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MEASURING CONTAGION EFFECT OF GREEK SOVEREIGN DEBT CRISIS ON INDONESIA

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ABSTRACT

As Greek Debt Crisis emerged, many countries suffered contagion to some level. Indonesia might have been affected by the crisis even there was no strong link to transfers the shock. As the debt crisis has not yet over completely, we need to evaluate the impact of previous shock on Indonesian economy to anticipate the possibility of the next event. Employing Vector Auto Regressive (VAR) model to capture connection between Sovereign Credit Default Swap of two countries we found our estimation of Impulse Response Function of Indonesian CDS on shock in Greek CDS and concluded that the magnitude of debt crisis on Indonesia was considered to be very low. This dynamic told us that investors may have learnt that Indonesian economy was quite isolated from shock in Greece and they expected no change in the Indonesian sovereign risk.

Saat krisis utang Yunani memuncak, banyak negara terkena efek domino sampai derajat tertentu. Indonesia mungkin terkena juga dampak dari krisis walaupun tidak ada jalur yang kuat untuk mengalirkan krisis. Sampai saat ini krisis utang Yunani belum berakhir sepenuhnya dan karenanya perlu untuk mengevaluasi dampak dari krisis terhadap ekonomi Indonesia untuk antisipasi kemungkinan krisis susulan. Menggunakan model Vector Auto Regressive (VAR) untuk menangkap hubungan antara tingkat harga instrumen Sovereign Credit Default Swap antara dua negara: Indonesia dan Yunani, penelitian ini melakukan estimasi dampak krisis Yunani terhadap Indonesia melalui Impulse Response Function berbasis parameter model VAR. Hasil estimasi menunjukkan dampak krisis Yunani terhadap Indonesia adalah sangat lemah. Hal ini mengindikasikan bahwa investor mungkin telah menyadari bahwa ekonomi Indonesia cukup terisolasi dari krisis Yunani dan karenanya tidak mengubah persepsi sovereign risk Indonesia.

1. INTRODUCTION

1.1 Background of Study

In 2015, public in Indonesia as well as on the rest of the world were shocked again by a dramatic crisis in European zone especially in Greece. A typical public debt crisis that triggered unsustainable state budget as market punished the country by asking higher yield on its sovereign bond. Money was coming out from the country resulting dropped in investment and trade. Contraction on output was the consequent disaster that makes people suffered and its created satanic cycle as government revenues would fall further.

Question then arises in public discourse on whether crisis in Greece would affect Indonesian economy. Even thousand miles away separated both countries; many channels could send the impact of the crisis to Indonesia. Financial transmission would be the most concerned channel that might affect Indonesia economy. This could happen as investors then started evaluating their portfolios not only in European zone but also in the rest of the world including Indonesia.

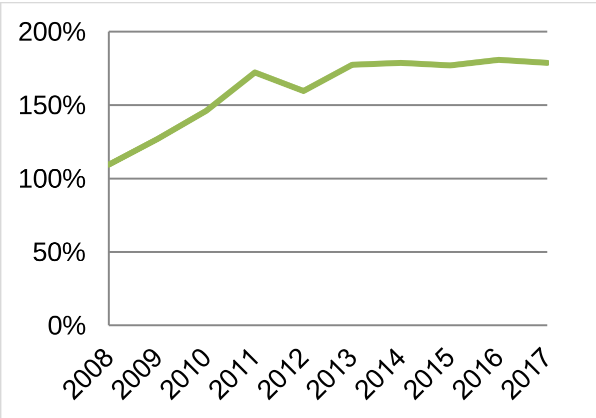
As Greece finally could manage its debt and prolonged sustainability of its public budget, the tension was a bit relief. But no one could guarantee that the problem was really over as public debt was still at very high proportion on country's GDP and deficit budget did still exist as people of Greece had stood against austerity program.

Hence, it will be still relevance for us to learn how the crisis affects Indonesia's economy. This paper contributes to measure the contagion of Greece debt crisis to Indonesia's economy through financial link: CDS market. Research on this issue is very few such on Suteja, Jaja; Suryaningprang, Andre; Zein, Elvira(2019) that investigate the contagion from Greece's debt crisis to Indonesian economy through stock market. Evaluating contagion through sovereign CDS will be a better approach since it is considered to be the source for contagion during the euro area debt crisis (Sarkozy, Juncker, Merkel, & Papandreaou, 2010).

1.2 Greek Sovereign Debt Crisis

The Greek crisis that started at the late 0f 2009 was a typical sovereign debt crisis. As government deficit kept mounting from time to time, the accumulation of debt was tremendously overlap the total income of the population. From Graphic 1 below we can see that debt toGDP ratio at 2008 already over 100% of GDP and sharply increasing to year 2011 at 172.10% asthe first phase of the crisis hit the country. After a bit decreasing in 2012, the figure is raising again to 180% until recent data at 2017.

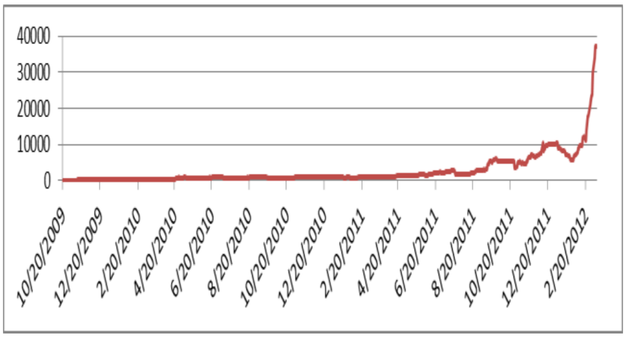
Figure 1. Greek Debt to GDP Ratio



Source: Reuters

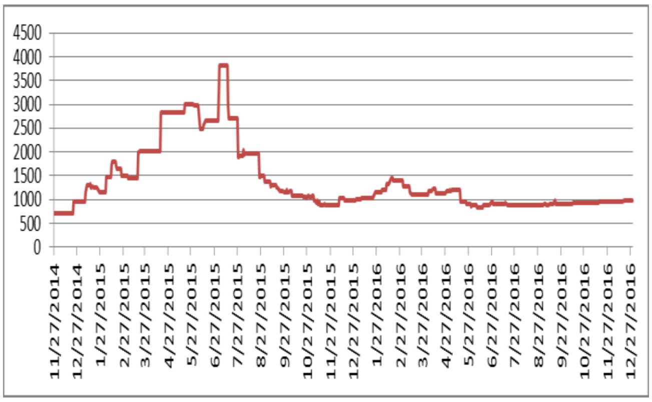
The story began in 2007-2008 when the country dealt with global finance crisis that lead to deepening fiscal deficit as government tried to boost the economy. The high level of total debt and the revelation of underreported government debt practice on previous periods in 2009, triggered distrust from investors. Market then punished Greece by lowering sovereign debt rating reflecting the upraising risk of the country. As a result, sudden reversal happened, investors asked higher yield on government bond and also other local assets. The risk of default was raising that could be seen on CDS market as shown in graphic 2 and 3 below.

Figure 2. Greek CDS premium 5-year term Bond 2009-2012



Source: Reuters

Figure 3. Greek CDS premium 5-year term Bond 2014-2016



Source: Reuters

2. LITERATURE REVIEW AND HYPOTHESIS

Contagion is defined as the spread of market disturbances from one country to the other. The process can be observed trough co-movements in exchange rates, stock prices, sovereign spreads and capital flows (Dornbusch, 2000). Many crises have shown how it happens. We still remember a massive and complex crisis that hit Indonesia in 1998 is started by currency crisis in Thailand, South Korea and some other countries in the region. Through some channels, shock in Thailand Bath has triggered shock in Indonesian Rupiah that followed by a more severe crisis as Indonesia's banking system was very fragile.

The channels of contagion can be divided in to direct or indirect contagion. Direct contagion is normal interdependence of market economies or fundamental based contagion. The shock in one country is transmitted to other country trough real and financial linkage. Indirect contagion is resulted from the behavior of investors or financial agents in responding financial crisis that eventually affect a country that has no fundamental relation with the source of crisis. Panics, loss of confidence, herd behavior, increasing risk aversion are among investor's reaction that transmits crisis to elsewhere.

2.1 Trade linkage

This fundamental channel works directly as a country faces lower demand of its product as crisis hit its trading partner. Lower demand turns in to lower production and press the output of the economy. The impact will be much higher to an open economy that depends on export.

There is another way of contagion happens trough trade linkage that is via currency rate. This linkage transfers a crisis when investors expect devaluation of a currency as policy of that country that may be taken to safe guard competitiveness as currency of competitors have fallen. Investors thus cut the demand of country's asset and triggering crisis.

2.2 Macroeconomic similarities

The macroeconomic similarities channel is the second channel to explain contagion. Countries with bad fundamental, which is close to a country's fundamental that already hit by crisis, will be the next subject of similar shock. This is due to information spillover against countries in similar situations and investors expect that the same problem will arise. This negative expectation leads to capital outflow as investors are out of the market.

2.3 Financial Linkages

Financial linkages transfer contagion effect in both direct and indirect contagion (Hernandez, 2001). In direct financial linkage, shock transferred from a crisis country to other economy who its investors face negative return on its investment. Loss of some big investors can lead in to balance sheet problems that spreads crisis through financial and banking system.

Financial linkage can transfer shock indirectly through at least three ways. First is due to investor's strategy to manage their portfolio that consists of asset in many countries. Negative shock on a country triggers less demand on other country's asset as the managers pull out resources to rebalance the portfolios.

Second is foreign investor liquidity problem**.** As their investment on a crisis country has fallen causes illiquidity in their mutual fund or hedge fund. To raise fund, they sell their investments in other country to finance redemptions by investors who decide to get out. Other explanation is related to increasing probability of a run on other economies as a country face a lower probability of repayment.

Third is information asymmetries and herd behavior. As information is costly to obtain, not all investors have information on ongoing crisis. Thus, generates herd behavior as they just follow what other investor do and that triggers massive cut on assets even from a country with good fundamental.

2.4 Measuring Contagion

The empirical literature on measuring contagion mainly can be divided into three parts based on the methods that widely used to identify contagion. Those are OLS (including VAR, ARCH/GARCH), principle components and correlation coefficients (Rigobon 2001). All of those methods need stability test for parameters on its estimation result. To qualify for stability test, the problem of heteroskedasticity must be addressed.

The use of impulse response function (IRF) based on estimated parameters to describe shock and response for the shock in its magnitude and time dimension is very popular in literature of measuring contagion. Guidolin M, Pedio M (2017), for instance, employs IRF based on parameters estimated with Vector Autoregression (VAR) and Markov Switching Vector Autoregression (MSVAR) to measure contagion in European financial crisis.

For the main purpose of this paper, we try to measure the contagion of the Greek recession on Indonesian economy and focus on the last shock in 2015. First of all, we should determine of what channel can transfer shock in Greece to Indonesian economy. We can evaluate that trade channel may not be the way to transfer the shock since Indonesia's export to Greece is below 0.1 % to total country's export. Both countries do not have much similarity in macroeconomics performance. Indonesia has much better fundamental of the economy with consistently grows positive on average 5% at last decade. Indonesian fiscal discipline is also impressive with achieved under 3% to GDP.

Thus, our hypothesis is that contagion channel will come from indirect financial link, in this case through sovereign CDS market that claimed to be primary source of the shock during European debt crisis. This link may transfer the shock even Indonesia and Greece have very limited connection in financial transactions. We already discussed before that shock in a country triggers investor to rebalance the portfolio and consequently cutting demand on other country assets in this case asset in Rupiah. Liquidity problem can also worsen the contagion as investors need to sell their assets everywhere else to get liquidity.

3. RESEARCH METHODOLOGY

To capture contagion from indirect financial link we consider using derivative instrument: sovereign Credit Default Swap (CDS). This derivative is traded to share risk from bond/credit holder to parties who sell CDS. Sometime there is no underlying transaction that called naked CDS. The latter is used for speculative motive.

As sovereign risk of Greece was uprising during crisis, we notice from graphic 2 that in the end of 2009 CDS premium started climbing and reached its peak at the beginning of 2012 before trading on this instrument was closed. After it went down for the next two years, the risk of default was going up again and achieves highest level on 2015.

Our research design is to explore events of shock in Greek CDS during the crisis and learn how the shocks affect Indonesian CDS on daily basis. Instead using level, the first difference is used to make data series stationary. We will use Vector Autoregressive Model (VAR) to capture the impact trough Impulse Response Function (IRF). Our reduced form of a standard VAR(p) model will be as follows:

$$y_t = C_0 + \sum_{j=1}^{p} A_j \, y_{t-j} + e_t (1)$$

y_t is 2 x 1 matrix representing the endogenous variables D(CDS_INA) and D(CDS_GRC) that refer to first difference of Indonesian and Greek sovereign CDS term 5-year premium. Both will be endogenous variables in the equation system and we take its first difference to make it stationer. A_0 is 2 x 1 matrix representing constant parameter for system equation.

A_j is 2 x 2 matrix of parameter for j lagged variable. e_t is 2 x 1 matrix representing white noise error terms with standard deviations σi and a zero covariance. p is the length of the lag that will be determined later.
We can also transform equation (1) above in to VAR (1) model:

$$\begin{bmatrix} y_t \\ y_{t-1} \\ \cdots \\ y_{t-p+1} \end{bmatrix} = \begin{bmatrix} C_0 \\ 0 \\ \cdots \\ 0 \end{bmatrix} + \begin{bmatrix} A_1 & A_2 & \cdots & A_p \\ I & 0 & \cdots & 0 \\ \cdots & 0 & \cdots & 0 \\ 0 & 0 & I & 0 \end{bmatrix} \begin{bmatrix} y_{t-1} \\ y_{t-2} \\ \cdots \\ y_{t-p} \end{bmatrix} + \begin{bmatrix} e_t \\ 0 \\ \cdots \\ 0 \end{bmatrix} \quad (2)$$

Where I = Identity matrix
Hence, we can keep generality even using a first-order model of VAR:

$$y_t = C_0 + Ay_{t-1} + e_t \quad (3)$$

Base on equation (3) above we will have impulse response function (Greene, 2001):

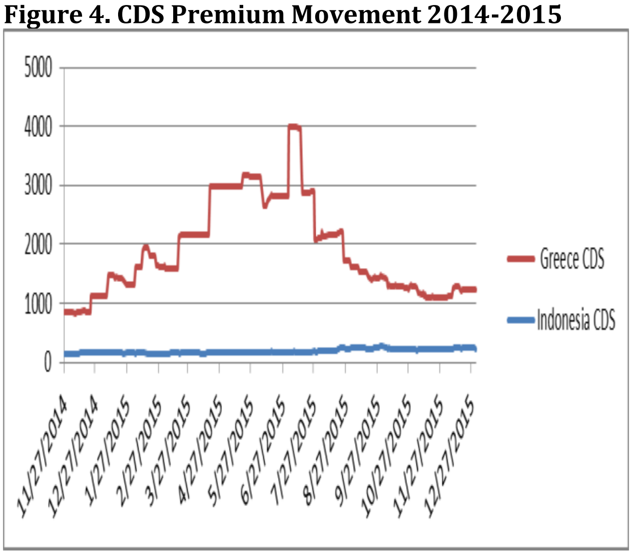
$$y_t = \acute{y} + \sum_{i=0}^{\infty} A^i e_{t-i} \quad (4)$$

The coefficients in the power of **A** are multiplier in the system. Here we can do simulation by giving shock to the equilibrium of the system by changing one unit of the error terms in one period (innovation) that yields series of changing in y_t that called impulse response.

4. RESULTS AND FINDINGS

We collect CDS premium series on daily basis for both countries from Reuters that can be seen on graphic 4 below. For both countries we use sovereign CDS 5-year term in USD denomination. As this research focus on the last shock, the sample period will be from 27/11/2014 – 31/12/2015.

Figure 4. CDS Premium Movement 2014-2015

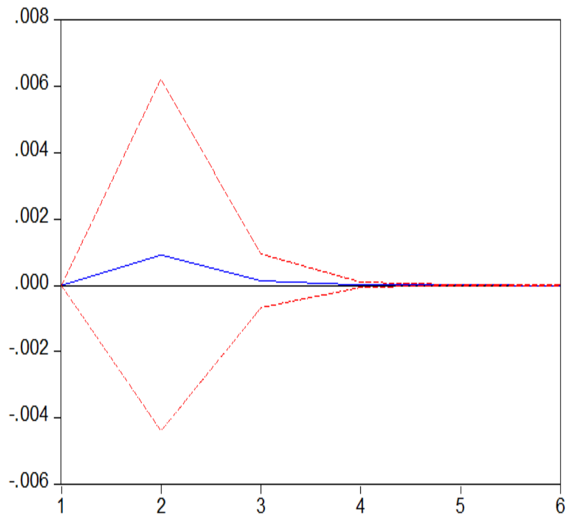


We see from graphic 4 that both series have different movement along the period. CDS Greece premium is very volatile since beginning and continually uprising, it reaches peak at mid of 2015. Conversely Indonesian CDS looks very stable at much lower level along the period.

We employ our VAR model and find Impulse Response Function to describe and measure how shock in Greece CDS affects Indonesia CDS during the last shock in 2015. Granger cointegration test has been conducted and it shows no cointegration between two series hence it justifies the use of VAR model (appendix 1). We have determined the long of the lag is 1 by considering it as the best model with highest F statistic.

The parameters are estimated using Ordinary Least Squares (OLS). For robust estimation we have conducted test for the residuals by Johansen test which does not reject the null hypothesis that the residuals are white noise (appendix 2). Stability test with inverse root of AR also concludes that the model is stable; hence our impulse response function will have its equilibrium (appendix 3).

Figure 5. First Difference CDS Premium Indonesia Response on 1 unit Error Shock First Difference CDS Premium Greece during Crisis



Graphic 5 shows response of first difference CDS Indonesia to shock in first difference CDS Greece as projected by our impulse response function based on VAR (1) model. At period ofthe shock (for i=0 inequation 4) the response is zero and one period later the shock has taken effect (i=1) and it soon decreases at following period and vanishes (one interval represents a day). Time of the contagion to take effect is quite fast: a day after shock.

The magnitude of the contagion however is very low at 0.000914 at one day after shock and the accumulative response is approximately 1 per mill (appendix 4). It means that the impact of shock in first difference of Greek CDS premium will affect in increasing first difference of Indonesian CDS premium in only 1 per mil of the size of the shock.

Table 1. VAR(1) Estimation Result

	D(CDS_INA)	D(CDS_GRC)
D(CDS_INA(-1))	0.097622	-1.785531
	[1.64396]	[-1.34204]
D(CDS_GRC(-1))	0.000914	0.051844
	[0.34499]	[0.87291]
C	0.296747	1.595818
	[0.86472]	[0.20755]

The result of impulse response factor that shows how low the magnitude of the shock can be traced to the estimation result of the VAR(1) model in table 1 above. Based on t-statistic, all of the parameter's estimation of the lagged endogenous variables are not statistically significant.

5. CONCLUSION

We can conclude from our estimation of Impulse Response Function of Indonesia CDS on shock in Greek CDS that there exists impact on debt crisis in Greece to uprising credit default risk in Indonesia through indirect financial link. But the magnitude is very low and statistically not significant. The shock propagates one day after but this can be underestimated since we use daily transactions instead of intraday transactions.

This result tells us that investors may have learnt that Indonesian economy is quite isolated from shock in Greece. It leads to positive expectation for Indonesia's sovereign risk to be stable during period of the crisis. This positive expectation keeps investor's appetite to hold Indonesian financial assets on their portfolio.

6. IMPLICATION AND LIMITATION

It should be considered that even contagion of Greek Debt Crisis on Indonesia is very low; it does not mean that Indonesia will be totally resilient on the possible future shock. It will depend on the magnitude of the shock and situation in the global economy that could be very dynamic. Investors and the authority still need to be cautious but not to be over reactive to response the next event.

To keep the positive expectation of the investors on Indonesian sovereign risk, all efforts to maintain discipline of fiscal policy must be supported. Greece's debt crisis gives clear lesson learnt on how important to have strong commitment from government and the politicians for sound policies to prevent prolong budget deficit and mounting debt with its all negative consequences.

The next study on this topic should consider analyzing contagion effect on group of countries such ASEAN countries instead of just single country. Comparison of the impact on each country will give valuable information on how contagion effect occurs on each country. The use of intraday trading data on CDS transaction, if available, will also generate better estimation especially for the speed of the contagion effect. Evaluating impulse response before and during crisis is also favorable to identify possible changes in magnitude and timelines.

Acknowledgement

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Appendix 1
Cointegration Test Result

Sample (adjusted): 12/02/2014 12/31/2015
Included observations: 283 after adjustments
Trend assumption: Linear deterministic trend
Series: D(CDS_INA) D(CDS_GRC)
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	5.97E-05	0.017247	15.49471	1.0000
At most 1	1.26E-06	0.000357	3.841466	0.9870

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	5.97E-05	0.016890	14.26460	1.0000
At most 1	1.26E-06	0.000357	3.841466	0.9870

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

D(CDS_INA)	D(CDS_GRC)
-3.88E+14	-2.66E+12
8.97E+13	-1.14E+13

Unrestricted Adjustment Coefficients (alpha):

D(CDS_INA)	0.005961	0.006384
D(CDS_GRC)	0.987847	-0.017080

1 Cointegrating Equation(s): Log likelihood -2672.388

Normalized cointegrating coefficients (standard error in parentheses)

D(CDS_INA)	D(CDS_GRC)
1.000000	0.006839
	(0.23492)

Adjustment coefficients (standard error in parentheses)

D(CDS_INA)	-2.32E+12
	(1.3E+14)
D(CDS_GRC)	-3.84E+14
	(3.0E+15)

Appendix 2
Heteroskedasticity Test Result

VAR Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)
Date: 08/26/19 Time: 15:11
Sample: 11/27/2014 12/31/2015
Included observations: 283

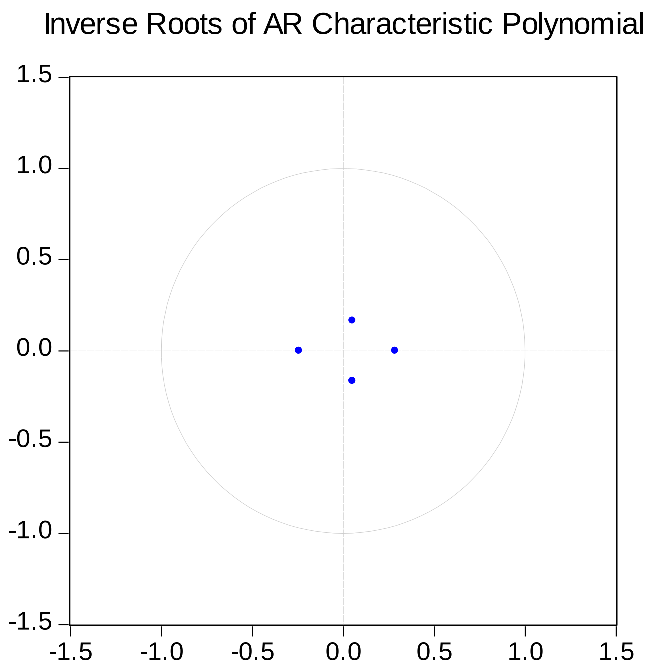
Joint test:

Chi-sq	df	Prob.
22.11652	24	0.5723

Individual components:

Dependent	R-squared	F(8,274)	Prob.	Chi-sq(8)	Prob.
res1*res1	0.072658	2.683499	0.0074	20.56210	0.0084
res2*res2	0.002030	0.069676	0.9998	0.574548	0.9998
res2*res1	0.004590	0.157936	0.9959	1.298997	0.9956

Appendix 3
Stability Test Result



Appendix 4
Table of Response on 1 unit Error Shock

Period	Magntude of Response
1	0.000000
	(0.00000)
2	0.000914
	(0.00265)
3	0.000137
	(0.00040)
4	1.43E-05
	(4.1E-05)
5	1.22E-06
	(3.4E-06)
6	8.71E-08
	(2.8E-07)

Appendix 5
VAR Estimation Result

Vector Autoregression Estimates
Sample (adjusted): 12/01/2014 12/31/2015
Included observations: 284 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	D(CDS_INA)	D(CDS_GRC)
D(CDS_INA(-1))	0.097622	-1.785531
	(0.05938)	(1.33046)
	[1.64396]	[-1.34204]
D(CDS_GRC(-1))	0.000914	0.051844
	(0.00265)	(0.05939)
	[0.34499]	[0.87291]
C	0.296747	1.595818
	(0.34317)	(7.68877)
	[0.86472]	[0.20755]
R-squared	0.009988	0.008946
Adj. R-squared	0.002942	0.001893
Sum sq. resids	9365.658	4701453.
S.E. equation	5.773192	129.3489
F-statistic	1.417475	1.268316
Log likelihood	-899.3865	-1782.424
Akaike AIC	6.354834	12.57341
Schwarz SC	6.393380	12.61196
Mean dependent	0.330634	1.046443
S.D. dependent	5.781702	129.4715
Determinant resid covariance (dof adj.)		557460.2
Determinant resid covariance		545745.1
Log likelihood		-2681.764
Akaike information criterion		18.92791
Schwarz criterion		19.00501