International Review of Business Research Papers
Vol. 12. No. 1. March 2016 Issue. Pp. 144 – 158

International Transmission Mechanism of Time Varying Risk Perceptions on European Financial Markets

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This research attempts to uncover the following important relationships: (i) to what extent is the risk perceptions on financial markets of one country contribute to risk perceptions on another country's financial markets; (ii) what is the duration of such international transmission mechanism of risk perceptions (if any) across countries; (iii) what is the lead-lag relationships of international transmission of risk perceptions in European financial market system. The results of the impulse response functions generated from a five VAR model suggests the following: (i) there exists a strong linkage among the risk perceptions on financial markets across the Europe; (ii) the risk perceptions on the U.K. financial markets seems to have the strongest international spillover impact on risk perceptions on Germany, France and Spain; (iii) the risk perceptions on France and Germany are transmitted to each other to a greater extent than to U.K or Spain; (iv) Italy seems to be the most segmented economy as its risk perception is transmitted least and is also impacted to a lesser extent by an increase in risk perceptions on other economies in the region.

Keywords: International Financial Markets, Risk, International Investment

JEL Classification Codes: G150, G170, F21

1. Introduction

The three separate researches by noble laureates Fama, Shiller and Hansen have collectively challenged the profession to determine whether fluctuations in asset prices are better explained by psychological and behavioral factors or by a more general theory of how investors react to uncertainty (Siegel, 2014). This study is motivated by these seminal arguments and examines how investors' perceptions of risk is transmitted internationally across the financial markets of France, Germany, Italy, Spain and U.K.

Specifically, this research attempts to uncover the following important relationships: (i) to what extent the risk perceptions on financial markets in one country is transmitted to another economy in the region; (ii) if such intentional transmission mechanism does exists, then what is the duration of such impact i.e., how long does the effect of such international spillover of risk perceptions lasts on the financial markets of another country in the region (iii) what is the lead-lag relationships between risk perceptions of European financial markets i.e., which country's risk

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perception (out of the five European financial markets in the sample) leads to changes in the risk perception of another country's market in the sample.

This study employs the time series data in monthly interval during January 2001 – November 2014 on the economic uncertainty developed by Baker, Bloom and Davis (2013) as proxies for risk perceptions on financial markets. The five European markets whose risk perceptions are considered in this study are as follows: U.K., Germany, France, Spain and Italy. The economic uncertainty index for each of these five countries in the sample is constructed from three components: first component quantifies news coverage of policy related economic uncertainty; second component reflects the number of federal tax code provisions set to expire in future years; and third component uses disagreement among economic forecasters as a proxy for uncertainty.

The results of the impulse response functions generated from a five variable vector autoregrssion model (VAR) model suggests the following: (i) there exists a strong linkage among the risk perceptions on financial markets across the Europe; (ii) the risk perceptions on the U.K. financial markets seems to have the strongest spillover impact on risk perceptions on Germany, France and Spain; (iii) the risk perceptions on France and Germany are transmitted to each other to a greater extent than to U.K or Spain; (iv) Italy seems to be the most segmented economy as its risk perception is transmitted least and is also impacted least by an increase in risk perceptions on other economies in the region.

These findings have direct implication for rational investors. There is a good case for policy measures to help investors make better choices and make the market more efficient by minimizing risk perceptions or uncertainties. Policy makers should be concerned about the potential for market bubbles or irrational exuberance due to higher uncertainty which can adversely affect economic activity and potentially has contagion effect across the economies in a region.

This paper is organized as follows: Section two presents the theoretical foundation and reviews the relevant literature on uncertainty while sections three and four presents the econometric methodology and the data. Section five discusses the empirical results and this is followed by the concluding remarks provided in section six.

2. Literature Review

The theoretical framework on perceptions of risk and financial market movements is based on Knight (1971) which differentiates between uncertainty and risk. Risk is characterized by randomness that can be measured precisely. An event is uncertain if it has an unknown probability (Ellsberg, 1961).This difference is important in financial markets. If risk were the only relevant feature of randomness well organized financial institutions should be able to price and market insurance contracts that only depend on risky phenomena. Uncertainty or perception of risk creates frictions that these institutions may not be able to accommodate. Individuals tend to prefer gambles with precise probabilities to ones with unknown odds. Risk and uncertainty are distinct characteristics of random environments but can affect investors' behavior differently. Since risk perceptions (uncertainty) are distinct from risk, it can exert a significance influence on individual behavior and can also be a significant determinant of equilibrium outcome.

Botterill and Mazur (2004) provide a literature review on the risk and risk perceptions and provide a strong linkages with uncertainty. They argue that since there exists a strong linkage between risk perceptions and uncertainty, firms employ processes that attempt to reduce risk by increasing certainty in decision making. They suggest that one of the most common techniques for reducing uncertainty or risk perceptions is to allocate probabilities to both desirable and undesirable outcomes.

Risk perceptions makes opportunities for mutually satisfactory trade difficult to find in an exchange economy Bewley (2001). A peculiar consequence of such perceptions is that individuals are unwilling to insure each other. This aversion to trade is counterbalanced by the presence of risk aversion, which makes mutual insurance attractive. Rigotti and Shannon (2001) show that equilibrium can be characterized by the interplay between uncertainty and risk. For example sometimes uncertainty is so large that no trade results; other times desire to insurance prevails and there is trade. This trade-off is not captured by the standard expected utility model where only risk aversion has a role.

It is well documented that firms and households in general consider the role of risk perceptions in decision making process. For example, since 2008 recession changing perceptions on future tax, spending, regulatory, health-care and monetary policies seems to slow the recovery from the recession by leading businesses and households to postpone investment, hiring and consumption expenditure. However, little empirical research is done to quantify the impact of such perceptions on risk on the international financial market linkages.

In an efficient financial market, one would expect the reaction of market only to the *unanticipated* component of explanatory variables. Elton and Gruber (1991) argue all the variables in a multi index model need to be *surprises* or *innovations* and therefore should not be predicted from their past values. Thus, asset pricing models such as Arbitrage Pricing Theory (APT) employ the unexpected component (innovations) of explanatory variables, while modeling expected returns. Perceptions on risk, by nature are surprises which may or may not be factored in the financial markets. In an expectation driven market such as options, stocks and bonds the valuations should factor in the current level of uncertainty at all times. The purpose of this research is to provide an empirical test of this relationship.

Empirical studies have analyzed the effect of economic risk perceptions on macroeconomic variables such as employment, output and productivity growth (Bloom, 2009); economic growth (Caglayan, Maioli and Mateut, 2012); firms' investments and cash flows (Baum, Caglayan and Talavera, 2010); economic activity (Bachmann, Elstner and Sims, 2010); output and inflation (Jones and Olson, 2013). However, the relevance of economic uncertainty on financial markets is examined to a lesser extent (For example, Antonakakis, Chatziantoniou and Filis, 2013 examined the co-movement between economic uncertainty and S&P 500 volatility and find significant relationships). Shun (2012) examines the impulse response function of economic policy uncertainty (EPU) and stock market returns in the Eurozone and shows that stock market returns are positively related to the changes in economic policy uncertainty. In addition, the results also reveal a strong feedback from the stock market.

This study extends the previous research and contributes by examining the *intensity* and *duration* of the effect of the international spillover effects of risk perceptions across as a set of European

financial markets. Specifically, it investigates the response (intensity and duration) of risk perceptions on financial markets of one European country (U.K., Germany, France, Spain and Italy) to changes in risk perceptions of other European country in the sample. It also investigates the lead-lag relationship of such international spillover effects of risk perceptions among these European financial markets.

The findings of this study could have direct implication for international investors. Evidence on significant role of international transmission mechanism of risk perceptions would suggest that asset pricing models should consider the role of changes in the global perception of risk of other countries in the region. By exploiting these surprises, rational investors can make superior profits in international financial markets. There is a good case for policy measures to help investors make better choices and make the market more efficient by minimizing uncertainty. The policy makers should be concerned about the potential for market bubbles or irrational exuberance due to higher uncertainty which can adversely affect economic activity.

Accordingly, the following hypotheses are formulated to test the impact, duration and lead lag relationships between risk perceptions of European countries:

- **H_1:** There is no significant effect of risk perception of one European country on risk perception of another European country.
- **H_2:** The no significant duration of the impact of risk perception of one European country on risk perception of other European country.
- **H_3:** There is no significant lead lag relationships between risk perceptions of a pair of European countries.

3. Econometric Methodology

The VAR model by Sims (1980) is chosen as an appropriate econometric approach to investigate the postulated relationships. In addition, the following additional factors are taken into consideration before the estimation: in an efficient financial market, one would expect the reaction of the stock market only to the *unanticipated* component of explanatory variables. Elton and Gruber (1991) argue all the variables in a multi index model need to be *surprises* or *innovations* and therefore should not be predicted from their past values. Thus, asset -pricing models such as Arbitrage Pricing Theory (APT) employ the unanticipated component (innovations) of explanatory variables. Since, the formulated models are multi index models; direct estimation in its present form would only give the relationships between the *anticipated* components. Such estimation would mean ignoring the effect of changes in the *unanticipated* components of investor sentiments and stock market returns and therefore could be misleading. To overcome such potential misspecification problems, the powerful impulse response functions (predicted pattern of surprise changes or innovations) are generated from the VAR model. Additionally, the prediction performance of VAR models has been shown to be better than the structural models during the past two decades (Litterman and Supel, 1983; Hakkio and Morris, 1984; Litterman, 1984; Lupoletti and Webb, 1986 and Webb, 1999).

It is also important to consider that the transmission of information contained in the stock returns may not always be contemporaneous due to the time delays in the generation and dissemination of information concerning both the noise and rational factors, especially macroeconomic

variables. Reporting delays may create lags between the observation of data concerning such variables and the incorporation of this information to stock prices. Hence, a model in which all variables are measured at time *t*, would imply an unrealistic assumption of *only* contemporaneous association. For this purpose the use of *Akaike information criterion* (*AIC*) and *Schwarz information criterion* (*SIC*) also helps in identifying the appropriate lag lengths. Thus the lags in the VAR model capture the dynamic feedback effects in a relatively unconstrained fashion and are therefore a good approximation to the true data generating process. The VAR model is expressed as follows:

$$Z(t) = C + \sum_{s=1}^{m} A(s)Z(t-m) + \varepsilon(t) \qquad (1)$$

Where, *Z(t)* is a column vector of variables under consideration, *C* is the deterministic component comprised of a constant, *A(s)* is a matrix of coefficients, *m* is the lag length and ***ε(t)*** is a vector of random error terms.

The VAR specification allows the researchers to do policy simulations and integrate Monte Carlo methods to obtain confidence bands around the point estimates (Doan, 1988). The likely response of one variable to a one time unitary shock in another variable can be captured by impulse response functions. As such they represent the behavior of the series in response to pure shocks while keeping the effect of other variables constant. Since, impulse responses are highly non-linear functions of the estimated parameters, confidence bands are constructed around the mean response. Responses are considered statistically significant at the 95% confidence level when the upper and lower bands carry the same sign.

It is well known theoretically that traditional orthogonalized forecast error variance decomposition results based on the widely used Choleski factorization of VAR innovations may be sensitive to variable ordering (Pesaran and Shin, 1996; Koop, Pesaran and Potter, 1996; Pesaran and Shin, 1998). To mitigate such potential problems of misspecifications, *generalized impulses* technique as described by Pesaran and Shin (1998) is employed in which an orthogonal set of innovations does not depend on the VAR ordering.

4. Data

A time series data in monthly interval during January 2001 – November 2014 is employed to test the postulated relationship. The sources and description of the data are as follows: the data on the risk perceptions on the five European financial markets (U.K., France, Germany, Spain and Italy) is taken from a previous study, Baker, Bloom and Davis (2013). This seminal research constructs indexes on economic uncertainty for these countries from three components. First component quantifies news coverage of policy related economic uncertainty; second component reflects the number of federal tax code provisions set to expire in future years; and third component uses disagreement among economic forecasters as a proxy for uncertainty. The growth or the continuously compounded returns of these perceptions on risk (or uncertainty index) are calculated to measure its rate of change in monthly intervals.

The link between economic fundamentals of a country with its financial markets is well established in the literature. To a large extent, the stock market performance and its volatility in returns are shown to depend on the future expectations regarding the economic performance. The natural extension of this relationship would be that risk perceptions or uncertainty on economy would play a significant role in determination of pricing in the financial market. Following this argument, the risk perception or uncertainty towards economy is used as an indicator of the risk perception or financial market of that particular economy. The economy and financial market of a country typically move in tandem and not independent or isolated from each other.

Table 1 reports the descriptive statistics for the mean percentage change for the five variables included in the study: changes in risk perceptions on financial markets of U.K, Spain, Germany, Italy and France. Accordingly, an interpretation of a positive rate of change for a particular financial market would be that the perception of risk in that particular market is increasing and vice-versa.

The mean of changes in risk perceptions for France, Spain and U.K. are positive suggesting that overall, investors have perceived the risk to be increasing in these markets. A possible reason could be that the timespan captures the two crisis (2001 and 2008) during which there was an extremely high global risk perceptions in the international financial markets. Moreover, the mean increase in risk perception for France is the highest followed by those in U.K., and Spain. On the other hand, the mean for Germany and Italy are negative suggesting a declining nature of perceptions of risk for these financial markets. Likewise, the standard deviation of changes in risk perceptions is the highest for France, followed by Spain, Germany and Italy suggesting a volatile nature of behavioral factors of international investors. The descriptive statistics also indicate that the volatility of changes in risk perception is the lowest for the U.K. financial market.

Table 1: Descriptive statistics: changes in risk perceptions

	France	Germany	Italy	Spain	U.K
Mean	0.80%	-0.02%	-0.01%	0.36%	0.56%
Median	1.26%	-2.76%	-0.95%	-1.16%	2.21%
Maximum	118.04%	113.07%	151.01%	170.57%	76.48%
Minimum	-120.36%	-89.01%	-97.38%	-95.37%	-62.99%
Std. Dev.	42.82%	39.19%	36.43%	42.36%	28.67%

Table 2 reports the cross correlation between the risk perceptions of the five European financial markets. The correlations for each pair in the sample is somewhat lower. The lowest correlation is 0.25 between France and Italy while the maximum correlation is 0.47 between Germany and Spain suggesting that global risk perception on each of these financial markets is unique. The determinant for perception of risk by international investors for each of these financial markets seems to be different for each European market.

Table 2: Cross-correlations

	France	Germany	Italy	Spain	U.K
France	1.00				
Germany	0.35	1.00			
Italy	0.25	0.27	1.00		
Spain	0.29	0.47	0.32	1.00	
U.K	0.35	0.40	0.23	0.30	1.00

Before proceeding with the main results, we first check the time series properties of each variable by performing unit root tests using Augmented Dickey Fuller (ADF) test (Dickey and Fuller, 1979, 1981). Based on the consistent and asymptotically efficient *AIC* and *SIC* criteria (Diebold, 2003) and considering the loss in degrees of freedom, the appropriate number of lags is determined to be two. In the case of the ADF test, the null hypothesis of nonstationarity is rejected. The inclusion of drift/trend terms in the ADF test equations does not change these results (Dolado, Jenkinson, and Sosvilla-Rivero, 1990).

5. Estimation Results

To analyze the dynamic relationship between risk perceptions of European financial markets a five variable VAR model with two lags as depicted in equation 1 is estimated. The variables included in this VAR model are continuously compounded return or changes in risk perceptions for the following five European financial markets: U.K., Germany, France, Spain and Italy.

The VAR model developed by Sims (1980) is useful in capturing the linear interdependencies among multiple time series variables. The VAR model generalizes the univariate autoregressive model by allowing for more than one evolving variable. All variables in a VAR are treated symmetrically in a structural sense and each variable has an equation explaining its evolution based on its own lags and the lags of the other time series variables. VAR modeling does not require as much knowledge about the forces influencing a variable as do structural models with simultaneous equations. The only prior knowledge required is the details of variables which can be hypothesized to affect each other in an intertemporal fashion.

Sims (1980) suggests that autoregressive systems like these are difficult to describe succinctly. Especially, it is difficult to make sense of them by examining the coefficients in the regression equations themselves. Likewise, Sims (1980) and Enders (2003) show that the *t*-tests on individual coefficients are not very reliable guides and therefore do not uncover the important interrelationships among the variables. Sims (1980) recommends focusing on the system's response to typical random shocks i.e., impulse response functions. Given these theories, the relevant impulse response functions are analyzed and not much emphasis is placed on the estimated coefficients of the VAR models and provide the VAR estimation results in the technical appendix.

Accordingly, the generalized impulse responses from the VAR model are generated to trace the response of one variable to a one-standard-deviation shock to another variable in the system. The Monte Carlo methods is employed to construct confidence bands around the mean

response. When the upper and lower bounds carry the same sign, the responses become statistically significant at the 95% confidence level. On each graph, "percentage returns" are on the vertical and "horizon" is on the horizontal axis.

Figure 1 plots the international transmission of risk perception on U.K. to other European countries i.e., impulse responses of risk perceptions on European financial markets to one time standard deviation increase in the risk perception on U.K. The response of all the four European markets (France, Germany, Italy, and Spain) are positive and significant. The impact is almost similar for France, Germany and Spain and somewhat lower for Italy. The duration of this impact lasts for approximately 2 months in all the four cases. This suggests an international transmission of risk perceptions of U.K. to other to European markets is strong in magnitude and lasts for a substantial duration.

Figure 1: Response of risk perceptions in Europe to risk perception in U.K.

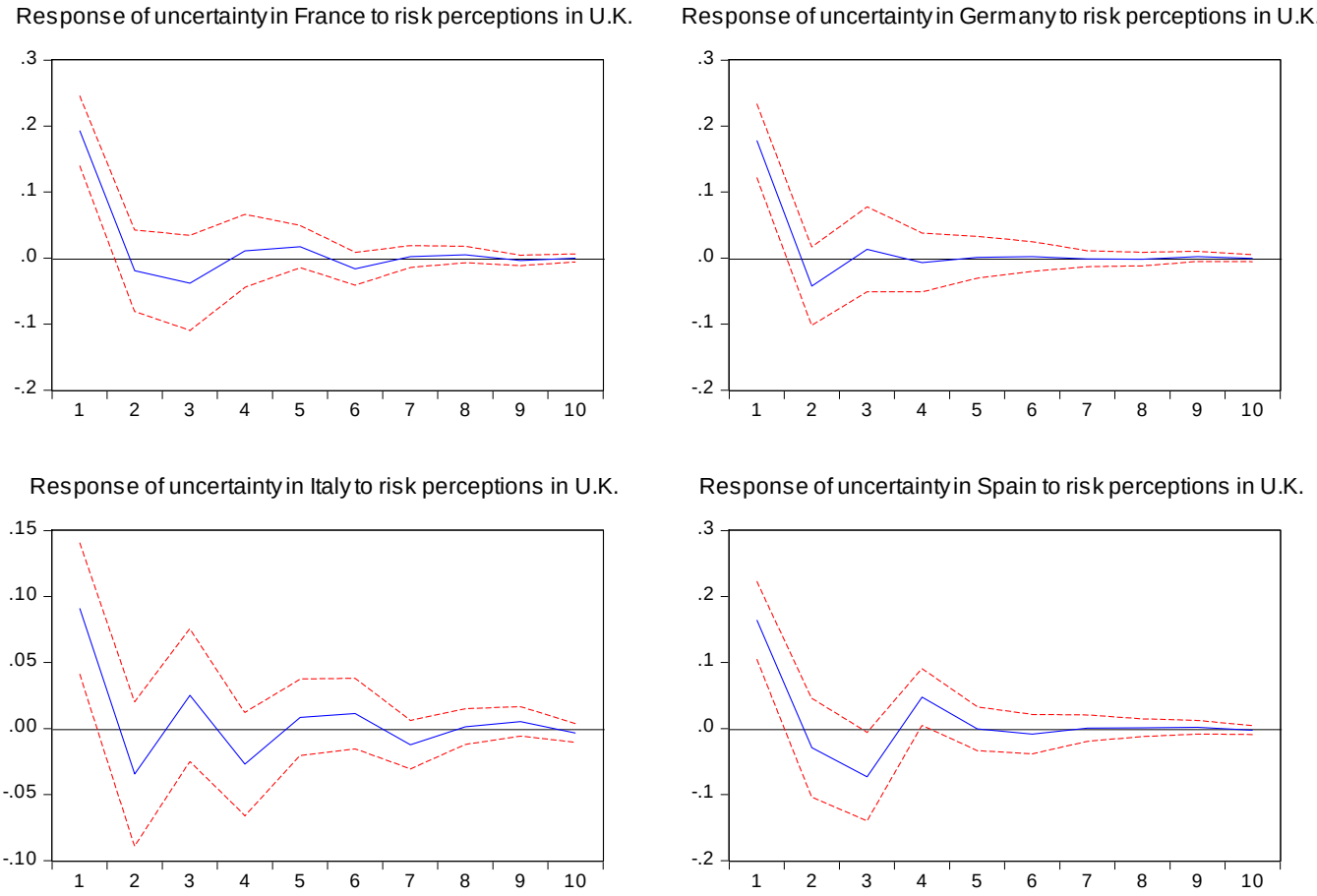


Figure 2 plots the impulse responses of risk perceptions in France, Italy, Spain and U.K. to shocks in risk perceptions on Germany. Similar to the results for U.K.'s shock, the responses of European financial markets are significant and positive for approximately two months. The magnitude of response of France to shocks in Germany seems to be the strongest among all European markets. However, the response of Italy and Spain are of lower magnitude than their response to the U.K' shock. Moreover, the response of U.K. seems to be of somewhat lower

magnitude. This result suggests that financial markets of France and Germany are interrelated to a greater extent than any other two markets in the sample.

Figure 2: Response of risk perceptions in Europe to risk perception in Germany

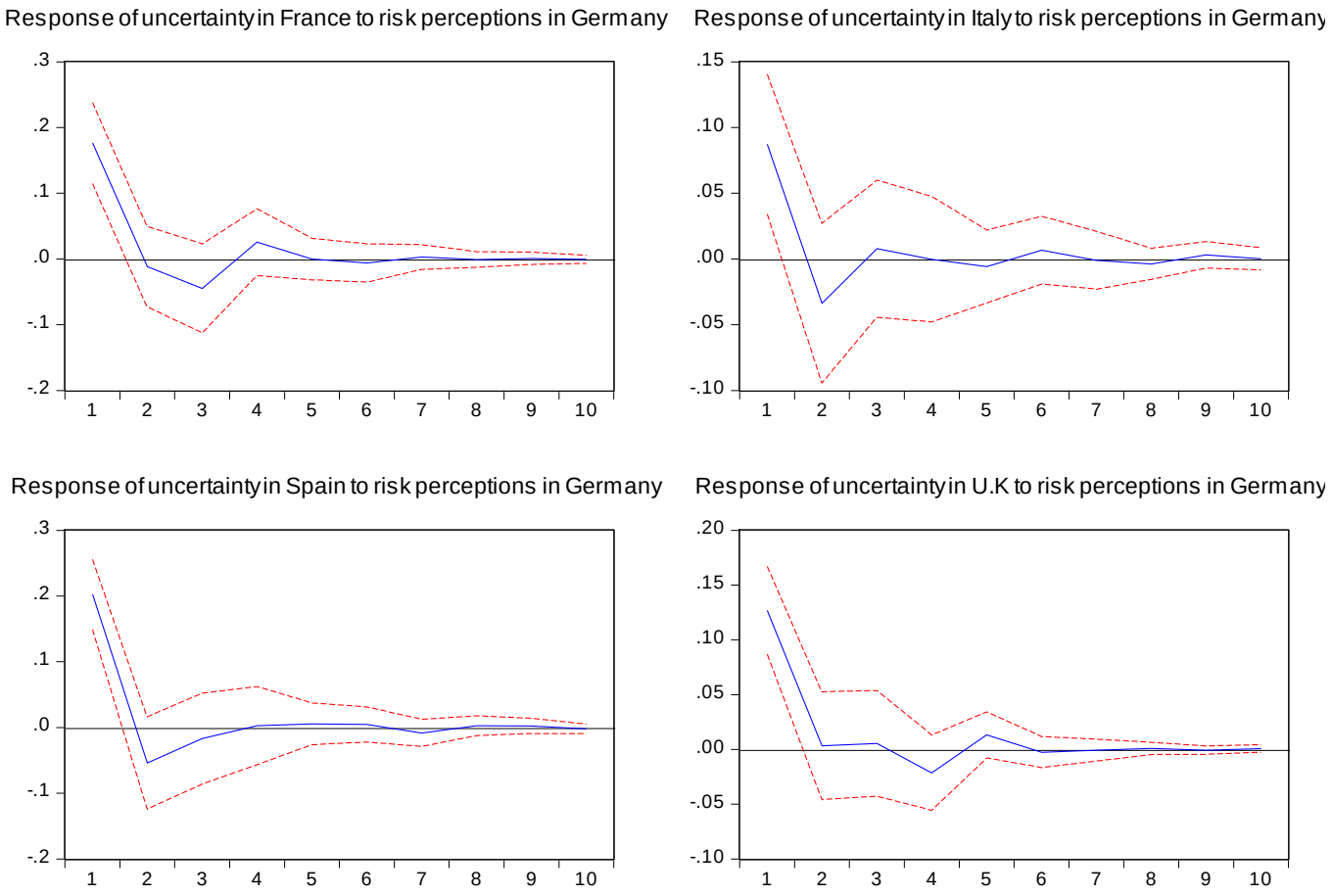


Figure 3 plots the international transmission of risk perception on France to other European countries i.e., impulse responses of risk perceptions on European financial markets to one time standard deviation increase in the risk perception on France. The results are very similar to the ones obtained for shocks in Germany. The responses of Germany, Italy, Spain and U.K. are significant and positive for approximately two months. The magnitude of response of Germany to shocks in France is similar to the response of France to Germany (obtained in the figure 2) and seems to be the strongest among all European markets. However, the response of Italy seems to be the lowest followed by Spain. Moreover, both Spain and Italy's responses are of lower magnitude than their response to the U.K' shock. Moreover, the response of U.K. seems to be of somewhat lower magnitude. This result suggests consistent with the previous findings that the risk perceptions on France and Germany are transmitted to each other to a greater extent than to U.K or Spain

Figure 3: Response of risk perceptions in Europe to risk perception in France

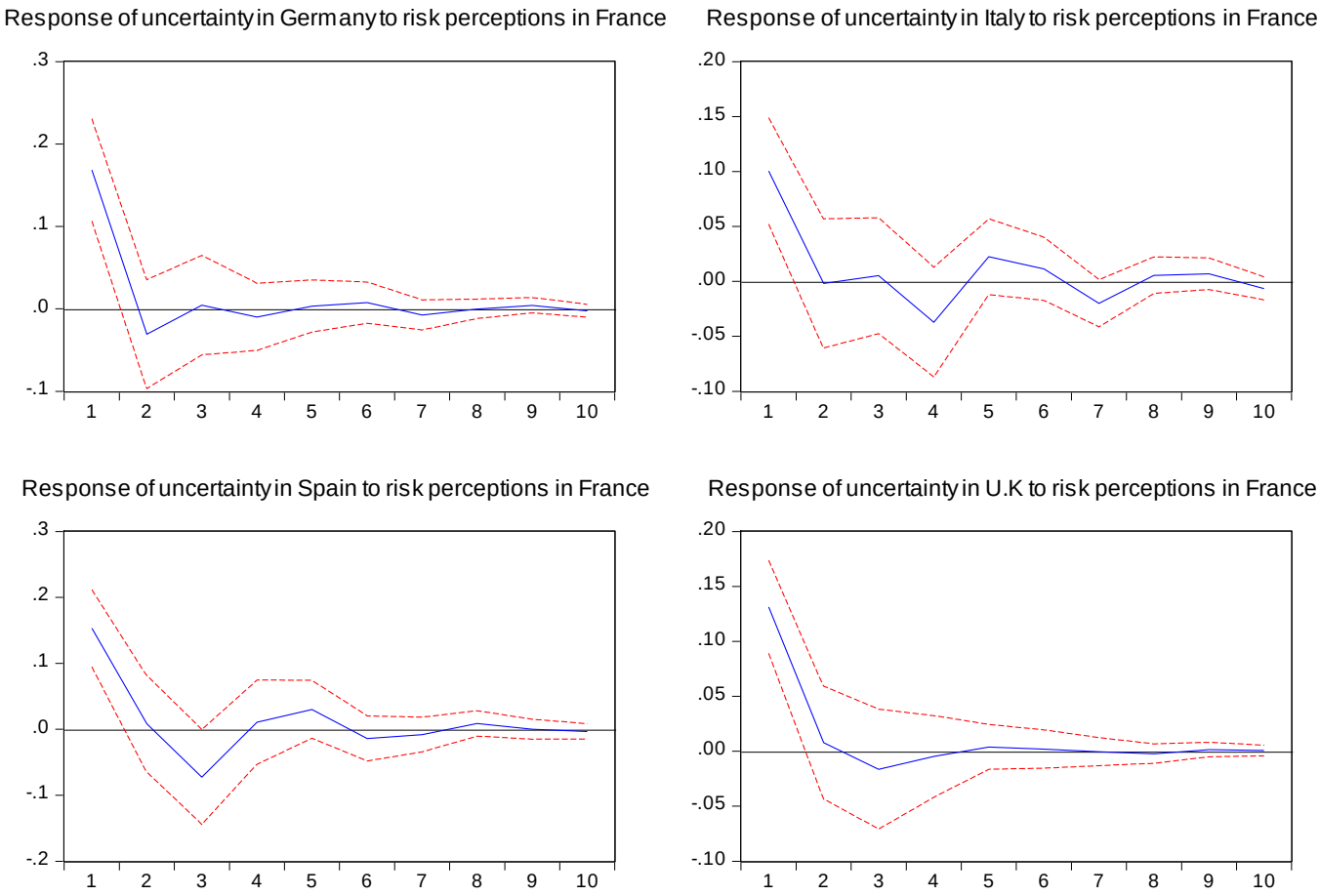


Figure 4 plots the impulse responses of risk perceptions in Germany, France, Spain and U.K. to shocks in risk perceptions on Italy. Unlike the impact of U.K., France and Germany, the shocks in Italy's risk perceptions seems to have lesser effect on the risk perceptions of European markets. The lowest impact is on U.K. while Germany, France and Spain are of similar magnitude. Moreover, the duration of these responses seems to be lower and lasts for a little over a month This result suggests that financial markets of Italy seems to be the most segmented economy in the region as its risk perception is transmitted to the least extent.

Figure 4: Response of risk perceptions in Europe to risk perception in Italy

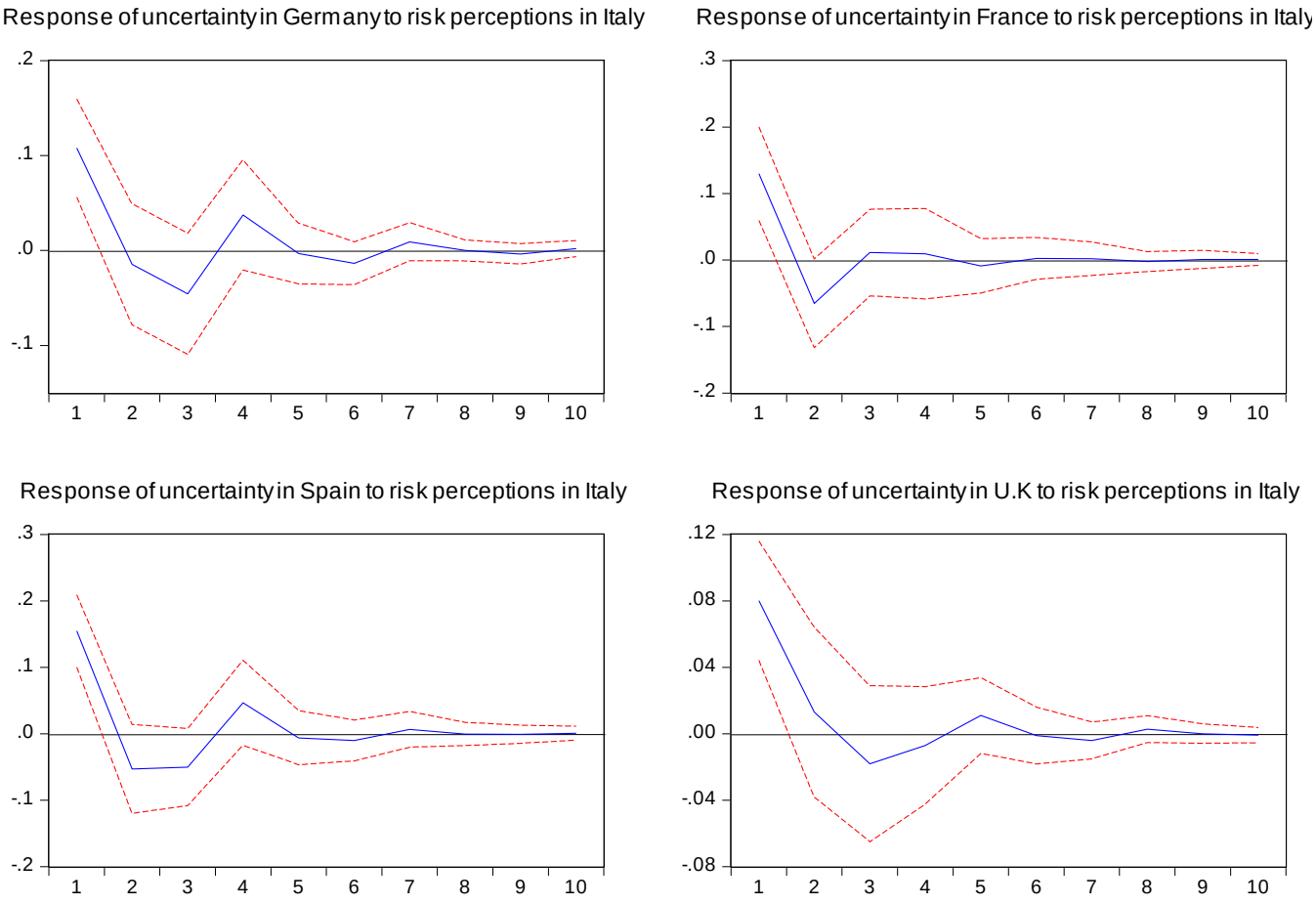
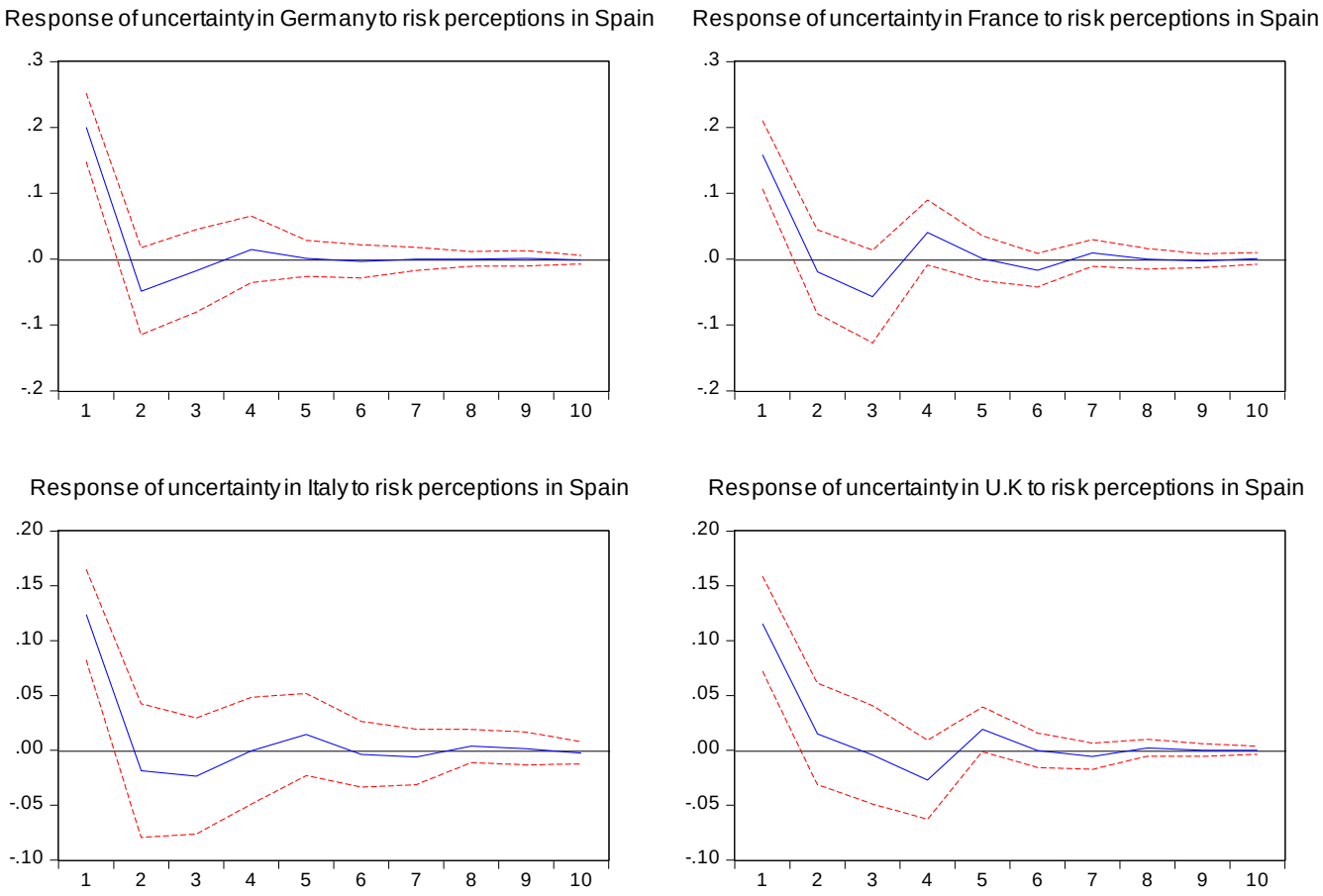


Figure 5 plots the international transmission of risk perception on Spain to other European countries i.e., impulse responses of risk perceptions on European financial markets to one time standard deviation increase in the risk perception on Spain. The results for both Germany and France are very similar. In both these cases, the transmission mechanism is strong and lasts for almost two months. However, the response of U.K. and Italy seems to be of lesser magnitude compared to the ones for France and Germany.

Figure 5: Response of risk perceptions in Europe to risk perception in Spain



The above impulse response functions presented in figures 1-5 reject the null hypotheses (H_1, H_2, and H_3) of insignificant international transmission mechanism of risk perceptions from one European economy to the other. The rejection of the three hypotheses indicate the existence of the following relationships: overall, the results suggests that government policy uncertainty in U.K. seems to have the greatest spillover impact on government policy uncertainty in Germany, France, and Spain'. The impulse responses obtained from a five variable VAR model suggest that the European financial markets are strongly interrelated in that the shocks in risk perceptions in one country is strongly transmitted internationally to other financial markets in the region. Specifically, the shocks in U.K.'s risk perception has strongest impact in other European markets. The impact and response of risk perceptions on France and Germany are very similar. The changes in risk perceptions on one of these countries in response to shock in the other country are of almost equal duration and magnitude suggesting strong linkages between them. Italy seems to display the lowest response and of lesser duration than any other country in the sample indicating it to be the most segmented in the region.

6. Conclusion

The purpose of this research is to empirically examine the mechanism in which risk perceptions on a financial market is transmitted internationally to other countries in the region. In addition, to the magnitude of international spillover effect of risk perceptions, it also investigates the duration

of which such impact lasts i.e., how long does the effect of international spillover of risk perceptions lasts on the financial markets of another country in the region. Lastly, using a sample of five European financial markets, it examines the lead-lag relationships among the changes in their risk perceptions i.e., which country's risk perception (out of the five European financial markets in the sample) leads to changes in the risk perception of another market in the sample.

It employs the time series data in monthly interval during January 2001 – November 2014 on the economic uncertainty developed by Baker, Bloom and Davis (2013) as proxies for risk perceptions on the five European markets. The five European markets whose risk perceptions are considered in this study are as follows: U.K., Germany, France, Spain and Italy. One limitations of this research is the choice of economic uncertainty data to represent the risk perceptions. Future research could validate the findings of this paper by using alternate dataset and/or using volatility econometric models such as multivariate EGARCH.

The results of the impulse response functions generated from a five variable vector autoregrssion model (VAR) model suggests the following: (i) there exists a strong linkage among the risk perceptions on financial markets across the Europe; (ii) the risk perceptions on the U.K. financial markets seems to have the strongest spillover impact on risk perceptions on Germany, France and Spain; (iii) the risk perceptions on France and Germany are transmitted to each other to a greater extent than to U.K or Spain; (iv) Italy seems to be the most segmented economy as its risk perception is transmitted least and is also impacted extent by an increase in risk perceptions on other economies in the region.

These findings have direct implication for rational investors. There is a good case for policy measures to help investors make better choices and make the market more efficient by minimizing risk perceptions or uncertainties. Policy makers should be concerned about the potential for market bubbles or irrational exuberance due to higher uncertainty which can adversely affect economic activity and potentially has contagion effect across the economies in a region.

Endnotes

1. This research was supported by the ORCA award fund from the UHD.

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