An application of MGARCH-DCC analysis on selected currencies in terms of gold Price

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Abstract

The trading between currencies in Islam when both parties' responsibilities are postponed to the future has been regarded as non-halal or un-islamic. Since there are many controversies in the area of currency, there have been suggestions to enhance investments in gold to avoid the element of 'syubhah' or doubts since gold has been used in the past for many functions. Investment in gold has been in demand for the past few years especially in hedging strategies. In this paper, we study the relationships between selected currencies in terms gold prices and their movements in volatility and correlation using the MGARCH-DCC analysis. Findings of the study tend to indicate the opportunities of various diversification portfolios for the interested gold investors. The findings of the study are of benefit to gold investors especially for diversification and investment purposes.

Key Words: MGARCH-DCC, gold, Euro, Pound, US Dollar, Japanese Yen, Malaysian Ringgit, Canadian Dollar

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1. Introduction and Motivation of the paper

Investments are crucial in maintaining a stable financial system. It has become a tool in creating a balance in the system and produces productivity in the economy. While the usual investment tool, being one of the common ones are mostly placed in the stock market. However, in this area, there is a need to know the tools well in order to achieve a good profit making investment and at the same time trying to minimize risk.

While making profit is one of the reasons to make investment, Islam provides basic guidelines that need to be adhered to in order to produce halal outcomes. Those in the stock market are divided into both halal and non-halal investments; the same goes for such investments in the currency market, or in its Arabic term, sarf.

It is known in Islamic Finance that the exchange between two currencies on the spot price is totally permissible, while it is clearly forbidden to exchange currencies when both parties' responsibilities are shifted to the future. However, when it comes to those where one party's responsibility is shifted to future, controversies arise as there are scholars who oppose and others who support. Since this is not the main intention of this paper, it is enough to say that in areas where there are controversies, it is better to leave them for better ones.

This discussion then leads to the main point which is to support gold as another tool of investment. Gold has been currently used as an investment tool especially in hedging purposes. Banks and finance houses in Malaysia particularly have started to include gold investment as one of their services where customers can buy gold per gram and can decide whether to keep the gold or let the bank keep them safe. In other words, if a customer is interested in buying gold, they would go to the bank and choose how many grams of gold they are willing to buy and exchange the money for gold. It works just like exchange of currencies, except that we are exchanging money for gold. The banks offering this service include Maybank and finance companies like Kuwait Finance House.

Gold is a precious metal which is has been used as both property and financial asset. It was one of the basic usages in the money system in history until it was pegged to the dollar following Bretton Woods. It was after 1973 that gold lost its function as the mean of exchange when the European countries let their exchange rate float against the dollar. Gold then became a personal saving tool and a part of the Central Bank Reserves. (Toraman, Basarir, & Bayramoglu, 2011).

During the Gold Standard, gold's value was determined by both its purchasing power. When paper currencies existed, they were then measured against gold. However, at the time when paper currencies inflated to finance the World Wars, the Gold Standard was abandoned and gold stopped functioning as a currency. Then came the era of the Bretton Woods Accord (1944) where US dollars were made convertible into gold at a fixed rate. Therefore from 1934 to 1971, gold's value was worth $35 per ounce, which was set by Franklin Roosevelt. This finally came to an end when in 1971; Richard Nixon was forced to abandon the fixed rate between the gold and the dollar.

So we may ask what the value (in dollars) of gold an ounce is today. Well, this will have to depend on two factors; the inflation of dollars and inflation of gold. The relationship between gold prices and the Dollar Index has always been said to be inversely related. That is, when the amount of dollars increases, gold price will go down. At the same time, in terms of gold inflation, as the amount of gold increases, gold price will also go down.

As investors are looking for the best places to invest their money, gold can now become one of them. This is because for the past few years, the value of gold has been quite on an increase relative to the weakening dollar.

Based on the current phenomenon, it is predicted that gold prices will always be on the increase over the long term although it may at times drop occasionally. In order to provide greater strength to the prediction, it is best to test the available data to see how the selected currencies work and fluctuate in terms of gold prices.

Previous studies have mostly embarked on finding the relationships among currencies themselves but not many have tested them in terms of gold prices; and none so far, from the author's limited knowledge has chosen the method used in this analysis to investigate the issue.

It is therefore a challenge to analyze the relationships between these currencies in terms of gold prices and with these relationships, it would be clear if gold can become the viable material for investment or even to function well as a currency as in the Gold Standard. The analysis will be based on the MGARCH-DCC method as will be explained in the Research Methodology section.

2. Research Objectives

Many Islamic scholars have qualitatively described that the economy will function well if we switch to using gold as a currency. This is because of the particular characteristics of gold that has its own intrinsic value compared to the paper money which does not. At the same time, the speculations of currency futures are not allowed in Islam, therefore limiting the tools for investments in the Islamic setting. However, the pro-gold experts still believe that gold can function well as an investment tool or even to return to its usage as a currency.

The research intends to find out the relationship of currencies in terms of gold prices to see how they move in the long run. In short, this paper will try to answer the following questions:

1. What are the apparent relationships between selected currencies in terms of gold prices?
2. With the said relationships (in terms of volatility and correlation), what can be said about gold's potentiality to become an investment tool or even a currency?

3. Literature Review

Various literatures have discussed the general relationship between currencies including those of spot and future prices. Many of them also investigate some of the relationships between commodities and currencies ranging from the oil market to the stock exchange market.

Nuradli and Hanifah (2005) focuses on the currency risk as a major factor that contributed to the 1997 crisis and analyzed the gold prices and exchange rate fluctuations. At the same time, they attempted to test whether gold could become the optimal currency if used as an international payment settlement tool in the near future, following Tun Dr. Mahathir's suggestion during the 9th OIC summit. They found through the results of standard deviations and correlations that diversification can serve as a useful method to reduce exchange rate risk and therefore gold could be used as a tool in investment through currencies that have low correlation.

Gold was also tested as a hedge against the dollar by Capie, Mills, and Wood (2005). The authors tested this through weekly data for thirty years using gold price, sterling-dollar, and yen-dollar currency rates. They found that there was a negative, inelastic relationship between gold and the two currencies but the strength varies over time. They concluded that although gold served as a hedge against the dollar, it was only up to a degree that depends on the unpredictable political events.

Other than that, Tully and Lucey (2006) carried out a power GARCH examination on the gold market to test the relationship between the dollar and gold prices and also other macroeconomic variables. They also included the estimate of the goodness of fit of each model and likelihood ratio tests to assess the significance using both APGARCH, with the inclusion of a GARCH term, free power term, and unrestricted leverage effect term. The found that the dollar does have an influence on the gold market, consistent with the fact that gold is always priced initially in US dollars, and considering that US has been the holder of largest reserves of gold.

Another interesting study which closely relates to this current paper is to determine the factors that affect the price of gold which also adopts the same method, MGARCH model. Toraman, Basarir and Bayramoglu (2011) used monthly data of oil prices, the US exchange rate, inflation rate, and real interest rates and through their empirical findings, they show that there was a high correlation between gold prices and US exchange rate, but negatively. This is true considering that as the amount of US money increases (inflation), the exchange rate drops (purchasing power drops), while causing gold prices to move up.

4. Research Methodology

In this study, we relied on the Multivariate Generalized Autoregressive Conditional Heteroscedastic (MGARCH) from Pesaran and Pesaran (2009) and the Dynamic Conditional Correlations (DCC). We test for the normal and t distributions beforehand to find out which of the two actually fits our case better. The software *Microfit* is used to calculate both the unconditional correlation coefficients and the conditional cross-asset correlations.

In the MGARCH (p,q) model, the conditional variance and covariance of each asset will depend on both its own past conditional variance and of other assets. This technique especially helps investors facing such issues relating to contemporary financial issues on minimizing risk through diversifying their assets. Through this technique, they are able to understand the volatilities of and correlations between asset returns that change over time. Assets that have a low correlation among them will be a good diversifying tool to investors to minimize risk.

While the DCC in this regard, will account for the mean and variances of the time series as compared to other methods such as rolling regressions and Kalman filters which only considers changes in the mean.

Other than testing for both the normal and t distributions, we also tested whether the computed volatility is mean reverting or not through calculating $(1 - \lambda_{i1} - \lambda_{i2})$. If this estimate comes to zero, it means that it is not mean reverting; in other words, it does not come back to the mean or equilibrium. In most cases, the value of this estimate will be more than zero portraying that the volatility does not follow the IGARCH (which is when the estimate is zero), which also means that the shock to volatility is not permanent.

We also checked the validity of the t-DCC model through some diagnostic tests which will be explained later in the results section.

We model the volatility of six currencies in terms of gold prices which include the Euro, British Pound, Japanese Yen, US Dollar, Canadian Dollars, and Malaysian Ringgit. These are chosen based on previous literature and also those that could create convergence in the *Microfit* setting. In order to be able to compute, *Microfit* requires the data to be in return format, therefore the currencies in terms of gold prices are set in return format in this study.

The data is derived from the World Gold Council (WGC) website and also Bank Negara Malaysia monthly bulletins. It stretches from August 2001 to February 2010 for the core of the paper, and February 2010 to February 2011 for the forecasting period.

5. Empirical Findings and Interpretations

From the initial test of both normal and t distributions, the following table shows the comparison between the two with a summary of the maximized log-likelihood estimates of λ_1 and λ_2 and values of δ_1 and δ_2 .

Table 1: Estimates of λ_1,λ_2 ,δ_1 andδ_2 for the six currencies in terms of gold prices

		Multivariate normal distribution		Multivariate t distribution	
		Estimate	T-Ratio	Estimate	T-Ratio
Lambda 1 (λ_1)	Euro	.94136	137.85	.94779	128.96
	Japanese Yen	.93515	92.96	.95635	112.29
	US Dollars	.94888	164.22	.95454	155.83
	Canadian Dollars	.95048	152.91	.95823	143.16
	Pound Sterling	.94444	166.97	.94871	144.77
	Malaysian Ringgit	.94256	108.28	.93485	75.134
Lambda 2 (λ_2)	Euro	.03957	9.1565	.03370	7.5421
	Japanese Yen	.04964	7.4814	.032271	5.7557
	US Dollars	.03389	9.7184	.027965	7.9531
	Canadian Dollars	.031648	8.7603	.024721	6.8380

Pound Sterling	.037244	10.401	.032463	8.1613
Malaysian Ringgit	.044647	7.6463	.049574	5.8242
Delta 1 (δ_1)	.94414	182.08	.95604	226.49
Delta 2 (δ_2)	.02458	14.885	.02267	13.787
Maximized Log-Likelihood	43716.3		44062.6	
Degrees of freedom (df)	-		10.403	16.487

From table 1, the estimates of the volatility decay parameters show highly significant values. Comparing between the normal and t distributions, we find that the normal distribution gives a maximized log-likelihood of 43716.3 while that of t distribution gives a value of 44062.6 which is larger than that of the normal. Also, we find the degree of freedom for the t distribution is below 30, which together with the previous statement suggest that the t distribution is more appropriate for the case in this study. Therefore, the following computation will be based on the t-distribution estimates.

Following this, we find the estimated unconditional volatilities through the diagonal elements in the matrix and the unconditional correlations through the off-diagonal elements for the six currencies. The following table shows these estimates:

Table 2: Estimated Unconditional Volatility and Correlation Matrix for the Six Currencies

	EURO	JY	USD	CD	PS	MYR
EURO	.010891	.048239	.84623	.84242	.90293	-.015648
JY	.048239	.012873	.09934	.01684	.04926	.021492
USD	.84623	.099342	.01220	.84246	.85160	.002897
CD	.84242	.016842	.84246	.01193	.83891	.3494E-3

PS	.90293	.049267	.85160	.83891	.01148	-.022009
MYR	-.0156	.021492	.00289	.3494E-3	-.02200	.012404

EURO – Euro

JY – Japanese Yen

USD – US Dollars

CD – Canadian Dollars

PS – British Pound

MYR – Malaysian Ringgit

The values highlighted show the diagonal elements which gives the value of the unconditional volatility of the currencies on its own. Other values off the diagonal line give the unconditional correlations between two currencies in terms of gold prices. From the diagonal elements, we summarize the volatility ranking of currencies in gold prices from lowest to highest as below:

1. Euro (.010891)
2. British Pound Sterling (.01148)
3. Canadian Dollars (.01193)
4. US Dollars (.01220)
5. Malaysian Ringgit (.012404)
6. Japanese Yen (.012873)

These values show that the Euro has been stable throughout the period of study in terms of its gold price while the Japanese Yen has been quite volatile over the years. It goes in line with the initial reasoning behind creating the Euro in 1999 as a real currency for the European nation to reduce fluctuations. The British Pound (PS) being the second after the Euro with its low volatility seems logical with the reasoning that the Pound somehow is reflected upon the Euro. There have been studies showing that these coupled currencies always work together and the volatility of the Euro has some effect on the Pound. This is called the volatility spillover between exchange rates. This also shows that the Euro is more influential among the European currency and that volatility interaction corresponds to information transmission. (Inagaki, 2007). Following this, British Pound traders will have to pay attention to the information disseminated from the Euro to see the movements of this currency into buying or selling gold.

The Japanese Yen gold price seem to be moving up and down over the years depending on the Yen currency which also fluctuated over this period where the Bank of Japan constantly maintains a policy of keeping the Yen weak against other major currencies which include the Euro, British Pound and the US Dollars. The reason behind this policy was to make sure that exports were enhanced to induce economic growth in Japan. It may also have been impacted by the drop of Japan's main stock index, the Nikkei 225 which declined by 80 percent which finally improved starting 2003 when Japan boosted its GDP growth of 2 percent between 2003 and 2007.

In the case of gold prices in Malaysian Ringgit, it has been quite volatile after the Yen which may be caused by the currency itself which had to fluctuate accordingly following the pegging and de-pegging period. Since the period of study starts in 2001, the Malaysian Ringgit was in its pegging period and later started to appreciate against the US Dollar in the beginning of 2005 when Bank Negara announced the end of the peg in July 21, 2005. The apparent volatility during the pegging period is quite surprising since the Ringgit was always pegged at a value of 3.80 against the US Dollar. However, if we scrutinize the US Dollar in terms of its gold value itself, it fluctuated during this period causing gold prices in Malaysian Ringgit to also be quite volatile. After the Ringgit was de-pegged from the US Dollar in 2005, it has been appreciating and depreciating between the periods from 2005 to 2011. It follows that the gold prices also tend to move up and down with the floating Ringgit against several major currencies.

The next analysis is regarding the cross correlation between the currencies in terms of their gold prices. The following table summarizes the values estimated ranking from the lowest to highest correlation.

Table 3: Ranking of Unconditional Correlations of Currencies in terms of Gold prices

EURO	JY	USD	CD	PS	MYR
MYR*	CD	MYR*	MYR*	MYR*	PS
JY*	MYR*	JY*	JY*	JY*	EU
CD	EU	CD	PS	CD	CD
USD**	PS**	EU**	EU	USD**	USD**
PS**	USD**	PS**	USD**	EU**	JY

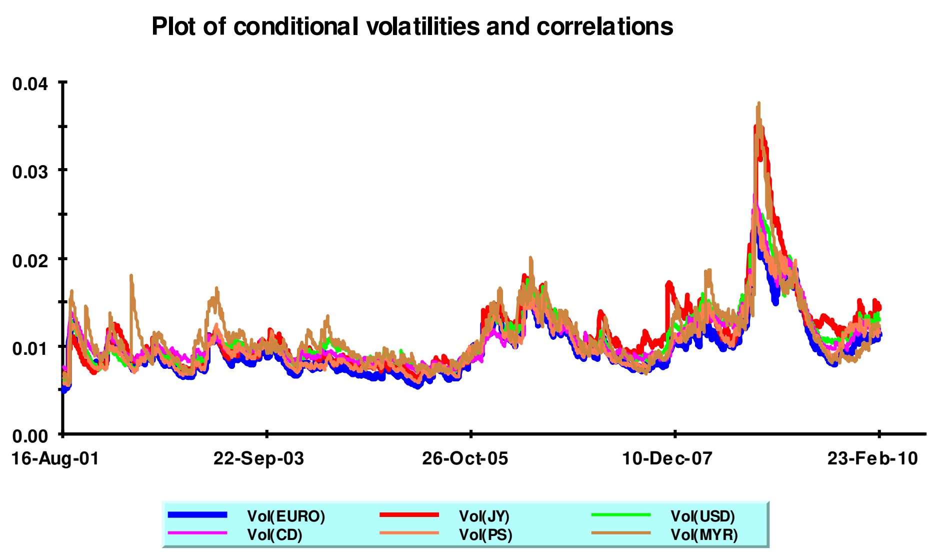
The above rankings show that all currencies except the Yen have the lowest correlation with Malaysian Ringgit. The Yen also ranks second in all but Malaysian Ringgit in its correlation with regard to other currencies. These are marked with a single star in the table above. From these findings, we are able to interpret that most of the stronger currencies work well with the Asian market currencies like the Yen and Ringgit. This means that if a European investor is looking to invest in gold, he could opt for buying it in Ringgit to minimize his risk since the EURO-MYR correlation is the lowest among other currencies which gives a diversification effect on his investment.

The stronger currencies in this study (USD, PS, EU), which are marked with a double star in the table above, show that combinations of these with other currencies turns out to be highly correlated. This means that there are no diversification benefits to invest in a combination of say, Japanese Yen for US Dollar to buy gold. It is better off for an investor to buy gold in his own currency instead of looking for other currencies. The same goes for such combinations of the British Pound and the Euro and also between US Dollar and the British Pound.

All our investigation so far has only dealt with the unconditional volatilities and correlations. We have not come yet to the conditional basis. That is, we only looked into the average volatility and correlation in the sample period which seems quite contradictory to real economic intuition. It is much safer to base our prediction and conclusion through a dynamic aspect of investigation which will be through the Dynamic Correlation Coefficient (DCC).

Firstly, through *Microfit*, we observe the temporal dimension of volatility which is shown graphically along the period from 2001 to 2010. This general whole picture of the volatility for all currencies in gold prices is shown in the following graphical representation:

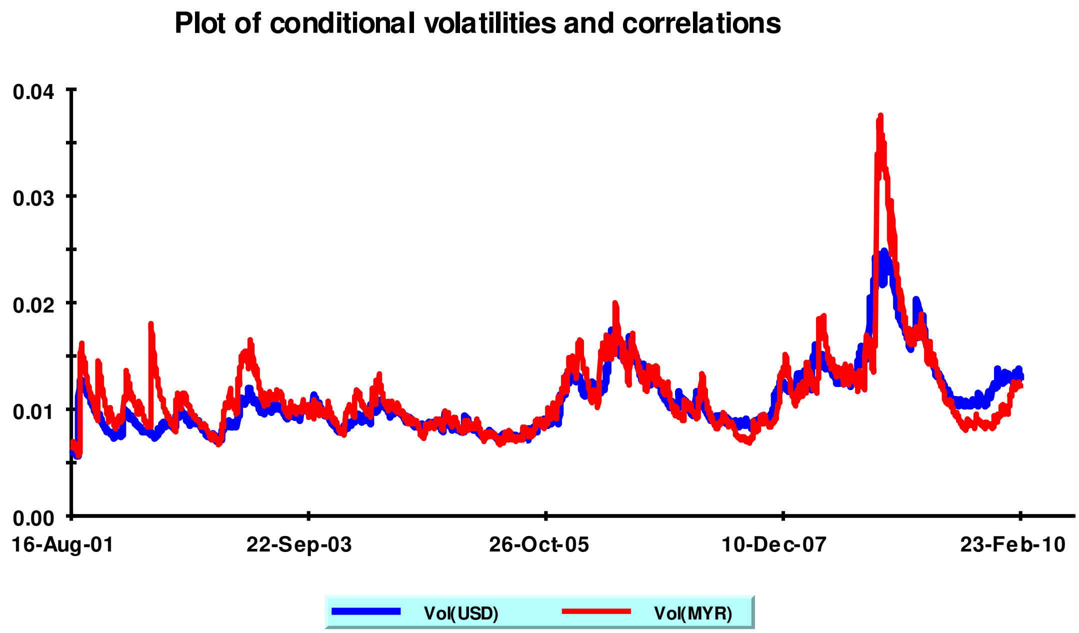
Figure 1: Conditional Volatility – all currencies in terms of gold price



This graph shows a general picture of what has been going on over the 9 years of study with gold prices in different currencies. All currencies except for the Ringgit and the Yen seem to be quite steady over the years with overlapping lines which tend to show their stability. However, the Ringgit and the Yen show obvious volatility over the years, especially between 2007 and 2010, which would probably be in 2008 when the Global Financial Crisis hit.

When we compare the Ringgit and US Dollar volatilities, there is a clearer picture to show how the Ringgit somehow follows the US Dollar pattern except that it goes further up when US Dollar goes up, and vice versa. The following graph depicts this statement especially after 2005:

Figure 2: Conditional Volatility: USD and MYR

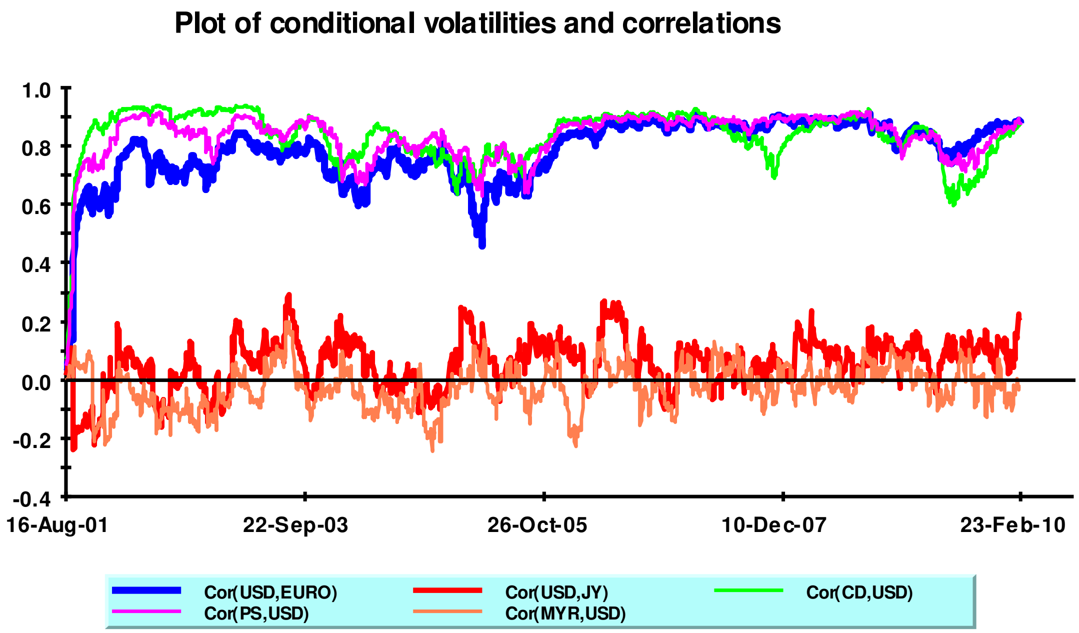


What can be said here is that, before 2005, when the Ringgit was pegged to the dollar, the volatility was quite on the low as compared to after 2005, when it shoots up. However, though after 2005 the Ringgit has been de-pegged and changed to the floating currency regime, its fluctuations somehow follows the dollar's movements as already mentioned. The Ringgit must somehow follow the dollar in order to regain its value and to avoid it from fluctuating too much. Gold investors during the peg period must have not worried so much about the gold price fluctuation since the Ringgit was stagnant at 3.80, although they would prefer the Ringgit to depreciate at the time so they could buy more gold for less if they were buyers of gold and to sell it in the future when the Ringgit appreciates.

One thing should be noted here that this graphical representation does confirm our earlier observation in the unconditional volatility which says that the Ringgit has been quite volatile.

Next, we turn to the conditional correlation of all the currencies combined with the US Dollars, since gold is always fixed at the Dollar price. Figure 3 below shows the plot of the correlations:

Figure 3: Conditional Correlations: USD and all other currencies in terms of Gold price

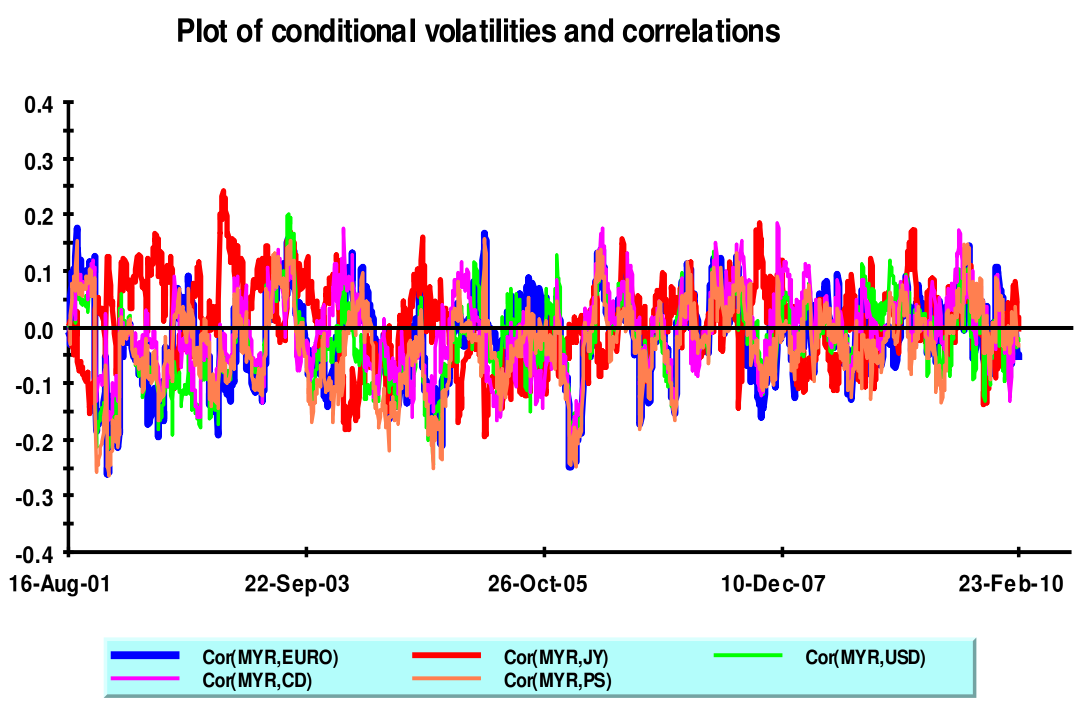


Again, we notice that the conditional correlation supports the unconditional correlation earlier in our discussion where the Yen and Ringgit both turn out to have among the lowest correlation with other currencies. Here, were able to see in a clearer picture that the Euro, Pound Sterling and Canadian Dollars have quite a high correlation with the US Dollar. The logical reasoning behind this is that all these currencies although in terms of gold prices tend to be more stable and are stronger. In other words, the level of stability and movements go together with the US Dollar as all the countries using these currencies are developed and equipped with vast economic development.

It is clear enough that the Japanese Yen and the Ringgit have low correlation with the US Dollar. This does not mean that Japan is not developed per se, but as mentioned, Japan's Bank policy has been keeping the Yen weak against major currencies and this shows in above graph. The policy allows Japan to also keep interest rates very low in order to boost exports. Thus the price of gold in Yen also tend to be weak against the major currencies, in this case the Dollar; and with the low correlation, we are able to guide investors to buy gold at the Yen price to gain diversification benefits. The same goes for investment for gold in terms of the Ringgit, since the correlation with US Dollar is also low which is at almost the same level as the Yen.

We also tested for the conditional correlation of the Ringgit with all other currencies. The figure below depicts this:

Figure 4: Conditional Correlation: MYR with all other currencies in terms of gold price



This outcome is also consistent with the earlier unconditional correlation that the Ringgit maintains a low correlation with other currencies. This is clear from the graph since all colored lines are overlapping showing a correlation between -0.25 to 0.25 with the Ringgit. Again, it is a good sign for investors who wish to invest in gold in this currency.

We also checked for linear restrictions to test whether the volatility of the currencies are mean reverting, that is by estimating $1 - \lambda_{i1} - \lambda_{i2}$. We also conducted various diagnostic tests to ensure the validity of our model used. In testing whether returns has non-mean reverting volatility, we used the Null hypothesis of H_0 being $\lambda_{i1} + \lambda_{i2} = 1$ which means that the process is non-mean reverting and the unconditional variance for the asset does not exist. The table below summarizes this:

Table 4: Testing for Linear Restrictions on $1 - \lambda_{i1} - \lambda_{i2}$

Asset	$1 - \lambda_{i1} - \lambda_{i2}$	Standard Errors	T-ratio
Euro	.018502	.0039431	4.6923
Japanese Yen	.011379	.0045298	2.5121
US Dollars	.017499	.0036039	4.8554
Canadian Dollars	.017047	.0039414	4.3252
British Pound	.018827	.0036508	5.1568
Malaysian Ringgit	.015575	.0055539	2.8042

From the table, we find that all values of t-ratio are significant and this is interpreted as mean reverting in nature. The volatility for currencies in terms of gold prices in the study decays and will come back to the mean or equilibrium; thus does not follow the IGARCH model where the shock to volatility is permanent.

When testing for validity through some diagnostic tests, most of these confirm our earlier findings that the t-distribution fits our case more aptly. This is easily explained through the test of serial correlation of residuals where we find the computed value of Lagrange Multiplier Statistic. In this test, the Null and alternative hypothesis are as follows:

H_0 : t-DCC model is correctly specified

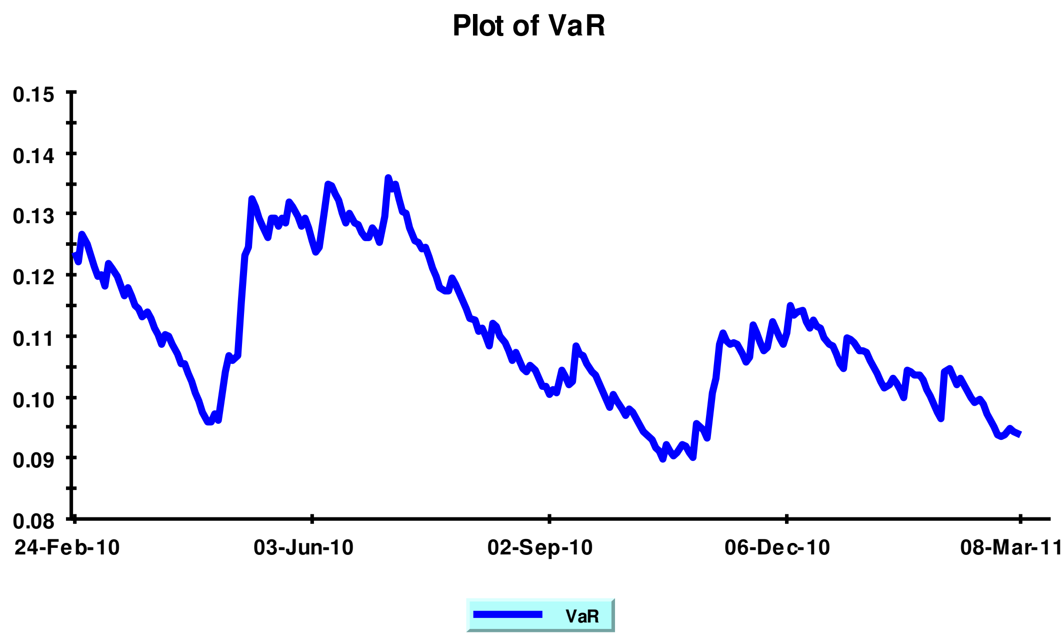
H_1 : t-DCC model is not correctly specified

We look at the value of the Chi-Square or the probability from the results. The Lagrange Multiplier Statistic value is 15.8 with the probability of 0.201 which concludes that we fail to reject the null hypothesis; therefore the model is correctly specified.

We also performed the Kolmogrov-Smirnov Goodness-of-fit Test, where the null hypothesis is rejected, which means that the probability integral transforms are not uniformly distributed. The histogram and graph can be referred to in the appendix.

While the plot of VAR for the forecasting period shows a decreasing pattern indicating that portfolio risk will likely decrease over time. This is shown below:

Figure 5 : Plot of VAR



An estimation of the t-DCC model on residuals is then obtained from a regression of returns on the variables' past values. The estimates of volatility and correlation decay parameters which are also in the appendix are found to be highly significant and very close to our earlier t-DCC model.

6. Limitations

This study is done on selected currencies' gold prices which had to comply with the rules of *Microfit* to be able to converge. Some important currencies like the Swiss Franc and Chinese Renminbi were tried but data failed to converge therefore had to be left out in this study.

7. Conclusions

This research has shown that the stronger currencies are highly correlated with the US Dollar and limits the diversification benefits. But the two Asian currencies seem to have a potential in the gold market which are especially targeted to gold investors. The main idea of this paper which was to show that gold can become a good tool of investment, is shown through the diversification combination of US Dollars and Japanese Yen, and also US Dollars and Malaysian Ringgit. The question whether gold could revert back to become a currency in the future is still unanswered since many economic happenings may change predictions. Many speculators are seeing that the US Dollar may depreciate in the long run which will drive the gold prices up. The trust people have in the price of gold will encourage them to invest more in gold instead of the currency futures and forwards which are still debatable in Islamic finance. The fact that more banks and finance companies are advertising their gold investment packages could mean more people will become more interested in buying gold for investment; and this could, in the future create an economy which functions from the basis of gold, just like how it used to be.

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http://www.silverbearcafe.com/private/gold101.html

APPENDICES

1. Multivariate GARCH with underlying multivariate Normal distribution

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Multivariate GARCH with underlying multivariate Normal distribution
Converged after 48 iterations
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Based on 2084 observations from 16-Aug-01 to 23-Feb-10.
The variables (asset returns) in the multivariate GARCH model are:
EURO JY USD CD PS MYR
Volatility decay factors unrestricted, different for each variable.
Correlation decay factors unrestricted, same for all variables.
****

Parameter	Estimate	Standard Error	T-Ratio[Prob]
lambda1_EURO	.94136	.0068288	137.8522[.000]
lambda1_JY	.93515	.010060	92.9608[.000]
lambda1_USD	.94888	.0057783	164.2155[.000]
lambda1_CD	.95048	.0062158	152.9143[.000]
lambda1_PS	.94444	.0056562	166.9742[.000]
lambda1_MYR	.94256	.0087047	108.2815[.000]
lambda2_EURO	.039571	.0043217	9.1565[.000]
lambda2_JY	.049642	.0066354	7.4814[.000]
lambda2_USD	.033893	.0034875	9.7184[.000]
lambda2_CD	.031648	.0036126	8.7603[.000]
lambda2_PS	.037244	.0035807	10.4013[.000]
lambda2_MYR	.044647	.0058390	7.6463[.000]
delta1	.94414	.0051852	182.0845[.000]
delta2	.024585	.0016517	14.8846[.000]

****
Maximized Log-Likelihood = 43716.3
****

Estimated Unconditional Volatility Matrix
2084 observations used for estimation from 16-Aug-01 to 23-Feb-10
Unconditional Volatilities (Standard Errors) on the Diagonal Elements
Unconditional Correlations on the Off-Diagonal Elements
****

	EURO	JY	USD	CD	PS	MYR
EURO	.010891	.048239	.84623	.84242	.90293	-.015648
JY	.048239	.012873	.099342	.016842	.049267	.021492

USD	.84623	.099342	.012200	.84246	.85160	.0028975
CD	.84242	.016842	.84246	.011934	.83891	.3494E-3
PS	.90293	.049267	.85160	.83891	.011489	-.022009
MYR	-.015648	.021492	.0028975	.3494E-3	-.022009	.012404

****

For the time-varying conditional volatilities and correlations see the Post Estimation Menu.

2. Multivariate GARCH with underlying multivariate t-distribution

4/15/2012 11:03:33 PM

Multivariate GARCH with underlying multivariate t-distribution
Converged after 23 iterations

****

Based on 2084 observations from 16-Aug-01 to 23-Feb-10.
The variables (asset returns) in the multivariate GARCH model are:
EURO JY USD CD PS MYR
Volatility decay factors unrestricted, different for each variable.
Correlation decay factors unrestricted, same for all variables.

****

Parameter	Estimate	Standard Error	T-Ratio[Prob]
lambda1_EURO	.94779	.0073492	128.9649[.000]
lambda1_JY	.95635	.0085164	112.2955[.000]
lambda1_USD	.95454	.0061255	155.8304[.000]
lambda1_CD	.95823	.0066934	143.1603[.000]
lambda1_PS	.94871	.0065531	144.7726[.000]
lambda1_MYR	.93485	.012442	75.1337[.000]
lambda2_EURO	.033707	.0044691	7.5421[.000]
lambda2_JY	.032271	.0056067	5.7557[.000]
lambda2_USD	.027965	.0035162	7.9531[.000]
lambda2_CD	.024721	.0036152	6.8380[.000]
lambda2_PS	.032463	.0039777	8.1613[.000]
lambda2_MYR	.049574	.0085118	5.8242[.000]
delta1	.95604	.0042212	226.4880[.000]
delta2	.022668	.0016442	13.7869[.000]
df	10.4030	.63098	16.4872[.000]

****

Maximized Log-Likelihood = 44062.6

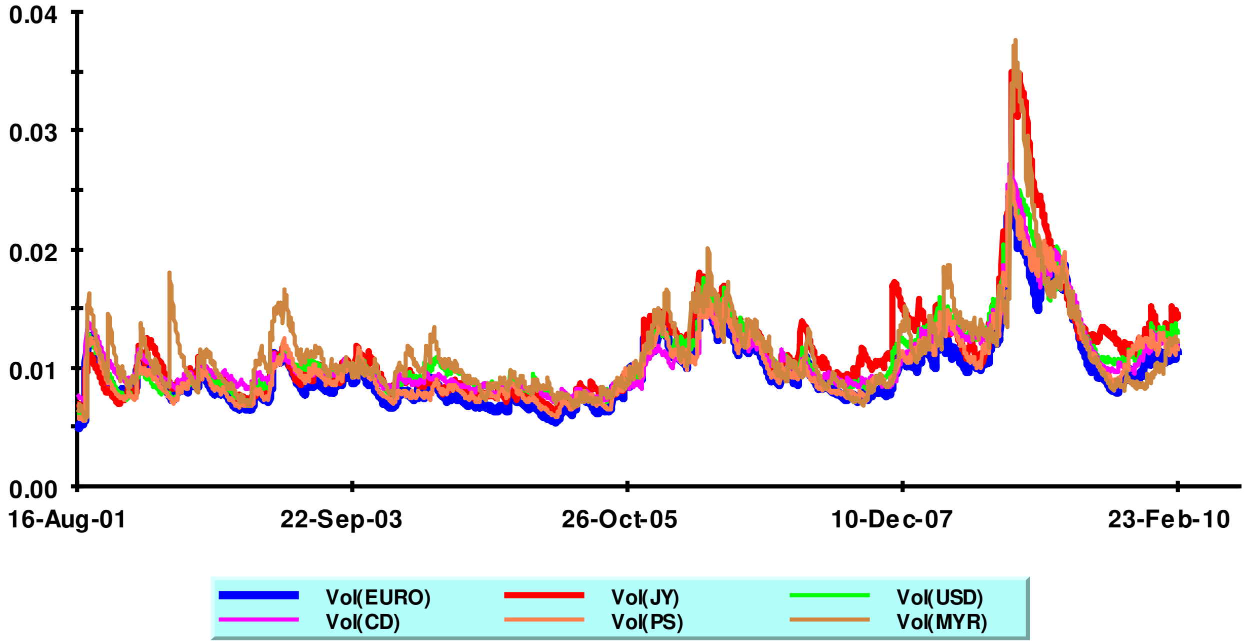
****
df is the degrees of freedom of the multivariate t distribution

Estimated Unconditional Volatility Matrix
2084 observations used for estimation from 16-Aug-01 to 23-Feb-10
Unconditional Volatilities (Standard Errors) on the Diagonal Elements
Unconditional Correlations on the Off-Diagonal Elements
****

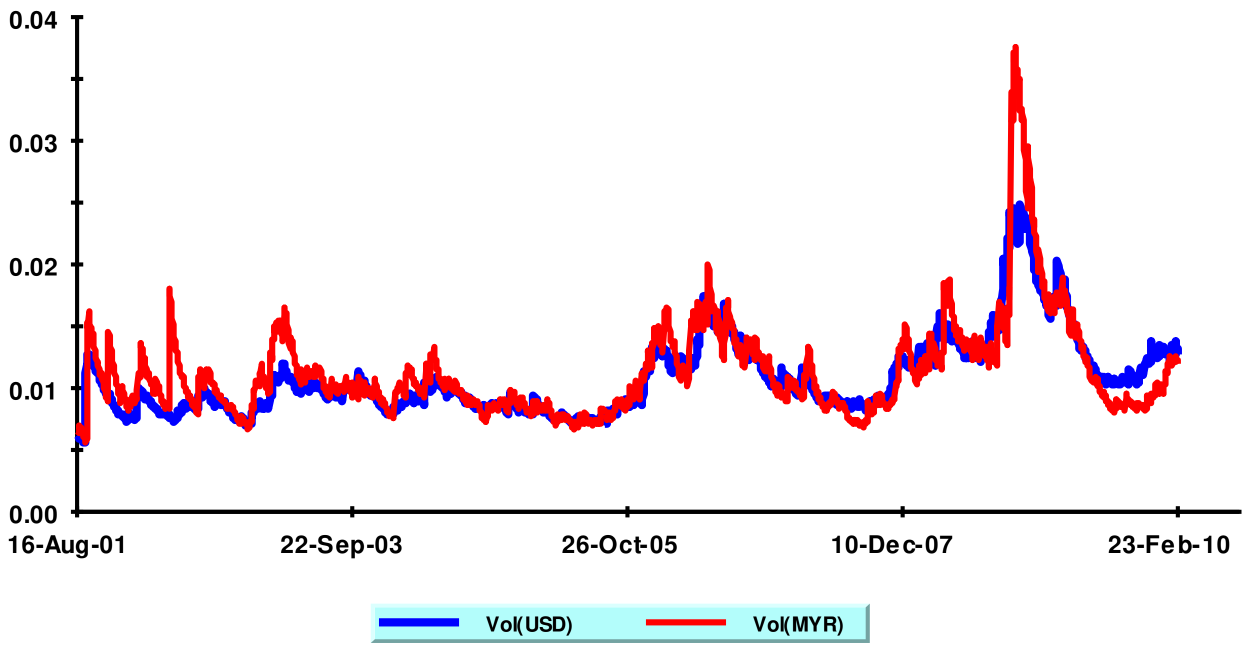
	EURO	JY	USD	CD	PS	MYR
EURO	.010891	.048239	.84623	.84242	.90293	-.015648
JY	.048239	.012873	.099342	.016842	.049267	.021492
USD	.84623	.099342	.012200	.84246	.85160	.0028975
CD	.84242	.016842	.84246	.011934	.83891	.3494E-3
PS	.90293	.049267	.85160	.83891	.011489	-.022009
MYR	-.015648	.021492	.0028975	.3494E-3	-.022009	.012404

****
For the time-varying conditional volatilities and correlations see the Post Estimation Menu.

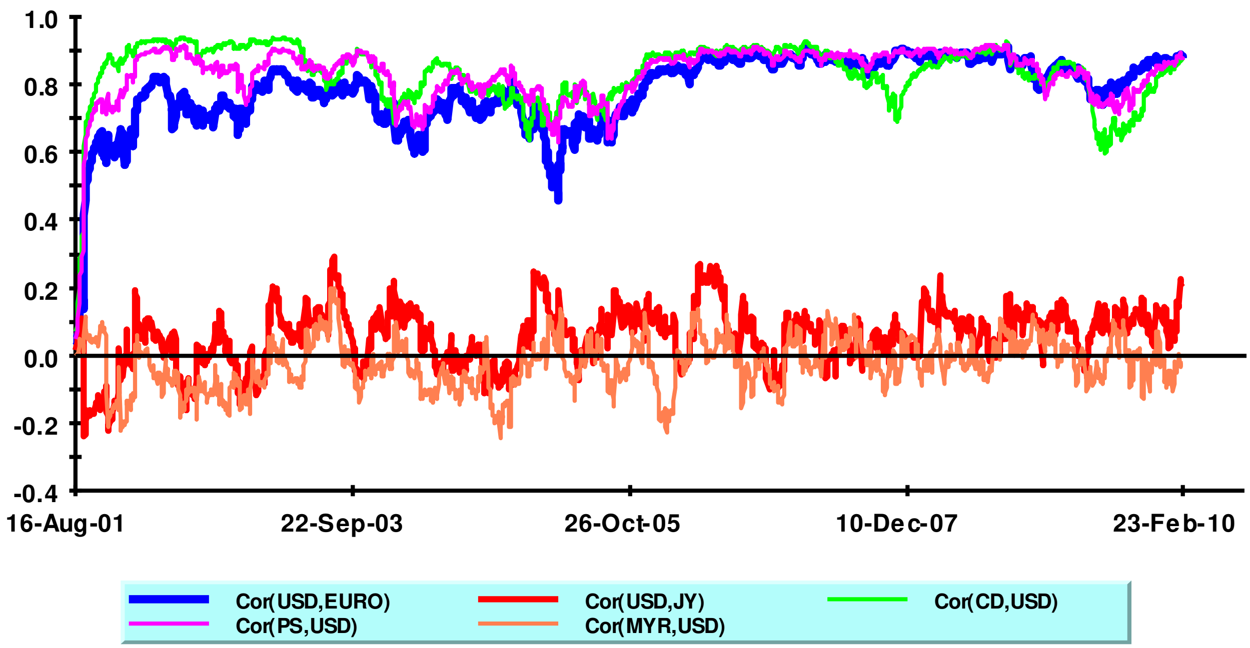
Plot of conditional volatilities and correlations



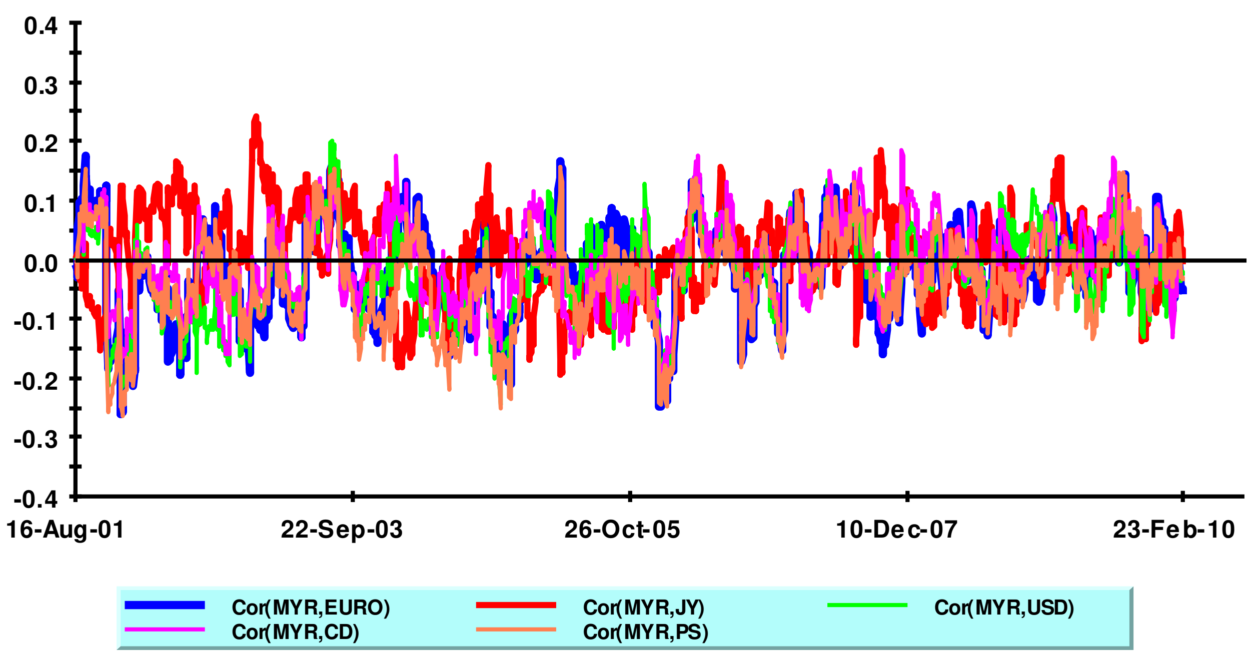
Plot of conditional volatilities and correlations



Plot of conditional volatilities and correlations



Plot of conditional volatilities and correlations



Testing for Non-Linear Restrictions

4/15/2012 11:14:24 PM

Analysis of Function(s) of Parameter(s)

****
******
The variables (asset returns) in the multivariate GARCH model are:
EURO JY USD CD PS MYR
Volatility decay factors unrestricted, different for each variable.
Correlation decay factors unrestricted, same for all variables.
2084 observations used for estimation from 16-Aug-01 to 23-Feb-10
****
******

List of specified functional relationship(s):
ZEROS = 1 - LAMBDA1_JY-LAMBDA2_JY
****
******

Function	Estimate	Standard Error	T-Ratio[Prob]
ZEROS	.011379	.0045298	2.5121[.012]

****
******

Estimated Variance Matrix of the Function(s) of the Parameters
2084 observations used for estimation from 16-Aug-01 to 23-Feb-10
****
******

	ZEROS
ZEROS	.2052E-4

****
******

4/15/2012 11:15:20 PM

Analysis of Function(s) of Parameter(s)
****
******
The variables (asset returns) in the multivariate GARCH model are:
EURO JY USD CD PS MYR
Volatility decay factors unrestricted, different for each variable.
Correlation decay factors unrestricted, same for all variables.
2084 observations used for estimation from 16-Aug-01 to 23-Feb-10
****
******

List of specified functional relationship(s):
ZEROS = 1 - LAMBDA1_MYR-LAMBDA2_MYR
****
******

Function	Estimate	Standard Error	T-Ratio[Prob]
ZEROS	.015575	.0055539	2.8042[.005]

****
******

Estimated Variance Matrix of the Function(s) of the Parameters
2084 observations used for estimation from 16-Aug-01 to 23-Feb-10
****

	ZEROS
ZEROS	.3085E-4

****

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Analysis of Function(s) of Parameter(s)
****
The variables (asset returns) in the multivariate GARCH model are:
EURO JY USD CD PS MYR
Volatility decay factors unrestricted, different for each variable.
Correlation decay factors unrestricted, same for all variables.
2084 observations used for estimation from 16-Aug-01 to 23-Feb-10
****

List of specified functional relationship(s):
ZEROS = 1 - LAMBDA1_CD-LAMBDA2_CD
****

Function	Estimate	Standard Error	T-Ratio[Prob]
ZEROS	.017047	.0039414	4.3252[.000]

****

Estimated Variance Matrix of the Function(s) of the Parameters
2084 observations used for estimation from 16-Aug-01 to 23-Feb-10
****

	ZEROS
ZEROS	.1553E-4

****

4/15/2012 11:16:24 PM

Analysis of Function(s) of Parameter(s)

****

The variables (asset returns) in the multivariate GARCH model are:
EURO JY USD CD PS MYR
Volatility decay factors unrestricted, different for each variable.
Correlation decay factors unrestricted, same for all variables.
2084 observations used for estimation from 16-Aug-01 to 23-Feb-10

****

List of specified functional relationship(s):
ZEROS = 1 - LAMBDA1_USD-LAMBDA2_USD

****

Function	Estimate	Standard Error	T-Ratio[Prob]
ZEROS	.017499	.0036039	4.8554[.000]

****

Estimated Variance Matrix of the Function(s) of the Parameters
2084 observations used for estimation from 16-Aug-01 to 23-Feb-10

****

	ZEROS
ZEROS	.1299E-4

****

4/15/2012 11:16:56 PM

Analysis of Function(s) of Parameter(s)

****

The variables (asset returns) in the multivariate GARCH model are:
EURO JY USD CD PS MYR

Volatility decay factors unrestricted, different for each variable.
Correlation decay factors unrestricted, same for all variables.
2084 observations used for estimation from 16-Aug-01 to 23-Feb-10
****

List of specified functional relationship(s):
ZEROS = 1 - LAMBDA1_PS-LAMBDA2_PS
****

Function	Estimate	Standard Error	T-Ratio[Prob]
ZEROS	.018827	.0036508	5.1568[.000]

****

Estimated Variance Matrix of the Function(s) of the Parameters
2084 observations used for estimation from 16-Aug-01 to 23-Feb-10
****

	ZEROS
ZEROS	.1333E-4

****

4/15/2012 11:17:33 PM

Analysis of Function(s) of Parameter(s)
****
The variables (asset returns) in the multivariate GARCH model are:
EURO JY USD CD PS MYR
Volatility decay factors unrestricted, different for each variable.
Correlation decay factors unrestricted, same for all variables.
2084 observations used for estimation from 16-Aug-01 to 23-Feb-10
****

List of specified functional relationship(s):
ZEROS = 1 - LAMBDA1_EURO-LAMBDA2_EURO
****

Function	Estimate	Standard Error	T-Ratio[Prob]
ZEROS	.018502	.0039431	4.6923[.000]

****

Estimated Variance Matrix of the Function(s) of the Parameters
2084 observations used for estimation from 16-Aug-01 to 23-Feb-10
****

	ZEROS
ZEROS	.1555E-4

****

Testing Validity of t-DCC Model

4/15/2012 11:18:37 PM

Test of Serial Correlation of Residuals (OLS case)

****

Dependent variable is U-Hat
List of variables in OLS regression:
Intercept
252 observations used for estimation from 24-Feb-10 to 08-Mar-11

****

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
OLS RES(-1)	.13184	.064613	2.0405[.042]
OLS RES(-2)	-.073724	.065205	-1.1306[.259]
OLS RES(-3)	.057256	.065225	.87782[.381]
OLS RES(-4)	.046359	.065099	.71214[.477]
OLS RES(-5)	.031644	.065376	.48403[.629]
OLS RES(-6)	-.0049096	.065655	-.074779[.940]
OLS RES(-7)	-.7361E-3	.065696	-.011204[.991]
OLS RES(-8)	.073870	.065675	1.1248[.262]
OLS RES(-9)	.10100	.065760	1.5359[.126]
OLS RES(-10)	-.082351	.066078	-1.2463[.214]
OLS RES(-11)	-.071674	.066178	-1.0830[.280]
OLS RES(-12)	-.048433	.065676	-.73746[.462]

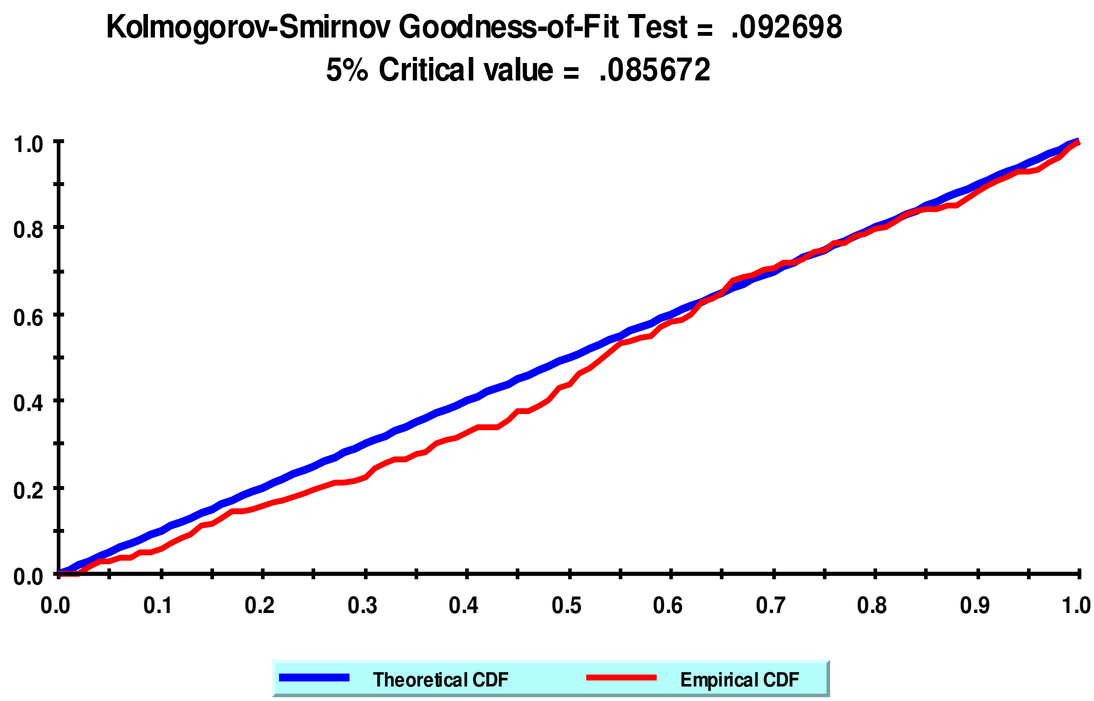
****

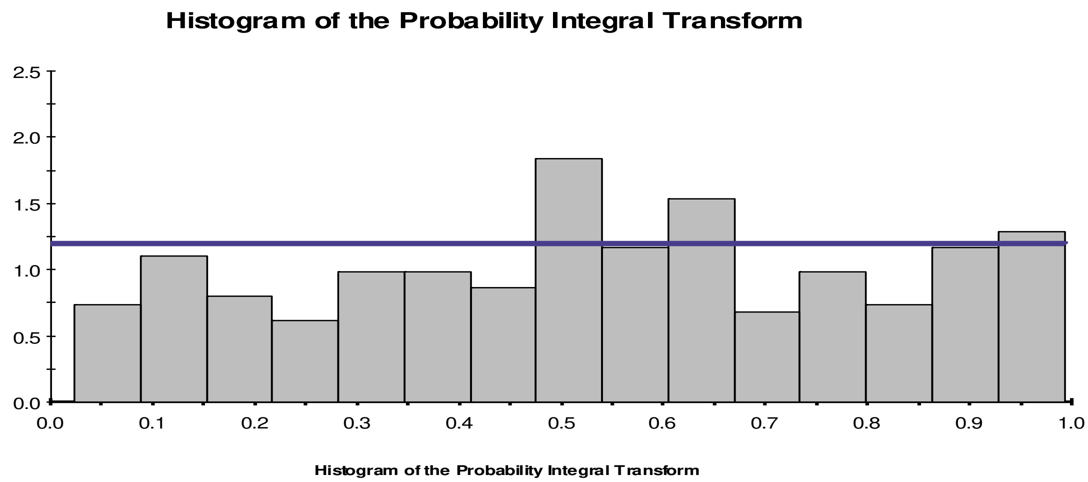
Lagrange Multiplier Statistic CHSQ(12)= 15.8000[.201]
F Statistic F(12,239)= 1.3323[.201]

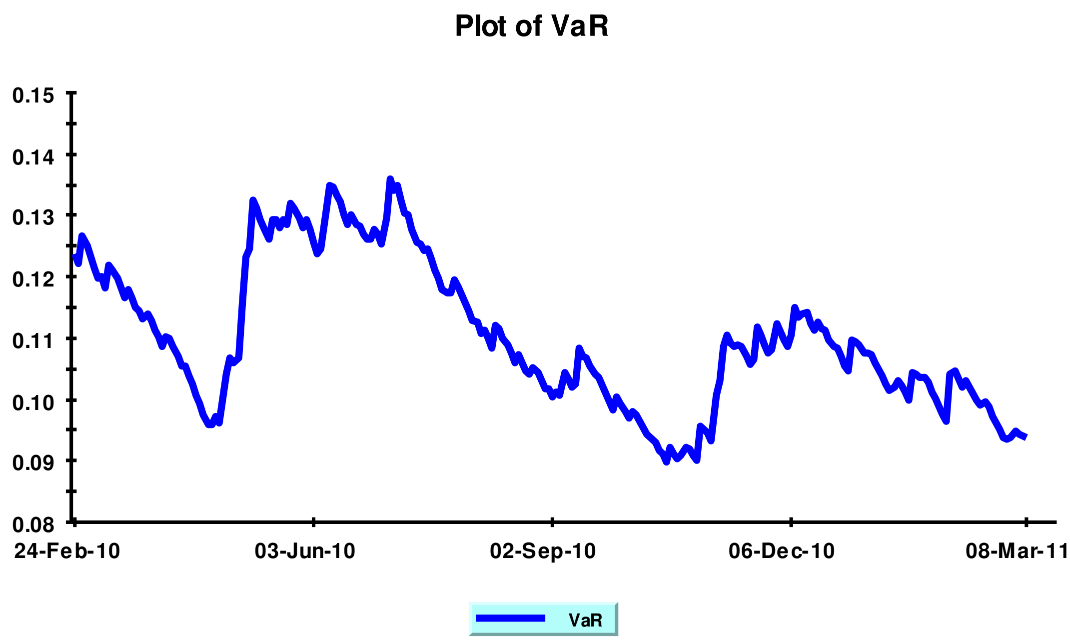
****

U-Hat denotes the probability integral transform.
Under the null hypothesis, U-Hat should not display any serial correlation.

****
******


Kolmogorov-Smirnov Goodness-of-Fit Test = .092698
5% Critical value = .085672
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Theoretical CDF
Empirical CDF



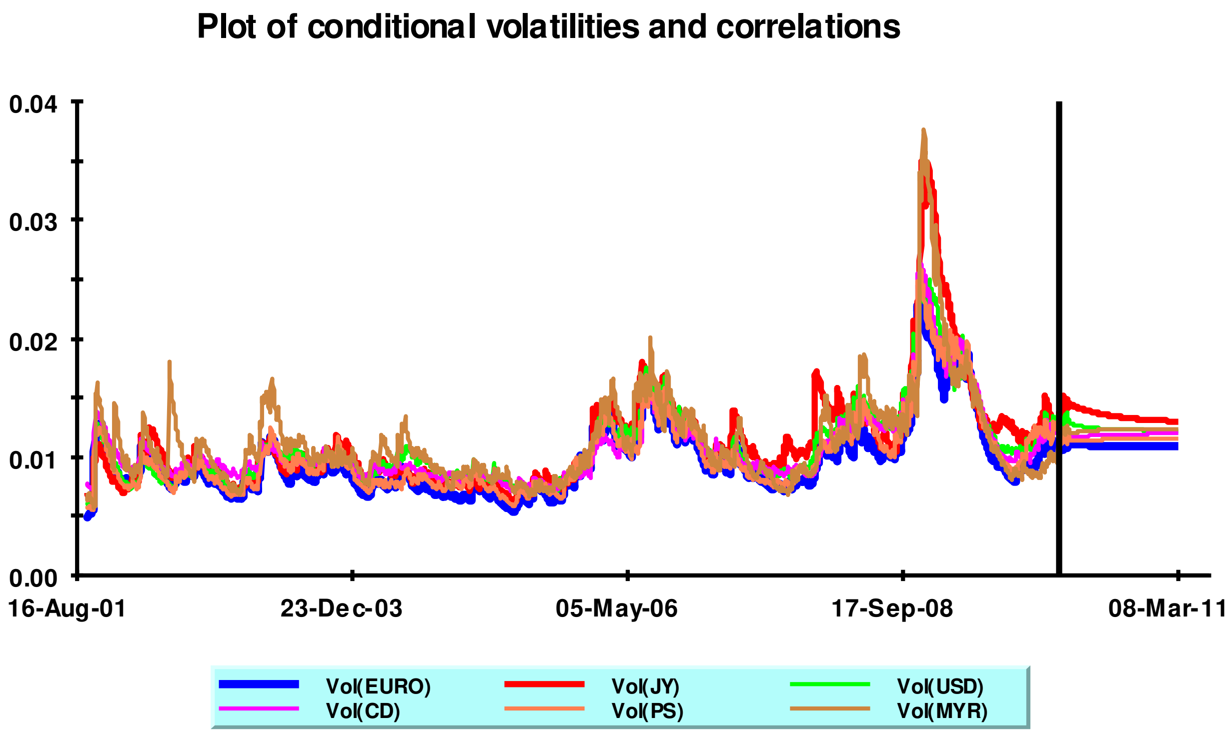


4/15/2012 11:21:59 PM

Mean VaR Exceptions and the Associated Diagnostic Test Statistics

****
******
Mean Hit Rate (pihat statistic) =   1.0000 with expected value of   .99000
 Standard Normal Test Statistic=   1.5954[.111]

Forecasting Conditional Correlations



MGARCH Applied to a set of OLS Residuals

4/15/2012 11:28:34 PM

Multivariate GARCH with underlying multivariate t-distribution
Converged after 24 iterations
****

Based on 2083 observations from 17-Aug-01 to 23-Feb-10.
The underlying multivariate GARCH model is:
CD CD(-1) C; EURO EURO(-1) C; MYR MYR(-1) C; USD USD(-1) C; JY JY(-1) C;
PS PS(-1) C
Volatility decay factors unrestricted, different for each variable.
Correlation decay factors unrestricted, same for all variables.
****

Parameter	Estimate	Standard Error	T-Ratio[Prob]
lambda1_CD	.95729	.0069288	138.1615[.000]
lambda1_EURO	.94820	.0073709	128.6413[.000]
lambda1_MYR	.93426	.012681	73.6757[.000]
lambda1_USD	.95329	.0063565	149.9695[.000]
lambda1_JY	.95577	.0086264	110.7950[.000]
lambda1_PS	.94877	.0065881	144.0137[.000]
lambda2_CD	.024928	.0036977	6.7414[.000]
lambda2_EURO	.033149	.0044450	7.4576[.000]
lambda2_MYR	.050062	.0086761	5.7701[.000]
lambda2_USD	.028824	.0036395	7.9195[.000]
lambda2_JY	.032429	.0056273	5.7628[.000]
lambda2_PS	.032184	.0039586	8.1303[.000]
delta1	.95632	.0042185	226.6955[.000]
delta2	.022297	.0016378	13.6142[.000]
df	10.4280	.63099	16.5265[.000]

****

Maximized Log-Likelihood = 44025.0
****

df is the degrees of freedom of the multivariate t distribution

Estimated Unconditional Volatility Matrix
2083 observations used for estimation from 17-Aug-01 to 23-Feb-10
Unconditional Volatilities (Standard Errors) on the Diagonal Elements
Unconditional Correlations on the Off-Diagonal Elements
****

	CD	EURO	MYR	USD	JY	PS
CD	.011896	.84041	.0079059	.83975	.014712	.83722
EURO	.84041	.010867	-.0095803	.84439	.045608	.90154
MYR	.0079059	-.0095803	.012359	-.3459E-3	.019779	-.019495

USD	.83975	.84439	-.3459E-3	.012180	.098397	.85069
JY	.014712	.045608	.019779	.098397	.012862	.047077
PS	.83722	.90154	-.019495	.85069	.047077	.011467

****
For the time-varying conditional volatilities and correlations see the Post Estimation Menu.

Regression Results for Each Equation

4/15/2012 11:29:04 PM

Ordinary Least Squares Estimation
****
Dependent variable is CD
2103 observations used for estimation from 20-Jul-01 to 23-Feb-10
****

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
CD(-1)	-.063329	.021773	-2.9086[.004]
C	.5898E-3	.2592E-3	2.2756[.023]

****

R-Squared	.0040106	R-Bar-Squared	.0035365
S.E. of Regression	.011873	F-Stat. F(1,2101)	8.4602[.004]
Mean of Dependent Variable	.5546E-3	S.D. of Dependent Variable	.011894
Residual Sum of Squares	.29616	Equation Log-likelihood	6340.7
Akaike Info. Criterion	6338.7	Schwarz Bayesian Criterion	6333.0
DW-statistic	2.0052		

****

Diagnostic Tests
****
* Test Statistics * LM Version * F Version *
****
* * * *

```
* A:Serial Correlation*CHSQ(1)  =   3.5571[.059]*F(1,2100)    =   3.5581[.059]*
*                  *                     *                       *
* B:Functional Form   *CHSQ(1)  =   3.1350[.077]*F(1,2100)    =   3.1352[.077]*
*                  *                     *                       *
* C:Normality        *CHSQ(2)  =   2642.2[.000]*      Not applicable        *
*                  *                     *                       *
* D:Heteroscedasticity*CHSQ(1)  =  32.2535[.000]*F(1,2101)    =  32.7247[.000]*
*******************************************************************************
   A:Lagrange multiplier test of residual serial correlation
   B:Ramsey's RESET test using the square of the fitted values
   C:Based on a test of skewness and kurtosis of residuals
   D:Based on the regression of squared residuals on squared fitted values


 4/15/2012                                        11:29:26 PM

                 Ordinary Least Squares Estimation
*******************************************************************************
Dependent variable is EURO
 2103 observations used for estimation from 20-Jul-01 to 23-Feb-10
*******************************************************************************
 Regressor             Coefficient       Standard Error        T-Ratio[Prob]
 EURO(-1)               -.050690           .021789           -2.3264[.020]
 C                    .5429E-3          .2365E-3            2.2956[.022]
*******************************************************************************
 R-Squared                 .0025695   R-Bar-Squared               .0020947
 S.E. of Regression          .010832   F-Stat.    F(1,2101)    5.4124[.020]
 Mean of Dependent Variable  .5167E-3   S.D. of Dependent Variable     .010843
 Residual Sum of Squares       .24651   Equation Log-likelihood        6533.6
 Akaike Info. Criterion        6531.6   Schwarz Bayesian Criterion      6525.9
 DW-statistic                 2.0033
*******************************************************************************



                        Diagnostic Tests
*******************************************************************************
*    Test Statistics  *        LM Version       *          F Version         *
*******************************************************************************
*                  *                     *                       *
* A:Serial Correlation*CHSQ(1)  =   2.3451[.126]*F(1,2100)    =   2.3444[.126]*
*                  *                     *                       *
* B:Functional Form   *CHSQ(1)  =   .55393[.457]*F(1,2100)    =   .55329[.457]*
*                  *                     *                       *
* C:Normality        *CHSQ(2)  =   2128.6[.000]*      Not applicable        *
*                  *                     *                       *
```

* D:Heteroscedasticity*CHSQ(1) = 10.7545[.001]*F(1,2101) = 10.7995[.001]*
****

A:Lagrange multiplier test of residual serial correlation
B:Ramsey's RESET test using the square of the fitted values
C:Based on a test of skewness and kurtosis of residuals
D:Based on the regression of squared residuals on squared fitted values

4/15/2012 11:29:43 PM

Ordinary Least Squares Estimation
****
Dependent variable is MYR
2103 observations used for estimation from 20-Jul-01 to 23-Feb-10
****

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
MYR(-1)	-.066671	.021770	-3.0626[.002]
C	.7524E-3	.2691E-3	2.7955[.005]

****

R-Squared	.0044444	R-Bar-Squared	.0039706
S.E. of Regression	.012322	F-Stat. F(1,2101)	9.3794[.002]
Mean of Dependent Variable	.7054E-3	S.D. of Dependent Variable	.012347
Residual Sum of Squares	.31900	Equation Log-likelihood	6262.5
Akaike Info. Criterion	6260.5	Schwarz Bayesian Criterion	6254.9
DW-statistic	2.0065		

****

Diagnostic Tests
****

Test Statistics	LM Version	F Version
A:Serial Correlation	CHSQ(1) = 5.4131[.020]	F(1,2100) = 5.4193[.020]
B:Functional Form	CHSQ(1) = 2.8631[.091]	F(1,2100) = 2.8630[.091]
C:Normality	CHSQ(2) = 8783.6[.000]	Not applicable
D:Heteroscedasticity	CHSQ(1) = 26.2800[.000]	F(1,2101) = 26.5873[.000]

****

A:Lagrange multiplier test of residual serial correlation
B:Ramsey's RESET test using the square of the fitted values
C:Based on a test of skewness and kurtosis of residuals

D:Based on the regression of squared residuals on squared fitted values

4/15/2012 11:30:06 PM

Ordinary Least Squares Estimation
****

Dependent variable is USD
2103 observations used for estimation from 20-Jul-01 to 23-Feb-10
****

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
USD(-1)	.0076596	.021816	.35110[.726]
C	.7356E-3	.2653E-3	2.7727[.006]

****

R-Squared	.5867E-4	R-Bar-Squared	-.4173E-3
S.E. of Regression	.012143	F-Stat. F(1,2101)	.12327[.726]
Mean of Dependent Variable	.7413E-3	S.D. of Dependent Variable	.012141
Residual Sum of Squares	.30981	Equation Log-likelihood	6293.3
Akaike Info. Criterion	6291.3	Schwarz Bayesian Criterion	6285.6
DW-statistic	1.9996		

****

Diagnostic Tests
****

Test Statistics	LM Version	F Version
A:Serial Correlation	CHSQ(1) = .55492[.456]	F(1,2100) = .55428[.457]
B:Functional Form	CHSQ(1) = .41629[.519]	F(1,2100) = .41578[.519]
C:Normality	CHSQ(2) = 1617.0[.000]	Not applicable
D:Heteroscedasticity	CHSQ(1) = 2.1494[.143]	F(1,2101) = 2.1495[.143]

****

```
  A:Lagrange multiplier test of residual serial correlation
  B:Ramsey's RESET test using the square of the fitted values
  C:Based on a test of skewness and kurtosis of residuals
  D:Based on the regression of squared residuals on squared fitted values


 4/15/2012                                   11:30:19 PM

                Ordinary Least Squares Estimation
*******************************************************************************
******
Dependent variable is JY
 2103 observations used for estimation from 20-Jul-01 to 23-Feb-10
*******************************************************************************
******
 Regressor              Coefficient       Standard Error         T-Ratio[Prob]
 JY(-1)                -.0016683            .021828           -.076431[.939]
 C                    .5926E-3          .2800E-3            2.1168[.034]
*******************************************************************************
******
 R-Squared                  .2780E-5   R-Bar-Squared               -.4732E-3
 S.E. of Regression           .012825   F-Stat.    F(1,2101)  .0058417[.939]
 Mean of Dependent Variable  .5916E-3   S.D. of Dependent Variable     .012822
 Residual Sum of Squares       .34555   Equation Log-likelihood         6178.5
 Akaike Info. Criterion        6176.5   Schwarz Bayesian Criterion      6170.8
 DW-statistic                  1.9990
*******************************************************************************
******



                         Diagnostic Tests
*******************************************************************************
******
*    Test Statistics  *        LM Version       *          F Version          *
*******************************************************************************
******
*                    *                     *                         *
* A:Serial Correlation*CHSQ(1)  =  .092568[.761]*F(1,2100)    =  .092440[.761]*
*                    *                     *                         *
* B:Functional Form   *CHSQ(1)  =   1.8354[.175]*F(1,2100)    =   1.8344[.176]*
*                    *                     *                         *
* C:Normality        *CHSQ(2)  =   4689.2[.000]*      Not applicable         *
*                    *                     *                         *
* D:Heteroscedasticity*CHSQ(1)  =  16.0170[.000]*F(1,2101)    =  16.1246[.000]*
*******************************************************************************
******
```

A:Lagrange multiplier test of residual serial correlation
B:Ramsey's RESET test using the square of the fitted values
C:Based on a test of skewness and kurtosis of residuals
D:Based on the regression of squared residuals on squared fitted values

4/15/2012 11:30:41 PM

Ordinary Least Squares Estimation
```
******************************************************************************
Dependent variable is PS
 2103 observations used for estimation from 20-Jul-01 to 23-Feb-10
******************************************************************************
 Regressor              Coefficient       Standard Error         T-Ratio[Prob]
 PS(-1)                 -.024518           .021806              -1.1244[.261]
 C                      .7107E-3          .2497E-3              2.8460[.004]
******************************************************************************
 R-Squared                    .6014E-3   R-Bar-Squared                  .1257E-3
 S.E. of Regression           .011431   F-Stat.    F(1,2101)    1.2642[.261]
 Mean of Dependent Variable  .6938E-3   S.D. of Dependent Variable     .011431
 Residual Sum of Squares       .27451   Equation Log-likelihood         6420.5
 Akaike Info. Criterion        6418.5   Schwarz Bayesian Criterion      6412.8
 DW-statistic                  2.0019   Durbin's h-statistic    -11.8956[.000]
******************************************************************************
```

Diagnostic Tests
```
******************************************************************************
*    Test Statistics  *        LM Version        *           F Version          *
******************************************************************************
*                     *                          *                              *
* A:Serial Correlation*CHSQ(1)  =   1.9563[.162]*F(1,2100)    =   1.9553[.162]*
*                     *                          *                              *
* B:Functional Form   *CHSQ(1)  =   .99985[.317]*F(1,2100)    =   .99890[.318]*
*                     *                          *                              *
* C:Normality         *CHSQ(2)  =   2897.0[.000]*      Not applicable          *
*                     *                          *                              *
* D:Heteroscedasticity*CHSQ(1)  =   .24653[.620]*F(1,2101)    =   .24632[.620]*
******************************************************************************
```
A:Lagrange multiplier test of residual serial correlation
B:Ramsey's RESET test using the square of the fitted values
C:Based on a test of skewness and kurtosis of residuals
D:Based on the regression of squared residuals on squared fitted values

Testing With Indian Currency Included

4/15/2012 11:37:07 PM

Multivariate GARCH with underlying multivariate Normal distribution
Converged after 35 iterations

****

Based on 2084 observations from 16-Aug-01 to 23-Feb-10.
The variables (asset returns) in the multivariate GARCH model are:
INDIAN EURO JY USD CD PS MYR
Volatility decay factors unrestricted, different for each variable.
Correlation decay factors unrestricted, same for all variables.

****

Parameter	Estimate	Standard Error	T-Ratio[Prob]
lambda1_INDIAN	.95038	.0074568	127.4515[.000]
lambda1_EURO	.94419	.0063176	149.4528[.000]
lambda1_JY	.93655	.0097797	95.7648[.000]
lambda1_USD	.95123	.0055232	172.2231[.000]
lambda1_CD	.95126	.0061411	154.8997[.000]
lambda1_PS	.94670	.0054191	174.6976[.000]
lambda1_MYR	.94215	.0087171	108.0808[.000]
lambda2_INDIAN	.040680	.0054542	7.4586[.000]
lambda2_EURO	.038321	.0040684	9.4193[.000]
lambda2_JY	.048923	.0065157	7.5085[.000]
lambda2_USD	.032785	.0033427	9.8079[.000]
lambda2_CD	.031728	.0035945	8.8269[.000]
lambda2_PS	.036396	.0034658	10.5014[.000]
lambda2_MYR	.045103	.0058671	7.6874[.000]
delta1	.96128	.0029395	327.0238[.000]
delta2	.018215	.0011422	15.9478[.000]

****

Maximized Log-Likelihood = 50121.0

****

Estimated Unconditional Volatility Matrix
2084 observations used for estimation from 16-Aug-01 to 23-Feb-10
Unconditional Volatilities (Standard Errors) on the Diagonal Elements
Unconditional Correlations on the Off-Diagonal Elements

****

	INDIAN	EURO	JY	USD	CD	PS
INDIAN	.012065	.010342	.024184	.022908	.012816	-.7132E-3
EURO	.010342	.010891	.048239	.84623	.84242	.90293
JY	.024184	.048239	.012873	.099342	.016842	.049267
USD	.022908	.84623	.099342	.012200	.84246	.85160
CD	.012816	.84242	.016842	.84246	.011934	.83891
PS	-.7132E-3	.90293	.049267	.85160	.83891	.011489
MYR	.0058390	-.015648	.021492	.0028975	.3494E-3	-.022009

Estimated Unconditional Volatility Matrix
2084 observations used for estimation from 16-Aug-01 to 23-Feb-10
Unconditional Volatilities (Standard Errors) on the Diagonal Elements
Unconditional Correlations on the Off-Diagonal Elements

****

	MYR
INDIAN	.0058390
EURO	-.015648
JY	.021492
USD	.0028975
CD	.3494E-3
PS	-.022009
MYR	.012404

****

For the time-varying conditional volatilities and correlations see the Post Estimation Menu.

4/15/2012 11:34:28 PM

Multivariate GARCH with underlying multivariate t-distribution
Converged after 25 iterations

****

Based on 2084 observations from 16-Aug-01 to 23-Feb-10.

The variables (asset returns) in the multivariate GARCH model are:
INDIAN EURO JY USD CD PS MYR
Volatility decay factors unrestricted, different for each variable.
Correlation decay factors unrestricted, same for all variables.
****

Parameter	Estimate	Standard Error	T-Ratio[Prob]
lambda1_INDIAN	.94583	.0080620	117.3204[.000]
lambda1_EURO	.94888	.0075168	126.2343[.000]
lambda1_JY	.95217	.0093484	101.8541[.000]
lambda1_USD	.95634	.0061936	154.4081[.000]
lambda1_CD	.95900	.0068987	139.0120[.000]
lambda1_PS	.95064	.0065873	144.3143[.000]
lambda1_MYR	.93109	.013481	69.0663[.000]
lambda2_INDIAN	.046651	.0064338	7.2510[.000]
lambda2_EURO	.031236	.0043502	7.1803[.000]
lambda2_JY	.033721	.0059132	5.7026[.000]
lambda2_USD	.025279	.0033218	7.6100[.000]
lambda2_CD	.022595	.0034673	6.5166[.000]
lambda2_PS	.029688	.0038097	7.7929[.000]
lambda2_MYR	.051264	.0089506	5.7274[.000]
delta1	.95939	.0040037	239.6285[.000]
delta2	.017821	.0013056	13.6497[.000]
df	10.7587	.60935	17.6561[.000]

****
Maximized Log-Likelihood = 50564.0
****
df is the degrees of freedom of the multivariate t distribution

Estimated Unconditional Volatility Matrix
2084 observations used for estimation from 16-Aug-01 to 23-Feb-10
Unconditional Volatilities (Standard Errors) on the Diagonal Elements
Unconditional Correlations on the Off-Diagonal Elements
****

	INDIAN	EURO	JY	USD	CD	PS
INDIAN	.012065	.010342	.024184	.022908	.012816	-.7132E-3
EURO	.010342	.010891	.048239	.84623	.84242	.90293
JY	.024184	.048239	.012873	.099342	.016842	.049267
USD	.022908	.84623	.099342	.012200	.84246	.85160
CD	.012816	.84242	.016842	.84246	.011934	.83891
PS	-.7132E-3	.90293	.049267	.85160	.83891	.011489

MYR	.0058390	-.015648	.021492	.0028975	.3494E-3	-.022009

Estimated Unconditional Volatility Matrix
2084 observations used for estimation from 16-Aug-01 to 23-Feb-10
Unconditional Volatilities (Standard Errors) on the Diagonal Elements
Unconditional Correlations on the Off-Diagonal Elements
****

	MYR
INDIAN	.0058390
EURO	-.015648
JY	.021492
USD	.0028975
CD	.3494E-3
PS	-.022009
MYR	.012404

****
For the time-varying conditional volatilities and correlations see the Post Estimation Menu.

Test of Serial Correlation of Residuals (OLS case)

****

Dependent variable is U-Hat

List of variables in OLS regression:

Intercept

252 observations used for estimation from 24-Feb-10 to 08-Mar-11

****

Regressor	Coefficient	Standard Error	T-Ratio[Prob]
OLS RES(-1)	.13580	.064589	2.1025[.037]
OLS RES(-2)	-.090456	.065365	-1.3839[.168]
OLS RES(-3)	.037360	.065358	.57162[.568]
OLS RES(-4)	.022721	.064928	.34995[.727]
OLS RES(-5)	.045754	.065236	.70137[.484]
OLS RES(-6)	.010260	.065393	.15689[.875]
OLS RES(-7)	-.015847	.065476	-.24202[.809]
OLS RES(-8)	.019531	.065426	.29851[.766]
OLS RES(-9)	.12291	.065415	1.8790[.061]
OLS RES(-10)	-.099183	.065921	-1.5046[.134]
OLS RES(-11)	-.021814	.066017	-.33043[.741]
OLS RES(-12)	-.055759	.065396	-.85263[.395]

****

Lagrange Multiplier Statistic   CHSQ(12)= 13.7468[.317]

F Statistic   F(12,239)=   1.1492[.321]

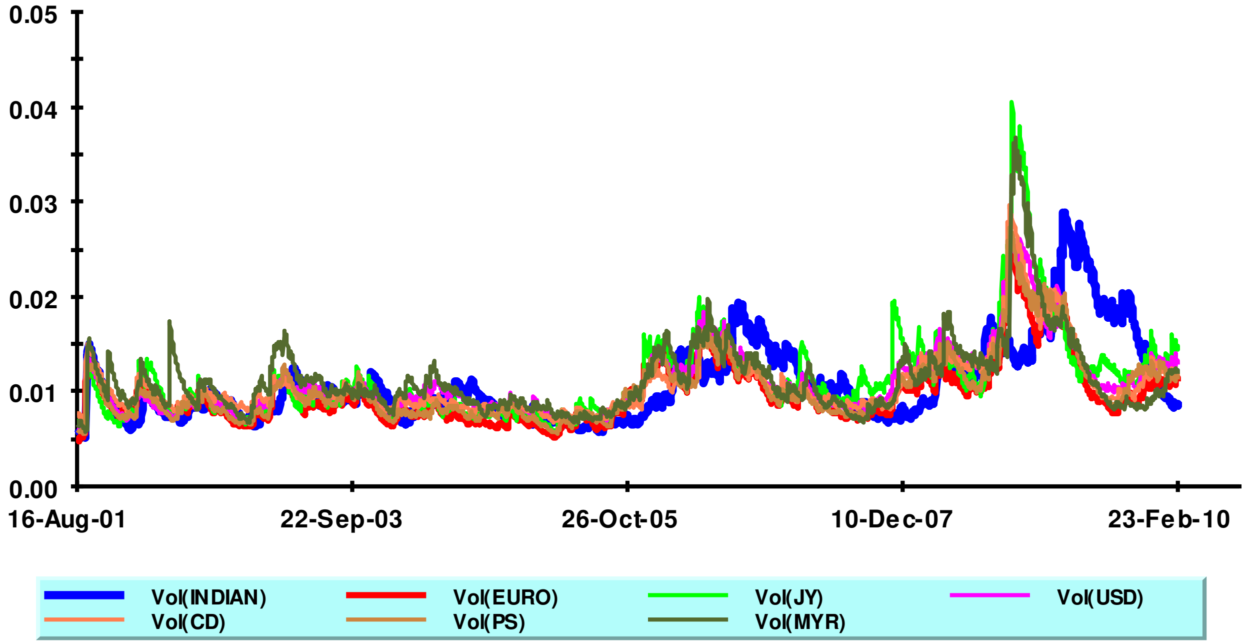
****

U-Hat denotes the probability integral transform.

Under the null hypothesis, U-Hat should not display any serial correlation.

****

Plot of conditional volatilities and correlations



Plot of conditional volatilities and correlations