Relationship between oil price and gross fixed capital formation: Malaysian case

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Abstract:

The aim of this paper is to investigate the lead-lag relation between oil price and gross fixed capital formation in an economy incorporating some other relevant macroeconomic variables such as, money supply and exchange rate. The standard time series techniques are used for the analysis. Malaysia is taken as a case study. The variables are bound together by a theoretical relation as evidenced in their being cointegrated. The generalized variance decomposition analysis tends to indicate that oil price is the most exogenous variable leading all other variables including gross fixed capital formation. The findings contain strong policy implications for the emerging economies like Malaysia.

Keywords: oil price, gross fixed capital formation, VECM, VDC, Malaysia

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1. Introduction

Oil is seen as both a bane and/or a boon to nations. This paper tries to explore the relationship (if any) with a few economic variables specifically with Malaysia's Gross Domestic Capital Formation (GDCF), Broad Money (M2) and the USD: MYR Rate of Exchange. This remains an humble attempt to move away from focusing on the often cited GDP measure that incorporates other chunks that make up the standard aggregate demand function namely consumption (public/private) and net exports. Linking this to money supply and the exchange rate addresses albeit in a "sweeping" manner the "money" sector of the economy. The shift from GDP is mainly to address largely financing/investment decision making of private enterprises which "intuitively" may differ from "individual" decision making.

In an environment where oil is seen as a dwindling resource, where development of alternative energy supply goes through peaks and troughs it is safe to opine that high oil prices relative to historical prices is a permanent feature in the global economy.

Thus there is continuing relevance to analyze the effects of the price of oil on various countries, on aspects of the economy in the search for long-term policy responses to this phenomenon.

2. Literature Review

There are numerous studies done on the subject of oil price impact on the economy as per Darby (1982), Burbidge and Harrison (1984), Gisser and Goodwin (1986), Lee, Ni and Ratti (1995) just to name a few. These studies focused on select countries and carried different emphasis thus drawing different conclusions.

Conclusions remain representative of differing opinions, uncertainties governing attempts to apply the rigors of the physical sciences to a human phenomenon. Thus there remains a spectrum of conclusions supported by data that reveal that oil prices may, may not and to what extent (if any) it influences economic growth.

Gross fixed capital formation as a subset of GDP dates back to the Kuznets's study on capital formation in the 1930s measuring the value of acquisitions of new or existing fixed assets by the business sector, governments and "pure" households (excluding their unincorporated enterprises) less disposals of fixed assets.

The emphasis here is on the business sector entailing the modern corporation as publicly traded entities. Managers are tasked at maximizing shareholders' value (the present value of the discounted cash flow from a given investment). Fama:(1965) who developed the Efficient Market Hypothesis (EMH) points to investors being able to correctly price the value of firms. These theorems have been subjected to theoretical and empirical analysis, accepted, rejected or modified although never fully discarded.

Intuitively therefore managerial decision making and arguably governmental decision making on allocating capital for acquisition and disposal of physical/fixed assets are more sophisticated compared to individual decision making in terms of investment.

3. Methodology

Data Set and Treatment

For the analysis, annual data for 40 years starting from 1971 was obtained from the World Bank website. All data were transformed by taking their logarithms. The variables chosen were: Gross Fixed Capital Formation (CF), Broad Money (M2), Crude Oil Price (OIL) and USD: MYR exchange rate (FX).

Cointegration Test

The above test applied to time series study is to determine the stationarity or non-stationarity of the variables under consideration. A variable is said to be integrated of order n, if it requires differencing n times to achieve stationarity. Therefore variables are cointegrated if they are non-stationary integrated of the same order and yet their linear combination is stationary.

The presence of cointegration implies that variables do not drift away from each other arbitrarily. Any deviation from the long run relationship will result in some other variables adjusting similarly to the long run path. Cointegration test provides information on the long run relationship among the variables it also entails theoretical relevance in.

The augmented Dickey-Fuller (ADF) test was used to determine the variables' stationarity properties or integration order. We test for stationarity or non-stationarity of each variable in their original and differenced form. We made sure that the level variable form is non-stationary and the differenced variable is stationary before proceeding to determine the lag order of the variables.

Long-Run Structural Modelling (LRSM)

After determining the number of lags and cointegrating relationship, LRSM is utilized to estimate theoretically meaningful long-run (or cointegrating) relations. We impose restrictions and over identifying it to see the relations of the variables based on theories.

Vector Error-Correction Modelling (VECM)

VECM identifies variables as either endogenous or exogenous in the long run. If the error correction coefficient in any equation is insignificant, the corresponding dependent variable of that equation is "exogenous". But if the coefficient is significant, it implies that the corresponding dependent variable is "endogenous". The size of the coefficient of the error correction term indicates the spread of a short term adjustment to bring about long term equilibrium and it represents the proportion by which the disequilibrium in the dependent variable is being corrected in each short period.

Variance Decompositions (VDCs)

VDC test for how relative endogeneity or exogeneity of the variables are. It decomposes the variance of the forecast error of a particular variable into proportions attributable to shocks in each variable in the system including its own. The relative endogeneity or exogeneity of a variable can be determined by the proportion of the variance explained by its own past shocks. The variable which is explained mostly by its own shocks is deemed to be the most exogenous of all variables. The variable that have a lot of decomposed proportions in other variables are said to be endogenous.

Impulse Response Functions (IRFs)

The Impulse response function is the graphical representation of information contained in the VDCs. The IRFs essentially map out the dynamic response of a variable owing to one period standard deviation shock to another variable.

Persistence Profiles

Persistence Profiles (PFs) maps out the dynamic response of the cointegrating vectors in the long run. The Persistent Profile traces out the effects of a system wide shock on the long run relations between the variables. We may ascertain the periods required for equilibrium after the whole system has been shocked.

4. Analysis and Findings

Step 1: Testing for stationarity/non-stationarity

The variables utilized were Gross Domestic Fixed Capital Formation (CF), Broad Money supply (M2), USD: MYR Exchange Rate (FX) and Crude Oil Price (OIL). The 'log' of the 'level' form of the variables and the 'first difference' of the log of the variables follows.

Log of level form variables:

LCF = log (CF); LM2 = log (M2); LFX = log (FX); LOIL = log(OIL);

First Difference of log level form variables:

DCF = LCF - LCF (-1); DLM2 = LM2 – LM2 (-1);

DLFX = LFX - LFX (-1); DOIL = LOIL - LOIL (-1);

The Augmented Dickey-Fuller (ADF) test was applied to the above; the 'calculated' estimates were compared against the 'critical' statistic values. The results of the ADF test have been summarized as per the below table.

Variable	Description (log)	Result
LCF	Gross Fixed Capital Formation	non-stationary
DLCF	1st. Diff. Gross Fixed Capital Formation	Stationary
LFX	USD:MYR Exchange Rate	non-stationary

DFX	1st. Diff. USD:MYR Exchange Rate	Stationary
LM2	Broad Money (M2)	non-stationary
DLM2	1st. Diff. Broad Money (M2)	Stationary
LOIL	Crude Oil Price	Stationary
DLOIL	1st. Diff. Crude Oil Price	Stationary

All the log level form variables are non-stationary and the first differenced log form are stationary.

Step 2: Determination of the order (or lags) of the VAR model

The inputs to determine the order of lags are as follows:

DCF & CONS DOIL DLM2 DLFX

We chose var (2) as the order of lags since the SBC criterion shows that var (2) has the highest value. Results are as the below.

```
Based on 33 observations from    8 to   40. Order of VAR = 6
 List of variables included in the unrestricted VAR:
 DCF
 List of deterministic and/or exogenous variables:
 CONS            DLM2            DLFX            DLOIL
*******************************************************************************
 Order    LL        AIC      SBC            LR test         Adjusted LR test
   6    33.8436   23.8436   16.3611                ------             ------
   5    33.7138   24.7138   17.9795  CHSQ(  1)=   .25967[.610]    .18098[.671]
   4    33.2883   25.2883   19.3022  CHSQ(  2)=   1.1107[.574]    .77416[.679]
   3    30.7791   23.7791   18.5413  CHSQ(  3)=   6.1291[.105]    4.2718[.234]
   2    30.5001   24.5001   20.0106  CHSQ(  4)=   6.6871[.153]    4.6607[.324]
   1    27.9356   22.9356   19.1943  CHSQ(  5)=  11.8160[.037]    8.2354[.144]
   0    23.4983   19.4983   16.5053  CHSQ(  6)=  20.6906[.002]   14.4208[.025]
*******************************************************************************
 AIC=Akaike Information Criterion     SBC=Schwarz Bayesian Criterion
```

Step 3: Testing cointegration

This determines the value of cointegrating relationship of the current model. We use 'multivariate' with var (2) to get the results based on 'eigen values' and the 'trace' statistics to determine the value of r (cointegrating relationship). If r = 0 is accepted, there is no cointegration among the variables. If r = 0 is rejected, there is cointegration among the variables.

The result below shows that maximized LL prefers r = 3, AIC prefers r = 2, SBC prefers r = 1 and HQC prefers r =2. We choose r =1 as the number of cointegrating vectors based on intuition.

```
   Cointegration with unrestricted intercepts and restricted trends in the VAR
   Cointegration LR Test Based on Maximal Eigenvalue of the Stochastic Matrix
*******************************************************************************
 38 observations from    3 to   40. Order of VAR = 2.
 List of variables included in the cointegrating vector:
 LCF            LM2            LFX            Trend
 List of I(0) variables included in the VAR:
 LOIL
 List of eigenvalues in descending order:
.51006     .25100    .052311      .0000
*******************************************************************************
 Null    Alternative    Statistic     95% Critical Value     90%Critical Value
 r = 0      r = 1        27.1121           25.4200               23.1000
 r<= 1      r = 2        10.9827           19.2200               17.1800
 r<= 2      r = 3         2.0417           12.3900               10.5500
```

```
******************************************************************************
 Use the above table to determine r (the number of cointegrating vectors).


   Cointegration with unrestricted intercepts and restricted trends in the VAR
         Cointegration LR Test Based on Trace of the Stochastic Matrix
******************************************************************************
 38 observations from    3 to   40. Order of VAR = 2.
 List of variables included in the cointegrating vector:
 LCF             LM2             LFX             Trend
 List of I(0) variables included in the VAR:
 LOIL
 List of eigenvalues in descending order:
.51006     .25100    .052311      .0000
******************************************************************************
 Null    Alternative    Statistic     95% Critical Value     90%Critical Value
 r = 0      r>= 1        40.1365           42.3400                39.3400
 r<= 1      r>= 2        13.0244           25.7700                23.0800
 r<= 2      r = 3         2.0417           12.3900                10.5500
******************************************************************************
 Use the above table to determine r (the number of cointegrating vectors).

  Cointegration with unrestricted intercepts and restricted trends in the VAR
Choice of the Number of Cointegrating Relations Using Model Selection Criteria
******************************************************************************
 38 observations from    3 to   40. Order of VAR = 2.
 List of variables included in the cointegrating vector:
 LCF             LM2             LFX             Trend
 List of I(0) variables included in the VAR:
 LOIL
 List of eigenvalues in descending order:
.51006     .25100    .052311      .0000
******************************************************************************
 Rank      Maximized LL        AIC             SBC             HQC
 r = 0       140.0704       125.0704        112.7885        120.7006
 r = 1       153.6265       132.6265        115.4318        126.5087
 r = 2       159.1178       134.1178        113.6480        126.8348
 r = 3       160.1387       133.1387        111.0313        125.2730
```

Step 4: Long Run Structural Modeling (LRSM)

The LRSM endeavors to estimate theoretically meaningful long-run (or cointegrating) relations by imposing on those long-run relations (and then testing) both identifying and over-identifying restrictions based on theories and information of the economies under review. The restriction applied was A1 = 1

```
ML estimates subject to exactly identifying restriction(s)
      Estimates of Restricted Cointegrating Relations (SE's in Brackets)
                         Converged after 2 iterations
  Cointegration with unrestricted intercepts and restricted trends in the VAR
******************************************************************************
 39 observations from    2 to   40. Order of VAR = 1, chosen r =1.
 List of variables included in the cointegrating vector:
 LCF             LM2             LFX             LOIL            Trend
******************************************************************************
```

```
 List of imposed restriction(s) on cointegrating vectors:
 A1=1
*******************************************************************************
                  Vector  1
 LCF                 1.0000
                  (   *NONE*)

 LM2                -2.7039          2.93     (SIGNIFICANT)
                  (   .92046)

 LFX                -.37841          0.3539   (INSIGNIFICANT)
                  (   1.0398)

 LOIL                .15680          1.185    (INSIGNIFICANT)
                  (   .13235)

 Trend               .25182
                  (   .12624)

*******************************************************************************
 LL subject to exactly identifying restrictions= 136.4934
*******************************************************************************
```

The result of identifying restriction to the co-integration equation or linear combination equation at this stage can be as follows:

vector 1

$LCF_t - 2.7039\ LM2_t - 0.37841\ LFX_t + 0.15680\ LOIL_t - \sim I(0)$

(0.92046) (1.0398) (0.13235)

where values in parenthesis are the standard deviation.

Over identifying restrictions as follows:

A1 = 0; A2=0; A4=0

```
ML estimates subject to over identifying restriction(s)
      Estimates of Restricted Cointegrating Relations (SE's in Brackets)
                         Converged after 19 iterations
  Cointegration with unrestricted intercepts and restricted trends in the VAR
*******************************************************************************
 39 observations from    2 to   40. Order of VAR = 1, chosen r =1.
 List of variables included in the cointegrating vector:
 LCF             LM2             LFX             LOIL            Trend
*******************************************************************************
 List of imposed restriction(s) on cointegrating vectors:
 A1=1; A2 = 0; A4 = 0
*******************************************************************************
                  Vector  1
 LCF                 1.0000
                  (   *NONE*)

 LM2                -.0000
                  (   *NONE*)

 LFX                -2.3282
                  (   3.0744)
```

```
 LOIL                  .0000
                 (   *NONE*)

 Trend               -.070302
                 (  .037673)

*******************************************************************************
 LR Test of Restrictions          CHSQ( 2)=   5.5256[.063]
 DF=Total no of restrictions(3) - no of just-identifying restrictions(1)
 LL subject to exactly identifying restrictions= 136.4934
 LL subject to over-identifying restrictions= 133.7306
*******************************************************************************
```

The co-integration equation or linear combination equation with the over identifying restrictions at this stage can be as follows:

vector 1

where values in parenthesis are the standard deviation.

$LCF_t - 2.3282\ LFX_t \sim I(0)$

(3.0744)

Step 5: Vector Error Correction Model (VECM)

The fifth step in the Time-Series techniques is the VECM. In this test, if the error-correction coefficient is insignificant, the corresponding dependent variable is ‘exogenous’. But if that coefficient is significant, that implies that the corresponding dependent variable is ‘endogenous’.

The results for this test as follows.

```
ECM for variable LCF estimated by OLS based on cointegrating VAR(1)
*******************************************************************************
 Dependent variable is dLCF
 39 observations used for estimation from    2 to   40
*******************************************************************************
 Regressor             Coefficient       Standard Error         T-Ratio[Prob]
 Intercept                 1.4917            1.0579              1.4101[.167]
 ecm1(-1)                -.065055            .049504            -1.3141[.197]
*******************************************************************************
 List of additional temporary variables created:
 dLCF = LCF-LCF(-1)
 ecm1 =    1.0000*LCF      0.00*LM2   -1.5533*LFX +   .10720*LOIL  -.082469*Tr
end
*******************************************************************************
 R-Squared                    .044592   R-Bar-Squared                    .018771
 S.E. of Regression            .15652   F-stat.    F(  1,  37)    1.7269[.197]
 Mean of Dependent Variable    .10194   S.D. of Dependent Variable       .15801
 Residual Sum of Squares       .90649   Equation Log-likelihood         18.0154
 Akaike Info. Criterion       16.0154   Schwarz Bayesian Criterion      14.3518
 DW-statistic                  1.2279   System Log-likelihood          133.7695
*******************************************************************************


                               Diagnostic Tests
*******************************************************************************
*    Test Statistics  *        LM Version        *         F Version          *
*******************************************************************************
*                     *                          *                            *
* A:Serial Correlation*CHSQ(   1)=   7.1493[.007]*F(   1,  36)=   8.0807[.007]*
*                     *                          *                            *
* B:Functional Form   *CHSQ(   1)=  .065400[.798]*F(   1,  36)=  .060471[.807]*
*                     *                          *                            *
* C:Normality         *CHSQ(   2)=  11.9518[.003]*       Not applicable       *
*                     *                          *                            *
* D:Heteroscedasticity*CHSQ(   1)=   1.8097[.179]*F(   1,  37)=   1.8004[.188]*
*******************************************************************************
   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

ECM for variable LM2 estimated by OLS based on cointegrating VAR(1)
*******************************************************************************
 Dependent variable is dLM2
 39 observations used for estimation from    2 to   40
*******************************************************************************
 Regressor             Coefficient       Standard Error         T-Ratio[Prob]
 Intercept                 .27189            .43442              .62588[.535]
 ecm1(-1)               -.0062155            .020330            -.30574[.762]
*******************************************************************************
 List of additional temporary variables created:
 dLM2 = LM2-LM2(-1)
 ecm1 =    1.0000*LCF      0.00*LM2   -1.5533*LFX +   .10720*LOIL  -.082469*Tr
end
*******************************************************************************
 R-Squared                   .0025200   R-Bar-Squared                   -.024439
 S.E. of Regression           .064279   F-stat.    F(  1,  37)   .093476[.762]
 Mean of Dependent Variable    .13911   S.D. of Dependent Variable      .063507
 Residual Sum of Squares       .15287   Equation Log-likelihood         52.7246
 Akaike Info. Criterion       50.7246   Schwarz Bayesian Criterion      49.0610
 DW-statistic                  1.1387   System Log-likelihood          133.7695
*******************************************************************************


                               Diagnostic Tests
*******************************************************************************
*    Test Statistics  *        LM Version        *         F Version          *
*******************************************************************************
*                     *                          *                            *
* A:Serial Correlation*CHSQ(   1)=   6.8620[.009]*F(   1,  36)=   7.6865[.009]*
*                     *                          *                            *
```

```
* B:Functional Form   *CHSQ(   1)=   4.2628[.039]*F(   1,  36)=   4.4177[.043]*
*                     *                         *                             *
* C:Normality         *CHSQ(   2)=   .71711[.699]*       Not applicable       *
*                     *                         *                             *
* D:Heteroscedasticity*CHSQ(   1)=   .56704[.451]*F(   1,  37)=   .54590[.465]*
*******************************************************************************
   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


ECM for variable LFX estimated by OLS based on cointegrating VAR(1)
*******************************************************************************
 Dependent variable is dLFX
 39 observations used for estimation from    2 to   40
*******************************************************************************
 Regressor              Coefficient       Standard Error         T-Ratio[Prob]
 Intercept                 -1.5328             .42722            -3.5879[.001]
 ecm1(-1)                  .071818            .019993             3.5922[.001]
*******************************************************************************
 List of additional temporary variables created:
 dLFX = LFX-LFX(-1)
 ecm1 =    1.0000*LCF      0.00*LM2   -1.5533*LFX +   .10720*LOIL  -.082469*Tr
end
*******************************************************************************
 R-Squared                     .25858   R-Bar-Squared                   .23854
 S.E. of Regression           .063213   F-stat.    F(  1,  37)   12.9039[.001]
 Mean of Dependent Variable  .0013908   S.D. of Dependent Variable     .072441
 Residual Sum of Squares       .14785   Equation Log-likelihood        53.3763
 Akaike Info. Criterion       51.3763   Schwarz Bayesian Criterion     49.7128
 DW-statistic                  1.6409   System Log-likelihood         133.7695
*******************************************************************************


                               Diagnostic Tests
*******************************************************************************
*    Test Statistics  *        LM Version        *         F Version          *
*******************************************************************************
*                     *                         *                             *
* A:Serial Correlation*CHSQ(   1)=   1.2809[.258]*F(   1,  36)=   1.2225[.276]*
*                     *                         *                             *
* B:Functional Form   *CHSQ(   1)= .0028707[.957]*F(   1,  36)= .0026501[.959]*
*                     *                         *                             *
* C:Normality         *CHSQ(   2)= 147.6700[.000]*       Not applicable       *
*                     *                         *                             *
* D:Heteroscedasticity*CHSQ(   1)=   1.1031[.294]*F(   1,  37)=   1.0770[.306]*
*******************************************************************************
   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


ECM for variable LOIL estimated by OLS based on cointegrating VAR(1)
*******************************************************************************
 Dependent variable is dLOIL
 39 observations used for estimation from    2 to   40
*******************************************************************************
 Regressor              Coefficient       Standard Error         T-Ratio[Prob]
 Intercept                  6.1415             2.0771             2.9567[.005]
 ecm1(-1)                  -.28287            .097203            -2.9101[.006]
*******************************************************************************
 List of additional temporary variables created:
 dLOIL = LOIL-LOIL(-1)
 ecm1 =    1.0000*LCF      0.00*LM2   -1.5533*LFX +   .10720*LOIL  -.082469*Tr
end
*******************************************************************************
 R-Squared                     .18625   R-Bar-Squared                   .16426
```

```
 S.E. of Regression           .30734   F-stat.    F(  1,  37)    8.4686[.006]
 Mean of Dependent Variable   .098596   S.D. of Dependent Variable      .33619
 Residual Sum of Squares       3.4949   Equation Log-likelihood        -8.2996
 Akaike Info. Criterion      -10.2996   Schwarz Bayesian Criterion    -11.9632
 DW-statistic                  2.1499   System Log-likelihood         133.7695
*******************************************************************************


                              Diagnostic Tests
*******************************************************************************
*    Test Statistics  *        LM Version        *         F Version          *
*******************************************************************************
*                     *                          *                            *
* A:Serial Correlation*CHSQ(   1)=   .38164[.537]*F(   1,  36)=   .35577[.555]*
*                     *                          *                            *
* B:Functional Form   *CHSQ(   1)= .0016309[.968]*F(   1,  36)= .0015055[.969]*
*                     *                          *                            *
* C:Normality         *CHSQ(   2)=  35.6226[.000]*       Not applicable       *
*                     *                          *                            *
* D:Heteroscedasticity*CHSQ(   1)=   .39480[.530]*F(   1,  37)=   .37839[.542]*
*******************************************************************************
   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
```

The table summarizes the findings on exogenous/endogenous variables.

ECM(-1) Variable	Description (log)	Result
LCF	Gross Fixed Capital Formation	***exogenous***
LM2	Broad Money	***exogenous***
LFX	USD:MYR exchange rate	***endogenous***
LOIL	Crude Oil Price	***endogenous***

Step 6: Variance Decompositions(VDCs)

The sixth step involves Variance Decomposition. This steps partitions the variance of the forecast errors into proportions attributable to shocks in each variable in the model equation including itself. The relative exogeneity/endogeneity was determined. Looking at the 10th horizon for each variable shocked, the percentage of the proportion can be realized.

ORTHOGONALIZED

TAKING HORIZON = 10

```
Orthogonalized Forecast Error Variance Decomposition for variable LCF
  Cointegration with unrestricted intercepts and restricted trends in the VAR
*******************************************************************************
 39 observations from    2 to   40. Order of VAR = 1, chosen r =1.
 List of variables included in the cointegrating vector:
 LCF             LM2             LFX             LOIL            Trend
*******************************************************************************
 List of imposed restrictions:
 A1=1;
*******************************************************************************
 Horizon    LCF          LM2          LFX          LOIL
   0      1.0000        0.00         0.00         0.00
   1      .99590    .0033428     .2469E-3     .5145E-3
   2      .98989    .0082356     .6084E-3     .0012676
   3      .98374     .013240     .9781E-3     .0020377
   4      .97811     .017833     .0013174     .0027446
   5      .97315     .021866     .0016153     .0033654
   6      .96889     .025340     .0018719     .0039001
   7      .96524     .028308     .0020912     .0043569
   8      .96214     .030839     .0022781     .0047464
   9      .95948     .033000     .0024378     .0050791
  10      .95721     .034851     .0025745     .0053640
*******************************************************************************
```

```
Orthogonalized Forecast Error Variance Decomposition for variable LM2
  Cointegration with unrestricted intercepts and restricted trends in the VAR
*******************************************************************************
 39 observations from    2 to   40. Order of VAR = 1, chosen r =1.
 List of variables included in the cointegrating vector:
 LCF             LM2             LFX             LOIL            Trend
*******************************************************************************
 List of imposed restrictions:
 A1=1;
*******************************************************************************
```

Horizon	LCF	LM2	LFX	LOIL
0	.21328	.78672	0.00	0.00
1	.43368	.55722	.0029480	.0061421
2	.60403	.37406	.0071034	.014800
3	.71279	.25409	.010739	.022374
4	.77856	.17979	.013507	.028140
5	.81853	.13355	.015541	.032380
6	.84350	.10396	.017041	.035505
7	.85963	.084358	.018164	.037845
8	.87043	.070912	.019022	.039632
9	.87791	.061373	.019690	.041024
10	.88326	.054393	.020220	.042128

****

Orthogonalized Forecast Error Variance Decomposition for variable LFX
Cointegration with unrestricted intercepts and restricted trends in the VAR
****
39 observations from 2 to 40. Order of VAR = 1, chosen r =1.
List of variables included in the cointegrating vector:
LCF LM2 LFX LOIL Trend
****
List of imposed restrictions:
A1=1;
****

Horizon	LCF	LM2	LFX	LOIL
0	.30787	.023018	.66911	0.00
1	.32375	.017903	.65826	.8789E-4
2	.33663	.014322	.64881	.2320E-3
3	.34714	.011752	.64072	.3944E-3
4	.35576	.0098615	.63382	.5557E-3
5	.36289	.0084369	.62797	.7069E-3
6	.36883	.0073395	.62299	.8444E-3
7	.37382	.0064766	.61874	.9673E-3
8	.37804	.0057854	.61510	.0010762
9	.38163	.0052223	.61198	.0011722
10	.38471	.0047565	.60928	.0012568

Orthogonalized Forecast Error Variance Decomposition for variable LOIL
Cointegration with unrestricted intercepts and restricted trends in the VAR
****
39 observations from 2 to 40. Order of VAR = 1, chosen r =1.
List of variables included in the cointegrating vector:
LCF LM2 LFX LOIL Trend
****
List of imposed restrictions:
A1=1;
****

Horizon	LCF	LM2	LFX	LOIL
0	.30629	.040751	.016193	.63677
1	.29026	.050210	.015429	.64410
2	.27669	.059028	.014778	.64951
3	.26517	.067053	.014222	.65356
4	.25537	.074247	.013748	.65663
5	.24701	.080637	.013342	.65901
6	.23985	.086284	.012993	.66087
7	.23368	.091261	.012692	.66237
8	.22834	.095647	.012431	.66358
9	.22370	.099514	.012204	.66458
10	.21965	.10293	.012006	.66542

****

Horizon	LCF	LM2	LFX	LOIL	TOTAL
LCF	95.7%	3.4%	0.25%	0.05%	100.0%
LM2	88.3%	5.4%	2.1%	4.2%	100.0%
LFX	38.4%	0.4%	60.9%	0.2%	100.0%
LOIL	21.9%	10.3%	1.3%	66.5%	100.0%

The variable LCF is the target variable however the above does not support this assertion. Similarly this applies to LM2. The variables LFX and LOIL exhibited lower reliance for their exogeneity from its past compared to LCF and LM2.

GENERALIZED

TAKING HORIZON = 10

```
Generalized Forecast Error Variance Decomposition for variable LCF
  Cointegration with unrestricted intercepts and restricted trends in the VAR
*******************************************************************************
 39 observations from    2 to   40. Order of VAR = 1, chosen r =1.
 List of variables included in the cointegrating vector:
 LCF             LM2             LFX             LOIL            Trend
*******************************************************************************
 List of imposed restrictions:
 A1=1;
*******************************************************************************
 Horizon    LCF          LM2          LFX          LOIL
   0     1.00000       .21328       .30787       .30629
   1      .99590       .17992       .30998       .31202
   2      .98989       .15624       .31067       .31545
   3      .98374       .13895       .31070       .31760
   4      .97811       .12602       .31046       .31899
   5      .97315       .11610       .31011       .31993
   6      .96889       .10835       .30973       .32058
   7      .96524       .10218       .30936       .32105
   8      .96214      .097183       .30902       .32140
   9      .95948      .093088       .30871       .32166
  10      .95721      .089686       .30844       .32187
```

Generalized Forecast Error Variance Decomposition for variable LM2

Cointegration with unrestricted intercepts and restricted trends in the VAR

****

39 observations from 2 to 40. Order of VAR = 1, chosen r =1.

List of variables included in the cointegrating vector:

LCF LM2 LFX LOIL Trend

****

List of imposed restrictions:

A1=1;

****

Horizon	LCF	LM2	LFX	LOIL
0	.21328	1.0000	.15274	.18891
1	.43368	.89083	.25625	.31443
2	.60403	.73694	.32685	.39946
3	.71279	.60231	.36700	.44748
4	.77856	.49982	.38842	.47289
5	.81853	.42447	.39968	.48608
6	.84350	.36892	.40556	.49285
7	.85963	.32733	.40859	.49625
8	.87043	.29556	.41009	.49785
9	.87791	.27082	.41076	.49848
10	.88326	.25119	.41097	.49860

****

Generalized Forecast Error Variance Decomposition for variable LFX

Cointegration with unrestricted intercepts and restricted trends in the VAR

****

39 observations from 2 to 40. Order of VAR = 1, chosen r =1.

List of variables included in the cointegrating vector:

LCF LM2 LFX LOIL Trend

****

List of imposed restrictions:

A1=1;

****

Horizon	LCF	LM2	LFX	LOIL
0	.30787	.15274	1.00000	.19518
1	.32375	.14467	.99873	.20270
2	.33663	.13813	.99664	.20872
3	.34714	.13282	.99428	.21357
4	.35576	.12846	.99195	.21751
5	.36289	.12486	.98975	.22075
6	.36883	.12186	.98776	.22344
7	.37382	.11934	.98598	.22569
8	.37804	.11721	.98440	.22758
9	.38163	.11540	.98301	.22919
10	.38471	.11385	.98178	.23057

****

Generalized Forecast Error Variance Decomposition for variable LOIL

Cointegration with unrestricted intercepts and restricted trends in the VAR

****

39 observations from 2 to 40. Order of VAR = 1, chosen r =1.

List of variables included in the cointegrating vector:

LCF LM2 LFX LOIL Trend

****

List of imposed restrictions:

A1=1;

****

Horizon	LCF	LM2	LFX	LOIL
0	.30629	.18891	.19518	1.0000
1	.29026	.19953	.18861	.99856
2	.27669	.20855	.18289	.99601
3	.26517	.21623	.17793	.99295
4	.25537	.22277	.17364	.98974
5	.24701	.22835	.16992	.98659
6	.23985	.23315	.16671	.98360
7	.23368	.23728	.16392	.98084
8	.22834	.24086	.16149	.97832
9	.22370	.24397	.15937	.97604
10	.21965	.24669	.15751	.97399

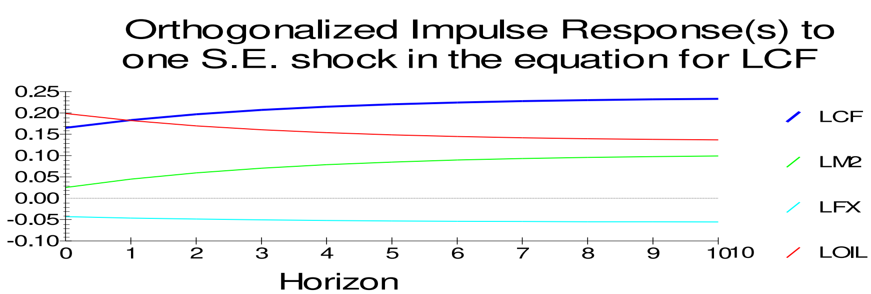
****

The orthogonalized VDCs assume that when a particular variable is shocked, all other variables in the system are switched off but the generalized VDCs do not make such a restrictive assumption. Nevertheless the results for the generalized VDCs do not provide any significant contrast to orthogonalized VDCs results.

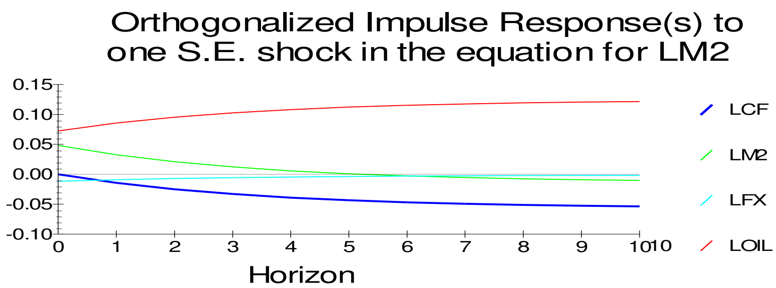
Step 7: Impulse Response Functions(IRFs)

IRFs map the dynamic response path of a variable owing to a one-period standard deviation shock to another variable. The IRFs are normalized such that zero represents the steady-state value of the response variable. The graphs of each variable are as follows:

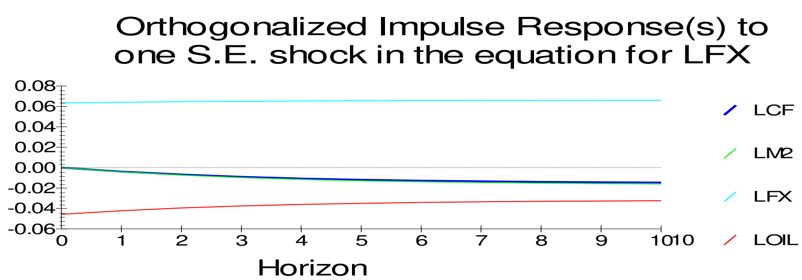
ORTHOGONALIZED:



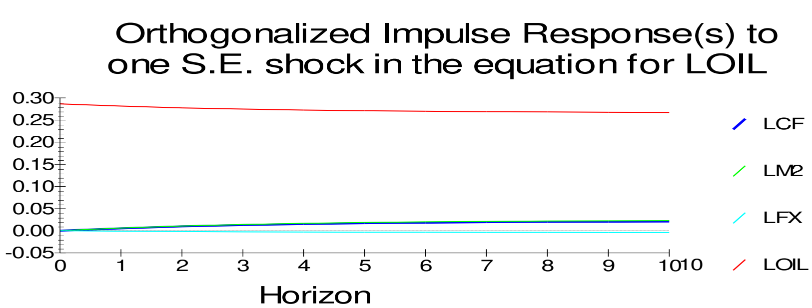
This graph shows the orthogonalized impulse response of other variables when LCF was shocked. The variables LM2 and LOIL responded mildly to the shock whilst LFX's respond was negligible. Thus CF is seen as only mildly responsive to the price of oil and money supply.



This graph shows the orthogonalized impulse response of other variables when LM2 was shocked. LCF and LOIL responded mildly to the shock whilst again LFX's respond remains negligible. Thus LM2 is seen as only mildly responsive to the price of oil and CF.

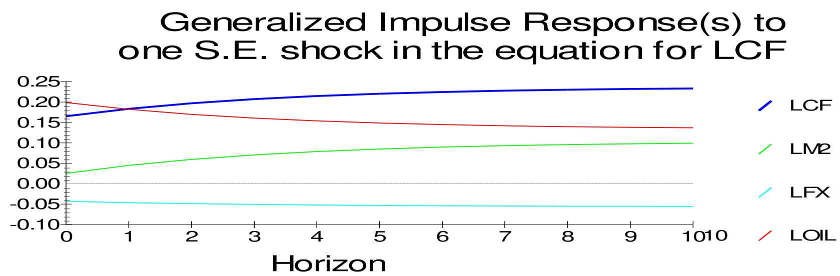


When LFX was shocked all the other variables were mildly responsive.



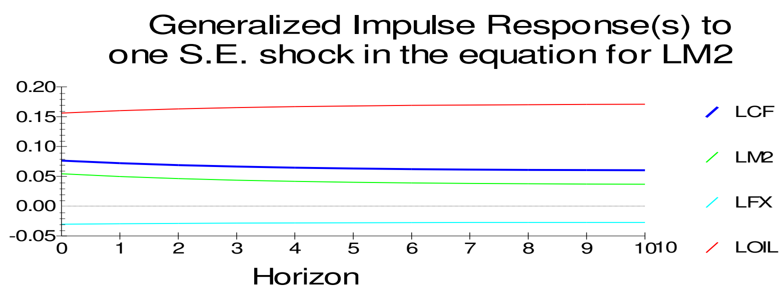
Shocking LOIL lead to LM2 and LCF responding mildly whilst LFX's respond remain negligible. The negligible to mild respond is seen to counter-intuitive.

GENERALIZED:

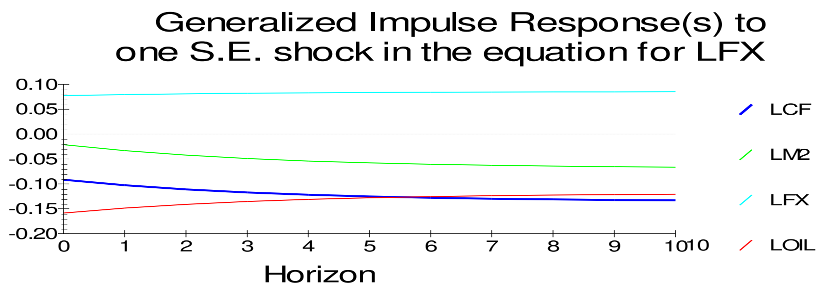


This graph shows the generalized impulse response of other variables

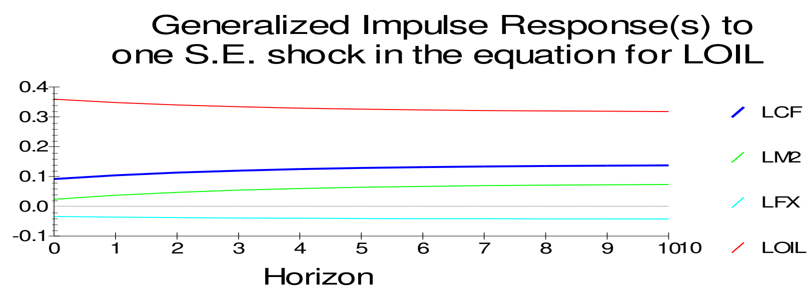
when LCF was shocked. Both LM2 and LOIL responded mildly whilst LFX's respond remain negligible.



This graph shows the generalized impulse response of other variables when LM2 was shocked. Both CF and LOIL responded mildly whilst LFX's respond remain negligible.



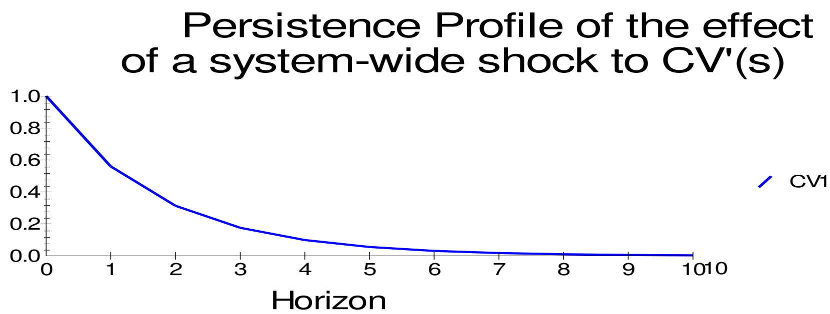
This graph shows the generalized impulse response of other variables when LFX was shocked. All variables responded albeit again mildly.



This graph shows the generalized impulse response of other variables when LOIL was shocked. Both LM2 and CF responded mildly whilst LFX's respond remain negligible.

Step 8: Persistence Profiles (PF)

The Persistent Profile trace out the effects of a system wide shock on the long run relations between the variables. From the graph below, we can see that after the whole system equations has been shocked; it takes about 9 periods for it to come back to its equilibrium.



5. Conclusion

The objective of this study was to examine the relationship of oil prices with gross fixed capital formation serving as "proxy" for investment decision making process pursued largely at business and governments. The cointegration test shows identified one cointegrating relationship equation. This shows that there is an indication of long run theoretical relationship of variables in the system. Although intuitively appealing, the results obtained do not rest well with the intuition thus requiring further research.

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