fig. 3. Index performance and perception of the single market evolution[9]

[9] Data for this graphics are used from: Bloomberg, OECD and European Commission, http://www.bloomberg.com/quote/SX5E:IND;
http://ec.europa.eu/economy_finance/db_indicators/surveys/index_en.htm;
http://stats.oecd.org/Index.aspx?QueryId=64225# online, [Accessed: 07.July 2016]

Constructing the Fan-Chart

To estimate the uncertainty degree on the single market level, we need to aggregate the risk factors into a measurement of global risk and transposition of this in the single market. For this we need to select and weight each risk factors which have a correspondent in both reference dimension. Because our research is focused on the single market, we consider useful to use as survey-based indicators the pricing of options used by the stakeholders to hedge. We follow this direction of measures in order to provide data about the market trends perceptions under risk sensitivity in terms of decision changes as momentum strategies[10], and to compute predictive percentages on uncertainty values change over underlying assets return[11]. Therefore, in this exercise the indicators used are:

1. Market expectations. Market expectations volatility, especially VSTOXX Index, is highly related with prospects of options price fluctuation and expectations on the single market[12].

2. Consumer price inflation. The consumer price inflation HICP (average change in time between price paid by households for a specific, regularly updated basket of consumer goods and services[13]) describes the price evolution of goods and services which have the role to satisfy in direct way the consumer needs. The relevance of this index is that it shows us the money transactions in relation with market demands.

3. Investment fund. The investment fund refers to the assets and liability of these in a time series.

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[10] Yong Sakong, Dermot J. Hayes and Arne Hallam, "Hedging Production Risk with Options", *American Journal of Agricultural Economics*, vol. 75, no. 2, 1993, pp. 408-415, and Joelle Miffre and Georgios Rallis, "Momentum Strategies in Commodity Futures Markets", *Journal of Banking & Finance* 31, 2007, pp. 1863–1886.

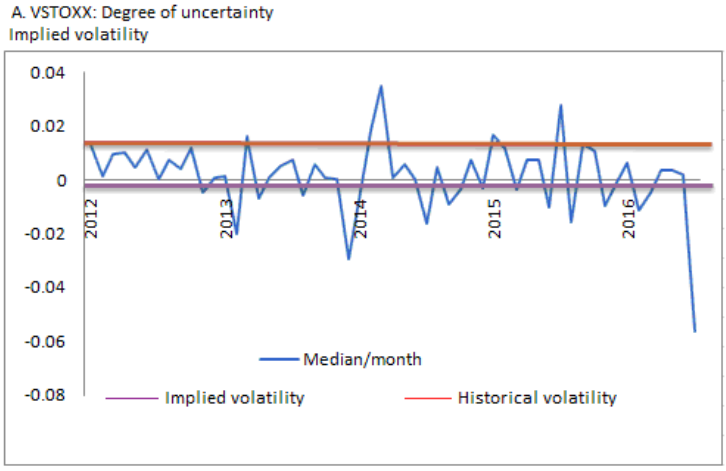
[11] Stephen J. Taylor, Pradeep K. Yadav, and Yuanyuan Zhang, "The Information Content of Implied Volatilities and Model Free Volatility Expectations: Evidence from Options Written on Individual Stocks", December 2007, [http://wise.xmu.edu.cn/Master/News/NewsPic/200822615948282.pdf], 29 June 2016.

[12] Note: This index have in composition the EURO STOXX 50 witch indexed the most important companies from European Union. Because of this the VSTOXX puts in evidence even the dynamics and roles of these companies on volatile evolution in time.

[13] https://www.ecb.europa.eu/stats/prices/hicp/html/index.en.html, 1 July, 2016.

Using these three indicators, the uncertainty and risk distribution (measured through the deviation and skewness) of the single market forecast is recovered from the link between the statistics of the volatility of the three market state trend indicators, assuming the existence of a linear relationship between them. To incorporate the above trend indicators into a measure of single market risk, the weight of each trend indicator volatility needs to be estimated. An option is to use the methodology proposed by Österholm[14] on the information incorporation and risk-neutral density model of Glatzer and Scheicher[15].

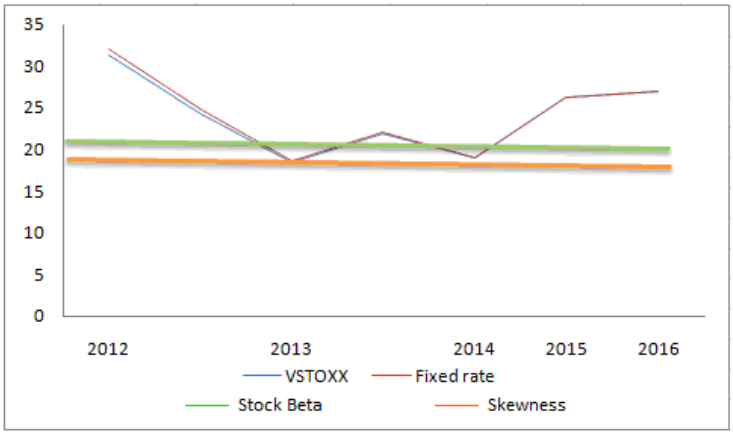
This consists from a ruling scenario on data sets with unique information about the distance between market perception under volatility density forecast and movement trends for each situation. Through this approach we consider that we make a useful illustration for the discussion on the uncertainty distribution, with remarks that depend generally by the forecast model and situations put in analysis.



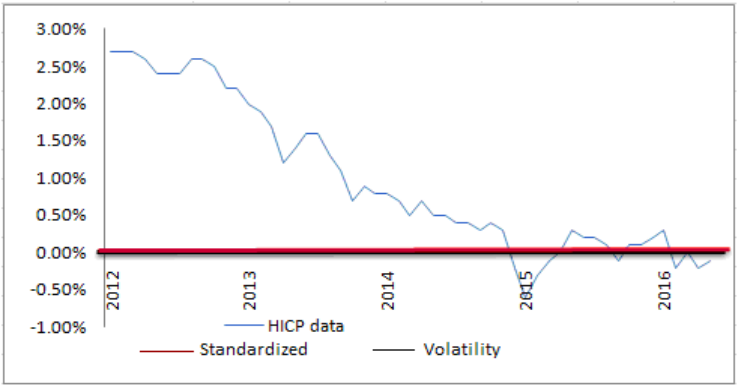
[14] Pär Österholm, Incorporating Judgement in Fan Charts, *Scandinavian Journal of Economics*, vol. 111, issue 2, 2009, pp. 387-415.

[15] Ernst Glatzer and Martin Scheicher, Modeling the Implied Probability of Stock Market Movements, *ECB Working Paper*, no. 212, January 2003.

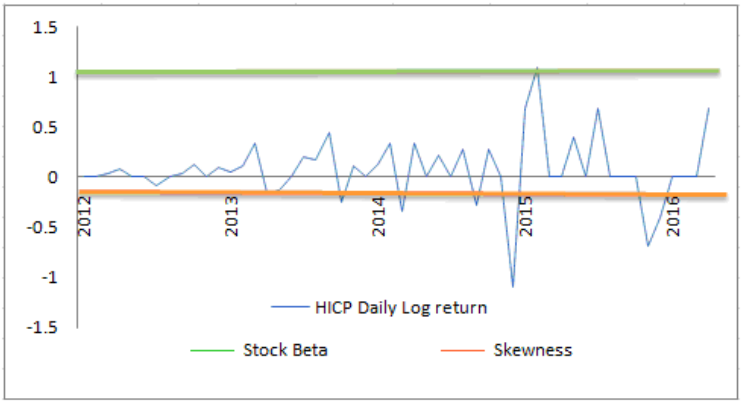
B. VSTOXX: Risk distribution
Skewness

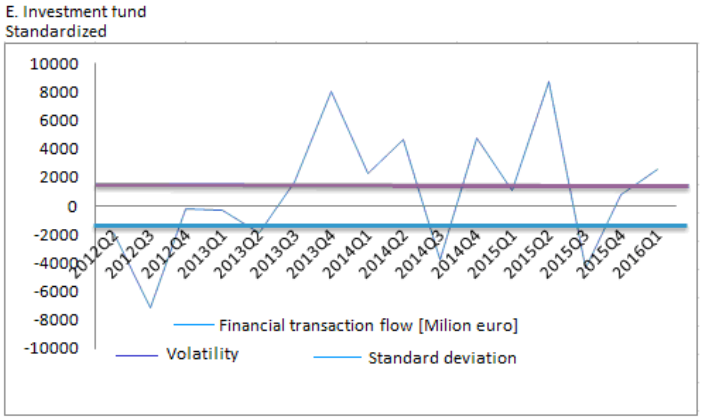


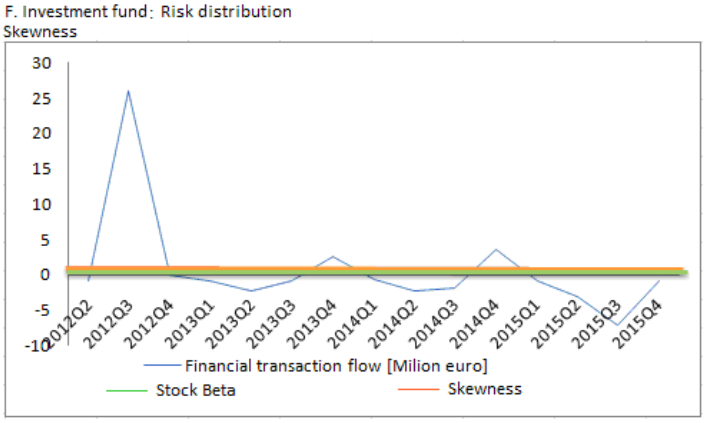
C. HICP: Degree of uncertainty
Standardized



D. HICP: Risk distribution
Skewness







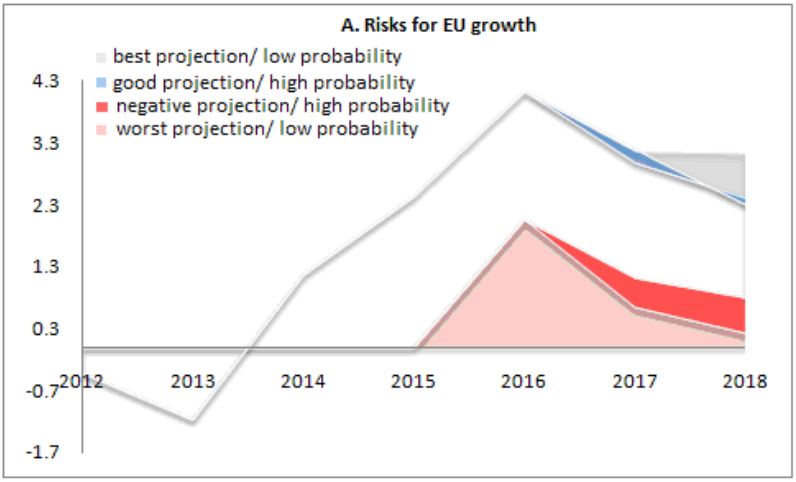
Sources: STOXX and ECB.

Uncertainty. *The implied volatility of the market expectations and volatility of options forecasts are maintained in the historical limits until the first half of the 2016. This high negative slip represents a negative perception of BREXIT future risk on short time from investors, without affecting market integrity. Correlated with this, the implied volatility of HICP, combined with lower evaluation, create premise to adjust the future uncertainty degree through maintaining convergence.* ***Risk distribution.*** *The distribution on market expectation increases to the upside while investment funds have an upward trend. Dynamics in the skewness in terms of distribution spread tends to be symmetrical. Combined, these elements suggest an equilibrium interval of uncertainty and maintain the shock impact degree to global risk projection on medium time, despite the internal single market shock.*

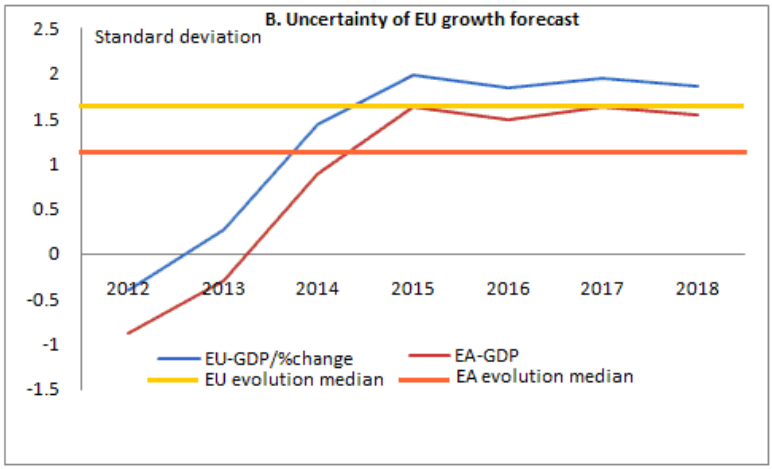
Fig. 4 Uncertainty and risk distribution for the single market trend[16]

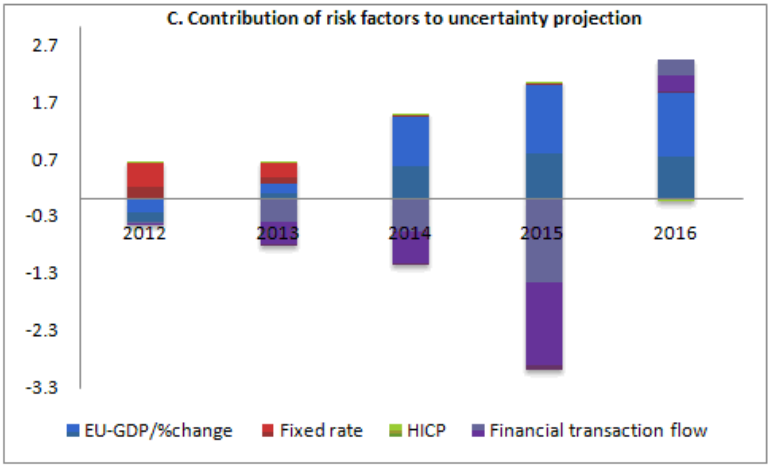
[16] The implied volatility variance options on the VSTOXX is recovered using the Black-Scholes formula from 1- and 12 month- past put the market expectation. B. The stock beta of expectation on the VSTOXX is calculated using linear regression line (fixed rate operations

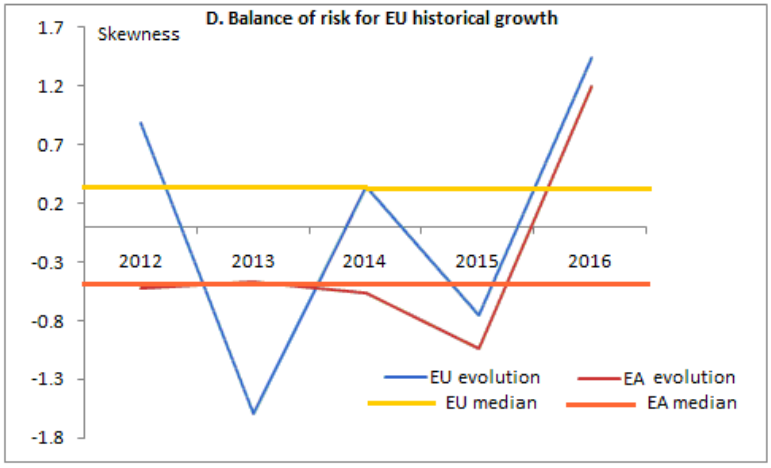
Now we turn to the *Fan-Chart* measurement to express the uncertainty using the indicators as parameters of the risk distribution. After we estimate the skew of each indicator chosen, we follow to interpret the distribution variance through the fuzzy number of capital cycle life. A convenient aspect of this application is that it highlights the crisp values of the linear relationship between the single market skewness and capital cycle life. We then use the result to compute the skew of single market evolution with the variance of global risk estimation as condition of elasticity.

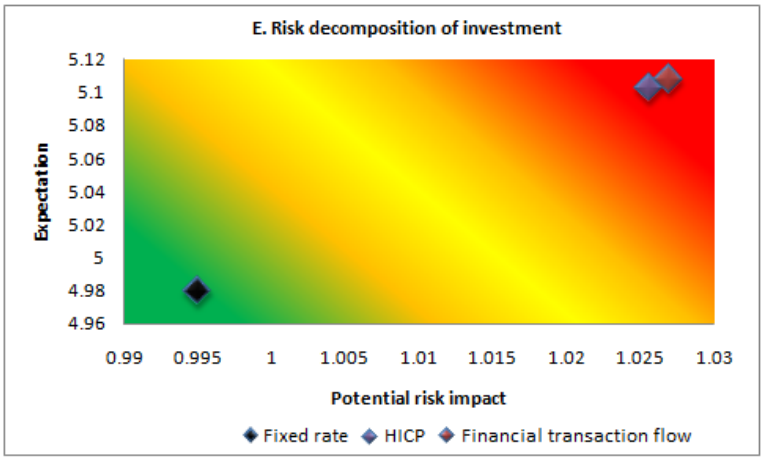


daily ln, index daily ln). This skewness is measured on a 12 month interval in relationship with stock volatility and compared with single market standard deviation. The data source used are:
https://www.stoxx.com/document/Indices/Current/HistoricalData/h_v2tx.txt;
https://www.ecb.europa.eu/stats/monetary/rates/html/index.en.html;
https://www.ecb.europa.eu/stats/prices/hicp/html/inflation.en.html;
http://sdw.ecb.europa.eu/quickview.do?SERIES_KEY=225.IVF.Q.U2.N.T0.A52.A.4.U4.0000.Z01.E&start=02-01-2012&end=07-07-2016&submitOptions.x=0&submitOptions.y=0&trans=BF, online, [Accessed 11.7.2016]


B. Uncertainty of EU growth forecast
Standard deviation
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
2012
2013
2014
2015
2016
2017
2018
EU-GDP/%change
EU evolution median
EA-GDP
EA evolution median


C. Contribution of risk factors to uncertainty projection
2.7
1.7
0.7
-0.3
-1.3
-2.3
-3.3
2012
2013
2014
2015
2016
EU-GDP/%change
Fixed rate
HICP
Financial transaction flow


D. Balance of risk for EU historical growth
Skewness
1.7
1.2
0.7
0.2
-0.3
-0.8
-1.3
-1.8
2012
2013
2014
2015
2016
EU evolution
EU median
EA evolution
EA median



Source: Author calculation

Uncertainty *around the single market growth forecast maintains the dynamic trends after the 2015 incidents and for the next years will be much above the historical median. Particularly, for the Euro area, the uncertainty projection will diminish and continue to remain in the historical corridor. Because of this difference, the risk propagation in global context of the EU market will aknowledge an asymmetric dispersion in the detriment of the positive potential and negative impact.*

Fig. 5. Risk of single market growth[17]

The *Fan-Charts* show distrust intervals with percentual probability of fluctuations and distortions around the negative prediction realizations in contrast with the optimistical evolution in the 2016 (Fig. 5 A). In our *Fan Chart* applications we used information available and predicted up to 2018. They

[17] (A) The projections represent the probable scenarios which are to be developed from the virtual effects starting with 2015. The trend line is obtained through a gravity equation between Global GDP and E.U GDP percents from changes made by adding the $\mu(c)$ as construction variable. (B) The dispersion is measured by the standard deviation. (C) The implication of the risk factors in comparison denotes the contribution as shocks in the GDP historical forecast. (D) The balance of risk is measured by the skewness. (E) In the Risk Decomposition of Investment, the calculation of point position is expressed through VAR 95 and CVAR 95. The source data used are:
http://www.imf.org/external/pubs/ft/weo/2016/01/weodata/weorept.aspx?sy=2012&ey=2018&scsm=1&ssd=1&sort=country&ds=.&br=1&pr1.x=86&pr1.y=6&c=163%2C998&s=NGDP_RPCH%2CNID_NGDP%2CTM_RPCH&grp=1&a=1#cs2;
and http://www.worldbank.org/en/publication/global-economic-prospects, online [Accessed 21 July 2016].

illustrate that the link uncertainty forecast between E.U and global network has growth above the medium average and follow to overcome the historical point. The period around the E.U growth in 2015-2016 illustrates the mistrust influence captured in *Fan Chart.* We correlate the *Fan Chart* analysis with the economic indicators from the balance risk to reveal the influence degree of the internal factors on the uncertainty evolution. However, this comparison is a general one and does not take into account all the differences existing among E.U members groups.

Uncertainty in growth prediction for the interval 2016-2018 is estimated to overcome the historical limits through the rise of the negative projections which start to increase since 2016. This is the effect of two causes, firstly, it is the maintained volatility value, which can express a stagnation. Secondly, it is the investors' perception face to potential positive states variations in a context where the investments present a fuzzy degree of the global portfolios. Thereby, forecast uncertainty will know new types of variations, with a crispy composition, but will remain in the risk median. However, an important variable to the future evolution will represent the perception of the BREXIT process into global markets and the investors' positioning into E.U. Because of this, the risk fluctuations can reflect concerns and mistrust captured by the risk decomposition, where there exist an expectation trend that inflation and liability of investments to play a significant role in risk influence.

Conclusion

In this paper, using the *Fan-Chart* methodology we estimated the single market uncertainty as a connectivity characteristic of the/with the global financial network. Through this initiative we followed to recognize the borders of the uncertainties domain which surround the connectivity channels with the global network. As an application we determined the degree of the forecasting distribution of variables which can influence the dynamics vector of sensitivity. The research methodology was based on the links between distribution skewness and balance risk. The novelty of this methodology is the assessment of the uncertainty risk forecast by the interpretation of data through cognitive mappings of the single market.

The aim of the paper was to provide an analysis for assessing the single market variables that are deemed to influence the market evolution under global uncertainty manifestation. Having this assessment done we attempted to discuss the risk forecast of the uncertainty over the projection distribution.

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