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The Asymmetric Effects and Spillovers of Inflation and Output Uncertainty between the US and Euro Area

Riyad Abubaker[1]

1. Introduction

With recent technological advancements -a country's domestic economy becomes more open and affected by global shocks. Agents within various countries become increasingly aware of the possible transmission of uncertainty shocks due to a negative impact on output, investment, and employment (Bloom 2009). This can happen through trade or financial channels. Authorities responsible for making policies such as monetary policy often adjust their tools to stimulate the economy. However, neglecting the external negative shocks can have an impact on the effectiveness of their policies.

The ARCH model (Engle, 1982) is an important tool used in measuring conditional volatility. In literature, the estimation and studies on the impact of economic uncertainty have expanded -with recent articles using conditional volatility of economic variables as a proxy for uncertainty. Examples of this include: stock market volatility (Bloom, 2009), exchange rate volatility (Grier and Smallwood, 2013), and inflation volatility (Fountas et al. (2006) and Caporale et al. (2010).

My paper builds on current research applying bivariate GARCH in mean models. With this, two equations are estimated: mean equation and variance equation. Rahman and Serletis (2009, 2011,), Grier and Smallwood (2011), Hegerty (2014). Numerous studies have demonstrated that two or more countries can be linked under one model. For example, Dees et al. (2013) constructs a multi-country rational expectations model in which the cyclical components of variables in a given country are inked to other countries.

Dungey et al. 2009) implement a structural VEC to study the response of economic activity to shocks in the US and Euro Area. In the context of uncertainty, this paper examines the impact of uncertainty shocks, and I distinguish positive shocks from negative shocks. Uncertainty effect is not limited to domestic economic activity. Rather, it can spread from one economy to another.

[1] Ph.D. candidate in the Department of Economics at University of California, Riverside 900 University Ave., Riverside, CA 92521, USA. E-Mail: rabub001@ucr.edu, Webpage:riyadabubaker.weebly.com The paper has been submitted on 11-12-2014

Spillovers of economic variables and their uncertainty have been an area of interest for many researchers. Netsunajev and Winkelmann (2014) find a significant spillover of inflation expectations between the US and Euro Area. In addition, they find that during macroeconomic stress, this spillover increases. Conrad and Karanasos (2014) study the link between output uncertainty and inflation uncertainty . Shih and Wang(2009) focus on return volatility spillover between developed and emerging European equity markets. They find that regional shocks are stronger than shocks that arrive from foreign countries. Sum (2012) shows that the policy uncertainty in U.S negatively affects the stock markets in Mexico and Canada. Berger and Herz (2014) construct a global macroeconomic uncertainty using a dynamic factor model that links 9 countries together. Colombo (2013) finds that US policy uncertainty significantly reduces European industrial production.

Uncertainty is measured by the conditional variance of GARCH models. I feel that it's crucial to mention that due to the variance being estimated by the squared residuals -the signs of errors are ignored. Zakoian (1994) developed a Threshold GARCH model (TGARCH) to solve this problem. He accomplishes this by assigning a dummy variable to squared errors when these errors are negative. This model helps in detecting the asymmetry of volatility. Many authors take this route and apply asymmetric volatility models. Cappiello et al.2006), Rahman and Apostolos (2010, 2011), Giannellis et al.2008). Using U.S. data, Grier et al. (2004) finds that asymmetric volatility exists in inflation and output. In addition to Grier et al. (2004) findings, I extend their model to include an asymmetry of external shocks effects -with special emphasis placed on different techniques such as difference-in-difference estimation.

The contribution of this paper to the existing literature is summarized below. This paper examines the asymmetry of output growth and inflation uncertainty for the U.S. and Euro Area. In addition, I focus on inflation and output uncertainty spillovers across the two regions. In adding dummy variables to the VAR representation, I investigate whether the state of the economy affects the magnitude of uncertainty effects. The remainder of this paper is organized as follows: Section 2 presents the empirical models. Section 3 describes the data. Section 4 shows the results. Section 5 provides the conclusions.

2. Empirical Model

This paper uses a bivariate GARCH model. The conditional volatility is used as proxy for uncertainty. I link the domestic variables directly to internal and external uncertainty measures. However, I do not link the U.S. variables of output growth and inflation to the E.A. or contrariwise. Rather, I regress these variables directly on uncertainty from both regions. I assume the output growth and inflation are given by the following expression:

$$Y_{it} = \Lambda_{i0} + \sum_{r=1}^{p} \Lambda_{ir} Y_{it-r} + (\Psi_i + \Gamma D_{it})\Upsilon_{it} + \Xi_{it} \quad (1)$$

$$Y_{it} = E(Y_{it}|\Omega_{i,t-1}) + \Xi_{it} \quad (2)$$

$$\Xi_{it}|\Omega_{i,t-1} \sim N(0, H_{it}) \quad (3)$$

i=US, Euro Area (EA)

Where Y_t is a vector of output growth and inflation variables: y_{it} =[$y_{it,}$ π_{it}]'. Output growth is defined as the first difference of logged real gross domestic product: y_{it} =[Log(GDP_{it}) - Log(GDP_{it-1}) Inflation rate is the difference of logged consumer price index : π_{it} =[Log(CPI_{it})- Log(CPI_{it-1})] is the mean equation where output growth and inflation are functions of their lags and uncertainty measures. Λ_0 is 2x1 matrix, Λ_i is 2 x 2 matrices. Ψ and Γ_i are 2 x 4 matrices. D_{it} is 4 x 4 -a matrix of dummy variables and it takes the form of identity matrix if both signs of error terms is negative. And, it becomes a zero matrix when both errors are nonnegative. $\Omega_{i,t-1}$ is information set at time t-1

And Ξ_i is a vector of error terms.

$$\Xi_{it} = \begin{bmatrix} \varepsilon_{it}^{y} \\ \varepsilon_{it}^{\pi} \end{bmatrix}' \quad (4)$$

where Ξ_{it} is assumed to be normally distributed with zero mean and variance-covariance matrix H_{it} :

$$H_{it} = \begin{bmatrix} h_{i(y)t} & h_{i(y,\pi)t} \\ h_{i(\pi,y)t} & h_{i(\pi)t} \end{bmatrix} \quad (5)$$

The diagonal elements of H_{it} are the variances of output growth and inflation. Off-diagonal elements are the covariance between the two variables. h_{it} is the variances vector in matrix H_{it} The covariance between output and inflation are ignored because null hypothesis in Johansen Cointegration Test can't be rejected In addition to the Λ matrix, the coefficients of Equation(1) are introduced by the following matrices:

$$h_{it}=\begin{bmatrix}h_{i(y)t}\\ h_{i(\pi)t}\end{bmatrix},\Upsilon_{it}=\begin{bmatrix}\sqrt{h_{i(y)t}}\\ \sqrt{h_{i(\pi)t}}\\ \sqrt{h_{j(y)t-1}}\\ \sqrt{h_{j(\pi)t-1}}\end{bmatrix},\Psi_i=\begin{bmatrix}\psi_{(y_i,y_i)} & \psi_{(y_i,\pi_i)} & \psi_{(y_i,y_j)} & \psi_{(y_i,\pi_j)}\\ \psi_{(\pi_i,y_i)} & \psi_{(\pi_i,\pi_i)} & \psi_{(\pi_i,y_i)} & \psi_{(1_i,\pi_i)}\end{bmatrix} \quad (6)$$

$$\Gamma_i=\begin{bmatrix}\gamma_{(y_i,y_i)} & \gamma_{(y_i,\pi_i)} & \gamma_{(y_i,y_j)} & \gamma_{(y_i,\pi_j)}\\ \gamma_{(\pi_i,y_i)} & \gamma_{(\pi_i,\pi_i)} & \gamma_{(\pi_i,y_i)} & \gamma_{(1_i,\pi_i)}\end{bmatrix},D_{it}=\begin{bmatrix}d^y_{it} & 0 & 0 & 0\\ 0 & d^\pi_{it} & 0 & 0\\ 0 & 0 & d^y_{jt} & 0\\ 0 & 0 & 0 & d^\pi_{jt}\end{bmatrix}$$

$$\mathrm{d}^m_{it}=\begin{cases}1 & \varepsilon^m_{i,t}<0\\ 0 & \varepsilon^m_{i,t}\geq 0\end{cases} \qquad d^m_{jt}=\begin{cases}1 & \varepsilon^\pi_{n,t-1}<0\\ 0 & \varepsilon^\pi_{n,t-1}\geq 0\end{cases} \qquad ,m=y,\pi$$

The square roots of h_{it} elements are the conditional standard errors. The coefficient of the first two columns in matrix Ψ detects the impact of domestic uncertainty on domestic variables. While the rest of the coefficients detect the impact of uncertainty generated in one region on the variables of the other region. The coefficients of the matrix Γ is introduced to capture the effects of uncertainty when variables experience negative shocks. Υ is a vector of uncertainty measures in which the external and internal volatility are directly given as an explanatory variable within the economic activity regressions. I use internal volatility at time t, while the lagged external volatility is used. The reason behind using square root $h_{j,t-1}$ that I assume that foreign economic shocks take time to arrive.

The conditional volatility follows GARCH (1,1) -diagonal vector model:

$$h_{it}=C_i+(A_i+BD_{it})vec(\Xi_{it-1}\Xi'_{it-1})+G_ih_{i,t-1}+F_ivec(\Xi_{jt-k}\Xi'_{jt-k}) \quad (7)$$

where h_t =vec(H_t) as defined in(6) , C_i is 2 x 1v matrix of constants: A, B, G, F, and D_t are 2 x 2 matrices of dummies for the Threshold GARCH model by which the additional terms are added to detect the asymmetry of volatility :

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$$D_{it} = \begin{bmatrix} d_t^y & 0 \\ 0 & d_t^\pi \end{bmatrix}, \quad d_{it}^m = \begin{cases} 1 & \varepsilon_{t-1}^m < 0 \\ 0 & \varepsilon_{t-1}^m \geq 0 \end{cases} \quad , m = y, \pi$$

The subscript k in equation (7) refers to the speed at which the volatility could immigrate from one region to another. Let's say that the U.S. experiences higher uncertainty in month t. Then k represents the number of months it takes for the U.S. volatility to affect the E.A. In this paper, I will assign different values for K to demonstrate the speed of uncertainty transmission. The matrix form of equation (7) can be written as:

$$\begin{bmatrix} h_{i(y)t} \\ h_{i(\pi)t} \end{bmatrix} = \begin{bmatrix} c_{i(y)} \\ c_{i(\pi)} \end{bmatrix} + \begin{bmatrix} a_{(iy)} & 0 \\ 0 & a_{(i\pi)} \end{bmatrix} \begin{bmatrix} \varepsilon_{iy,t-1}^2 \\ \varepsilon_{i\pi,t-1}^2 \end{bmatrix} + \begin{bmatrix} b_{(iy)} & 0 \\ 0 & b_{(i\pi)} \end{bmatrix} \begin{bmatrix} d_{(it)}^y \varepsilon_{iy,t-1}^2 \\ d_{(it)}^\pi \varepsilon_{i\pi,t-1}^2 \end{bmatrix} \quad (9)$$

$$+ \begin{bmatrix} g_{(i,yy)} & 0 \\ 0 & g_{(i,\pi\pi)} \end{bmatrix} \begin{bmatrix} h_{i(y)t-1} \\ h_{i(\pi)t-1} \end{bmatrix} + \begin{bmatrix} f_{(ij,yy)} & f_{(ij,y\pi)} \\ f_{(ij,\pi y)} & f_{(ij,\pi\pi)} \end{bmatrix} \begin{bmatrix} \varepsilon_{iy,t-k}^2 \\ \varepsilon_{i\pi,t-k}^2 \end{bmatrix}$$

The number zero is placed for each of the off-diagonal elements of matrices A, B, and G to accommodate a bivariate GARCH model. It should be noted that these zero values does not imply that there is no spillover within the domestic variables. If the coefficients of biy and $b_{i\pi}$ are significant, then I can conclude that the inflation and the output volatility are asymmetric. Finally, significant coefficients in matrix F provide evidence of output growth and inflation volatility spillovers.

In the context of this research, I introduce the dummy variables twice - First, in the volatility equation and second in the mean equation. This is done to investigate the relationship between GARCH model asymmetric volatility and the asymmetric effects. In contrast, most of the existing literature relies on TGARCH models when discussing the asymmetric effects of volatility.

The maximum likelihood method(ML) is used to estimate the model parameters in which the objective function should be maximized:

$$L_{iU}(\theta_i;Y_{it}) = -\frac{N}{2}Log(2\pi) - \frac{N}{2}Log(h_{i(m)t}) - \frac{1}{2h_{i(m)t}}\sum_{t=1}^{T}(\varepsilon_{it}^{m})^2 \qquad (11)$$

$$m = y, \pi$$

where the log likelihood is the sum of all conditional normal log likelihoods of the GARCH model.

3. Data

The US variables of output and Consumer Price Index are taken from the Federal Reserve Economic Database (FRED). Then variables of the output growth and inflation: y_t and π_t are calculated by taking the first difference of logged output and Consumer Price Index. The Euro Area data is drawn from the Area Wide Model (AWM) maintained by the European Central Bank. All variables are quarterly from 1970 Q1 to 2012 Q4.

Inflation calculations are based on the Consumer Price index (CPI) for the US. However, the Euro Area inflation is calculated based on the Harmonized Index of Consumer Prices (HICP). The HICP differs from the CPI in the aspects mentioned below: first, owner occupied housing is excluded from the HICP. Conversely, they may or may not be included in the CPI. Next, HICP includes households that are living within the country or visiting. While the primary focus of the CPI model is the residents. Third, HICP uses prices faced by consumers after taxes or duties, while CPI uses different methods by which part of these expenditures may be excluded. Table 1 provides summary statistics for the US and Euro Area output growth and inflation and Figure 1 plots these variables.

I use AIC criteria for lag selection, which allows me to use 3 lags. Following this, two tests are applied. The first of these tests judges if the model exhibits ARCH. The second is a unit root test that is conducted through the Augmented Dickey-Fuller test (1979). Figure 2 reports the resulting residuals from regressing the output growth and inflation on 3 lags of each of these variables. Four variable residuals display conditional heteroskedasticity with a p-value less than 10%. The unit root test indicates that all variables have no unit root with less significance toward the US inflation. Figure 3 plots the conditional standard errors.

4. Results

In this section, I provide the reader with the results of equations (1) and (9). The lag order is set to 3 -that is p=3. Table III asserts that asymmetric volatility exists in the US output growth and inflation, both variables are less volatile when shocks are negative with coefficients of -0.163092 and -0.24 8433 respectively. However, the coefficient of the US output growth in GARCH equation is more significant than that of inflation -it being 1 % compared to 10 %. Additionally, there is a significant spillover of inflation uncertainty from the Euro Area to the US. On the other hand, the economic activity in the Euro Area is not significantly affected by the uncertainty in the US. This is clearly shown from the insignificant coefficients in Table IV. The Euro Area output growth and inflation are symmetric to the signs of their shocks. Table V shows that the US output growth and inflation are also affected by the second lag of Euro Area squared errors.

In Table VI, the Euro Area output growth uncertainty is affected by the second lag of US inflation. Tables III-VI present two results of interest. First, the inflation spillovers between the US and Euro Area regions are more significant than that of output growth. Next, the US volatility responds immediately to Euro Area volatility. Nonetheless, it takes two or more quarters for the Euro Area to experience volatility spillovers for the US.

Table VII shows the effects of volatility on US output growth and inflation. The output growth is associated with higher levels of its own volatility. This is indicated by the coefficient of 1.709134, which is significant at a 1 % level. More importantly, the US output volatility displays asymmetric effect. Same magnitude output volatility has less effect when shocks are negative. This is confirmed by the negative significant coefficient of -1.388244. Therefore, asymmetric US output volatility leads to asymmetric effects on output. US inflation uncertainty is similar to output uncertainty in regards to their asymmetric effects -with a coefficient interaction term of -1.476800.

In Table VIII, Euro Area output matches the US in terms of the impact of output volatility and its symmetry. Furthermore, the inflation volatility in the Euro Area negatively effects the domestic output growth. While positively affecting the inflation rate. The sign of the shocks is irrelevant in relation to the effects on output growth. However remains important for inflation- as this increases less dramatically when shocks are negative. Table VIII provides asymmetric effect of volatility in the Euro Area -at a time when previous tables did not detect asymmetric volatility in these variables.

Tables and Charts

TABLE I: SUMMARY STATISTICS
1970Q1−2012Q4

Variable	Mean	Standard Deviation	Skewness	Kurtosis	J-B normality
y_t^{US}	0.006944	0.008401	−0.341315	4.934425	29.98189 [0.000000]
π_t^{US}	0.010539	0.008532	0.340041	6.032557	68.81979 [0.000000]
y_t^{EA}	0.005305	0.006559	−1.170957	7.146174	161.5617 [0.000000]
π_t^{EA}	0.011313	0.008655	0.630124	2.706012	11.93191 [0.002565]

TABLE II: UNIT ROOT TEST
Augmented Dickey-Fuller

Variable	Probability
y_t^{US}	0.0000
π_t^{US}	0.0700
y_t^{EA}	0.0000
π_t^{EA}	0.0000

Null Hypothesis: variable has a unit root
Null is rejected for all variables at 10% level

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TABLE III: CONDITIONAL VARIANCE OF GARCH(1,1) INCLUDING THE FIRST LAG OF FOREIGN VARIABLES
US

Dependent Variable					
Conditional Variance of Output ,h_{yt}			Conditional Variance of Inflation,$h_{\pi t}$		
Variable[a]	Coefficient[b]	S.E[c]	Variable	Coefficient	S.E
c_y	1.46E-06	1.04E-06	c_π	4.41E-07	9.37E-07
$\varepsilon^2_{y,t-1}$	0.128326***	0.045720	$\varepsilon^2_{\pi,t-1}$	0.262232*	0.157697
$d^y_t\varepsilon^2_{y,t-1}$	−0.163092***	0.053542	$d^\pi_t\varepsilon^2_{\pi,t-1}$	−0.248433*	0.148764
$h_{y,t-1}$	0.912368***	0.039693	$h_{\pi,t-1}$	0.726556***	0.126208
$\varepsilon^2_{EAy,t-1}$	−0.045138**	0.019497	$\varepsilon^2_{EAy,t-1}$	−0.016293	0.015273
$\varepsilon^2_{EA\pi,t-1}$	0.074797***	0.026861	$\varepsilon^2_{EA\pi,t-1}$	0.199150**	0.089270

[a]The term variables refers to the regressors in equation(9)
[b]***significant at 1% level, ** significant at 5% level, *significant at 10% level
[c]Standard error

TABLE IV: CONDITIONAL VARIANCE OF GARCH(1,1) INCLUDING THE FIRST LAG OF FOREIGN VARIABLES
EA

Dependent Variable					
Conditional Variance of Output ,h_{yt}			Conditional Variance of Inflation,$h_{\pi t}$		
Variable[a]	Coefficient[b]	S.E [c]	Variable	Coefficient	S.E
c_y	9.65E-06*	5.84E-06	c_π	1.52E-06	1.24E-06
$\varepsilon^2_{y,t-1}$	0.237074*	0.129378	$\varepsilon^2_{\pi,t-1}$	0.132591	0.136779
$d^y_t\varepsilon^2_{y,t-1}$	0.214412	0.306062	$d^\pi_t\varepsilon^2_{\pi,t-1}$	−0.162995	0.193531
$h_{y,t-1}$	0.285548	0.275427	$h_{\pi,t-1}$	0.814632***	0.123308
$\varepsilon^2_{USy,t-1}$	−0.011942	0.023999	$\varepsilon^2_{USy,t-1}$	−0.005478	0.010503
$\varepsilon^2_{US\pi,t-1}$	0.105749	0.085918	$\varepsilon^2_{US\pi,t-1}$	0.058219	0.047749

[a]The term variables refers to the regressors in equation(9)
[b]***significant at 1% level, ** significant at 5% level, *significant at 10% level
[c]Standard error

TABLE V: CONDITIONAL VARIANCE OF GARCH(1,1) INCLUDING THE SECOND LAG OF FOREIGN VARIABLES
US

Dependent Variable					
Conditional Variance of Output, h_{yt}			Conditional Variance of Inflation, $h_{\pi t}$		
Variable[a]	Coefficient[b]	S.E	Variable	Coefficient	S.E [c]
c_y	4.01E-07	6.81E-07	c_π	1.18E-06	1.17E-06
$\varepsilon^2_{y,t-1}$	0.072753***	0.029462	$\varepsilon^2_{\pi,t-1}$	0.205830*	0.128023
$d^y_t\varepsilon^2_{y,t-1}$	−0.137165**	0.048749	$d^\pi_t\varepsilon^2_{\pi,t-1}$	−0.197215	0.131229
$h_{y,t-1}$	0.958175***	0.033122	$h_{\pi,t-1}$	0.723412***	0.129366
$\varepsilon^2_{EAy,t-2}$	−0.030107	0.019026	$\varepsilon^2_{EAy,t-2}$	−0.018595	0.019716
$\varepsilon^2_{EA\pi,t-2}$	0.093350***	0.025758	$\varepsilon^2_{EA\pi,t-2}$	0.161498**	0.075870

[a]The term variables refers to the regressors in equation(9)
[b]***significant at 1% level, ** significant at 5% level, *significant at 10% level
[c]Standard error

TABLE VII: THREE LAGS MEAN EQUATIONS, p=3
US

Dependent Variable				
	Output, y_t		Inflation, π_t	
Variable[a]	Coefficient[b]	S.E [c]	Coefficient	S.E
c	0.007431***	0.002055	0.001807	0.001553
y_{t-1}	0.253213***	0.052826	0.065978*	0.039924
y_{t-2}	0.097648**	0.047838	0.022226	0.036153
y_{t-3}	−0.084840*	0.045143	0.031137	0.034117
π_{t-1}	−0.209015***	0.066626	0.615404***	0.050353
π_{t-2}	−0.076198	0.066718	−0.309996***	0.050422
π_{t-3}	−0.157784***	0.060992	0.452126***	0.046095
$\sqrt{h_{us,(y)t}}$	1.709134***	0.195675	0.081356	0.147882
$\sqrt{h_{us,(\pi)t}}$	−0.209037	0.302492	1.297358***	0.228610
$\sqrt{h_{EA,(y),t-1}}$	0.202804	0.235559	−0.127576	0.178025
$\sqrt{h_{EA,(\pi),t-1}}$	−1.016472**	0.514132	−0.551792	0.388558
$d^y_{us}\sqrt{h_{us,(y)t}}$	−1.388244***	0.098003	−0.059236	0.074066
$d^\pi_{us}\sqrt{h_{us,(\pi)t}}$	−0.014916	0.129782	−1.476800***	0.098083
$d^y_{EA}\sqrt{h_{EA,(y),t-1}}$	−0.125018	0.137621	−0.029535	0.104008
$d^\pi_{EA}\sqrt{h_{EA,(\pi),t-1}}$	0.017137	0.1662771	−0.250339**	0.125664
Adj R^2		0.716069		0.851395
No of Obs		167		167

[a]The term variables refers to the regressors in equation(1)
[b]***significant at 1% level, ** significant at 5% level, *significant at 10% level
[c]Standard error

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TABLE VIII: THREE LAGS MEAN EQUATIONS, p=3
EA

	Dependent Variable			
	Output, y_t		Inflation, π_t	
Variable[a]	Coefficient[b]	S.E [c]	Coefficient	S.E
c	0.006722***	0.001121	−0.002936***	0.001114
y_{t-1}	0.262919***	0.036840	0.182954***	0.036585
y_{t-2}	0.196173***	0.038604	0.019701	0.038337
y_{t-3}	0.059395*	0.035266	0.084207***	0.035022
π_{t-1}	0.055782	0.046414	0.247450***	0.046093
π_{t-2}	−0.053499	0.041579	0.252556***	0.041292
π_{t-3}	−0.085192*	0.045201	0.336545***	0.044889
$\sqrt{h_{EA,(y),t}}$	0.664692***	0.136182	0.053816	0.135240
$\sqrt{h_{EA,(\pi),t}}$	−0.966812***	0.310195	2.064546***	0.308050
$\sqrt{h_{us,(y)t-1}}$	−0.005312	0.113701	0.074063	0.112915
$\sqrt{h_{us,(\pi)t-1}}$	0.409247**	0.185058	−0.513038***	0.183778
$d^{y}_{EA}\sqrt{h_{EA,(y),t}}$	−1.689024***	0.075267	−0.136805*	0.074746
$d^{\pi}_{EA}\sqrt{h_{EA,(\pi),t}}$	−0.077936	0.093515	−1.582281***	0.092869
$d^{y}_{us}\sqrt{h_{us,(y)t-1}}$	0.020404	0.053034	−0.010912	0.052667
$d^{\pi}_{us}\sqrt{h_{us,(\pi)t-1}}$	0.086481	0.076791	−0.151030**	0.076260
Adj R^2		0.854998		0.921276
No of Obs		167		167

[a]The term variables refers to the regressors in equation(1)
[b]***significant at 1% level, ** significant at 5% level, *significant at 10% level
[c]Standard error

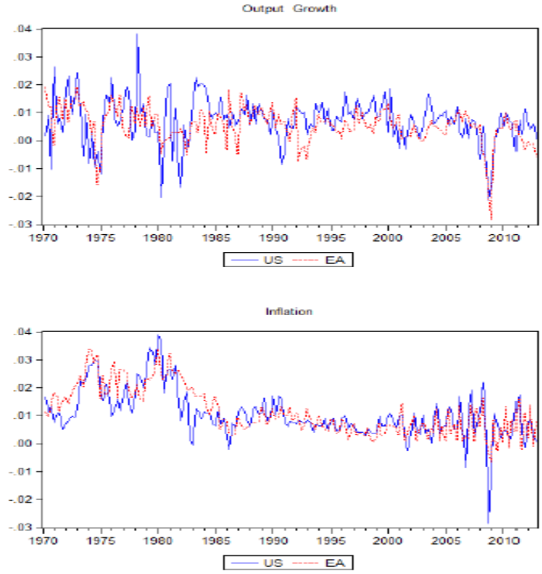

FIGURE 1: The output growth and inflation for the US and Euro Area 1970Q1-2012Q4

FIGURE 2: Residuals of the output growth and inflation for the US and Euro Area. These residuals are results of regressing output and inflation on 3 lags of each variable. P-value is the probability of making a mistake when rejecting the null hypothesis in which the null states that there is no heteroskedasticity.

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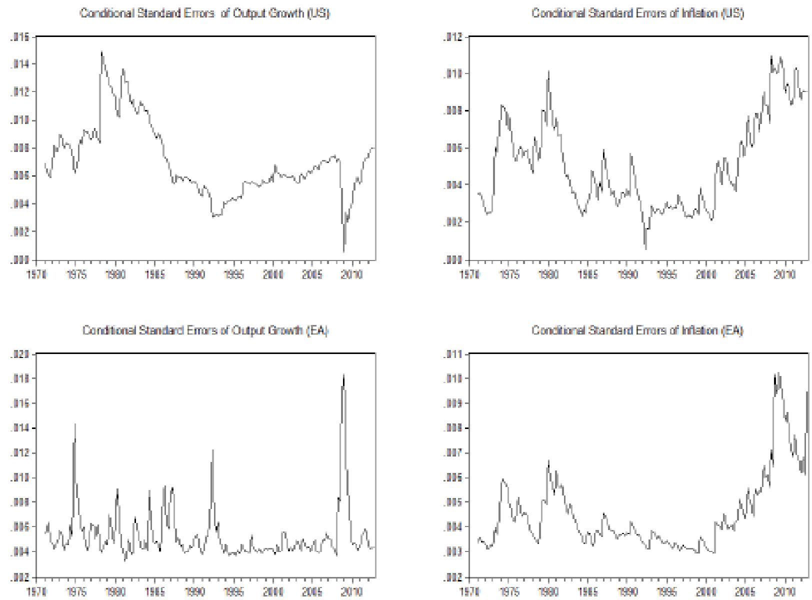

FIGURE 3: Conditional standard errors of inflation and output. Each variable is regressed on 3 lags of output growth and inflation.

5. Conclusion

This paper attempts to investigate the asymmetric impact and spillovers of inflation and output growth uncertainty for the US and Euro Area. Uncertainty is measured through autoregressive conditional heteroskedasticity models (ARCH). I use quarterly data on real GDP and consumer price index for the US and Euro Area from 1970Q1- 2012Q4. In adding dummy variables to the mean equations, I am able to differentiate between four asymmetrical aspects- First, asymmetric volatility in GARCH model,- Second, asymmetric effects of output and inflation on US and Euro Area economic activities,- Third, asymmetry between output and inflation spillovers across the two regions. And, lastly, asymmetry in the speed at which one region responds to uncertainty generated by another region.

Results show that output growth uncertainty and inflation uncertainty exhibit asymmetric volatility and its effects on the economy are also asymmetric. A symmetric volatility does not necessarily lead to a symmetric effects on economic activity. There is a significant spillover of Euro Area uncertainty to the US economy, while Euro Area economic activity is less responsive to US volatility within the same lag. But the Euro Area is more affected by US uncertainty after a few quarters. This is an indication of asymmetric speed of uncertainty transmission between the two regions.

The importance of this research is summarized in two points: First, the policy tools used to stabilize the economy such as monetary policy and fiscal policy have to take into consideration the asymmetric effects of policy changes. Second, because global economic conditions matter - it's important to take into consideration the state of external economies.

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