Groupwork Assignment Submission 2 M5

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Volatility Analysis

When variances change over time then it's difficult to model time series with traditional methods. This condition is called heteroskedasticity, meaning variance is congested together at some parts of the series and sparse in other parts. Time series especially the financial kind has heteroskedasticity as when the market sees large movement the market players tend to go into panic mode and start closing their position causing it to fluctuate even more.

In this report we will discuss a GARCH model for forecasting Apple stock from January 2018 to december 2019. We used ACF and PACF plot to check the autocorrelation of the lag values. Also for better visuals we defined a function to plot the time series and ACF and PACF plot called tsplot. First we checked which ARIMA model will best fit our time series. We found that AIC is lowest when order is (4,0,4). So, We have taken ARIMA(4,0,4) as the best fitted model.

But the residue of the ARIMA model shows correlation among lag terms which is more visible when we plot the square of the residue and take ACF and PACF plot of the square. So, the ARIMA model doesn't describe all the noise in the series. Because the series has conditional heteroskedasticity. So, we now fitted a GARCH(4,0,4) as its already stationary series. Then we forecasted the result with one step into the future.

Multivariate Analysis

Calculate the equilibrium FX for your local currency and do the following:
1. Describe the economic theories and models used to calculate equilibrium FX.
2. Indicate macroeconomic variables used to determine the equilibrium FX.
3. Explain the connection between linear regression and Vector Error Correction (VEC).
4. Calculate the equilibrium FX using VEC and comment all your results. You may use the Behavioral Equilibrium Exchange Rate (BEER) approach.

Economic theories and models used to calculate equilibrium FX

Foreign exchange market is like any other market in that there is something being sold and bought. As in any market, the foreign exchange market will be in equilibrium when the quantity supplied of a currency is equal to the quantity demanded of a currency. If the market has a surplus or a shortage, the exchange rate will adjust until an equilibrium is achieved. There are several models used to calculate equilibrium FX that each of them has different

theoretical assumptions and is appropriate for different time horizons (short/ medium/ long run). For example,

- UIP model (short run): The expected change in the exchange rate determined by interest differentials.
- PPP model (long run): The adjustment needed on the exchange rate between countries in order for the exchange to be equivalent to each currency's purchasing power.
- BEERs (short run): Real UIP with a risk premia and/or expected future movements in real exchange rates determined by fundamentals.
- FEERs (medium run): Real exchange rate compatible with both internal and external balance. Flow not full stock equilibrium.

Macroeconomic variables used to determine the equilibrium FX

- **Interest rates:** the global capital enjoys perfect mobility and that it will immediately take advantage of any interest rate differentials. A situation which is known as 'Covered Interest Rate Arbitrage'. First speculated by Keynes in the infamous "A tract on monetary reform" (Keynes, 1924), it is stipulated that investors will arbitrage interest rate differentials between countries to generate returns as these are closely related to interest rates, leading to short term capital flows and FX volatility.
- **Inflation:** Inflation, measured by Consumer Price Index, means the increase in the general price level of goods and services in an economy. The price rise leads to the depreciation of home currency in international parlance. Given the close relationship between interest rates and inflation, the effects discussed above suggest inflation has a material effect on currency valuation. Many studies model inflation and exchange rate targets in determination of emerging and established economy pricing stability and CPI (Engel, 2006).
- **Price of Bonds:** Any change in the economic conditions of a country will have a direct impact on the demand and supply for the domestic and the foreign bond. This shift in the demand/supply for bonds will in turn influence the exchange rate between the domestic and foreign economies. Bond Pricing discrepancies may come about via creditworthiness and default concerns which will closely interlink with currency valuation, one needs to look as far as Russian and Argentinian bond defaults of 1998 and 2001 respectively and the subsequent Currency devaluations (Aitor, 2012).
- **Balance of payments (BOP):** BOP is an indicator of outflow and inflow of foreign currencies which is occurred by international trade and services. It determines the foreign exchange reserves available in a country. Changes in a country's national income affect the country's current account. Consequently, the exchange rate is adjusting in a new level in order to achieve a new balance of payments equilibrium.
- **Monetary Policies of two countries**: The policies determine their currency exchange rate. The Monetary Approach uses two dynamics to determine an exchange rate, the price dynamics and the interest rates dynamics. A change in the domestic money supply leads to a change in the level of prices and a change in the level of prices leads to a change in the exchange rate. Relating this back to inflation rate and Keynes' paper it is conclusive that interest rate and monetary supply decision have a material impact on exchange rates, a 2005 paper concluded "On average, an unanticipated tightening of 25 basis points is found to appreciate the exchange rate by around 0.35 per cent" (Kearns, 2005).

Connection between linear regression and Vector Error Correction (VEC)

The VAR model describes the interrelationship among stationary variables, implementing linear regression, or time series analysis, to forecast or model relationships, as presented previously stationarity can be achieved via lags and differentials.

Vector Error Correction may also be implemented, it is another means of modelling irrespective of achieving stationarity, a special case VAR model for variables with stationarity in their difference I(1), or cointegration (LearnEconometrics, 2017). VEC integrates cointegration relationships among variables for calculation, as shown below the simple two variable cointegrated equation:

$$y_{2,t} = \beta y_{1,t}$$

Would have a corresponding VEC model:

$$\Delta y_{1,t} = \alpha_1(y_{2,t-1} - \beta y_{1,t-1}) + \epsilon_{1,t}$$
$$\Delta y_{2,t} = \alpha_2(y_{2,t-1} - \beta y_{1,t-1}) + \epsilon_{2,t}$$

In simpler terms VEC is a restricted VAR modelling method designed for nonstationary series that is known to be cointegrated (Hauser, 2018).

In this sense Vector Error Correction Models implement nonstationary time series data, whereby some linear regression combinations of the individual non-stationary series are in fact stationary, this being the cointegration shown above.

References

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