Problem Set #5

Saharnaz Babaei
saharnaz.babaei@grad.moore.sc.edu

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Elaboration

In this problem set, I use the data from my own paper (Heidari *et al.* (2016)) in which I estimated Markov-Switching model to answer the question how the correlation between oil price and the value added of industry and mine sector of Iran is affected by economic factors. What follows is the implementation of the time series data from estimated correlation between oil price and value added of industry and mine sector in Iran in Heidari *et al.* (2015) along with the required macroeconomic factors based on the literature.

Figure 1 and 2 show that the relationship between imports and the desired correlation seems to be non-linear. Hence, after assessing a linear estimation between variables of interest, I use a non-linear method to the research question. Results for the first linear model is provided in table 1. Where the model is defined as,

$$CORR_t = \beta_0 + \beta_1 GR_t + \beta_2 P_t + \beta_3 REER_t + \beta_4 POIL_t + \beta_5 IM_t + \epsilon_t \tag{1}$$

in which, $CORR$, GR, P, $REER$, IM, and $POIL$ are the dynamic conditional correlation between oil price uncertainty and growth of industry and mine sector in Iran, government expenditures, inflation, real effective exchange rate, total imports and crude oil price respectively.

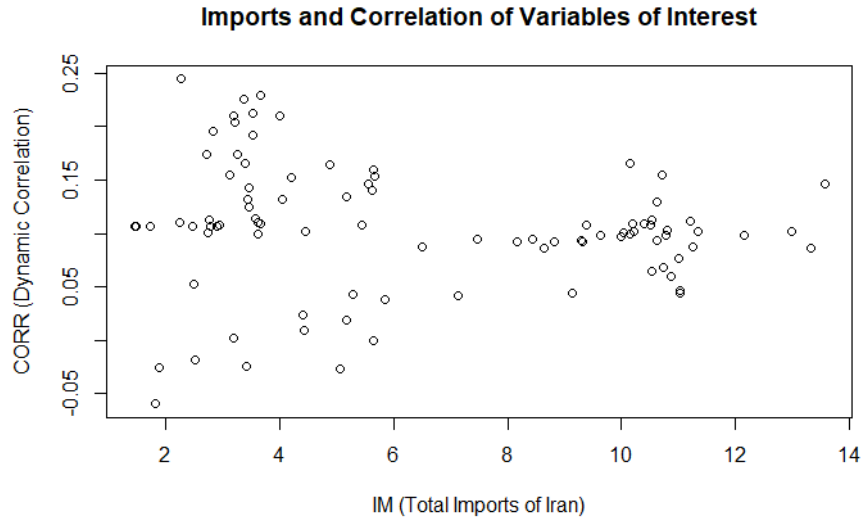

Figure 1: Relationship between total imports and the dynamic correlation of crude oil price and growth of industry and mine sector in Iran

The second linear specification is to separate the imports to capital goods, consumption goods, and intermediate goods and the model is defined as follows:

$$CORR_t = \beta_0 + \beta_1 GR_t + \beta_2 P_t + \beta_3 REER_t + \beta_4 POIL_t + \beta_5 CAPITALG_t + \beta_6 CONSUMPTIONG_t + \beta_7 INTERMEDIAT$$

(2)

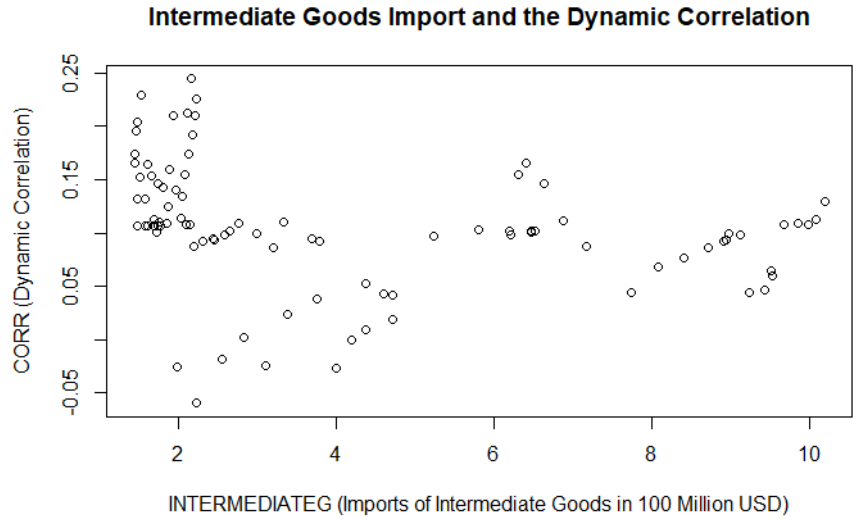

Figure 2: Relationship between imports of intermediate goods and the estimated dynamic conditional correlation

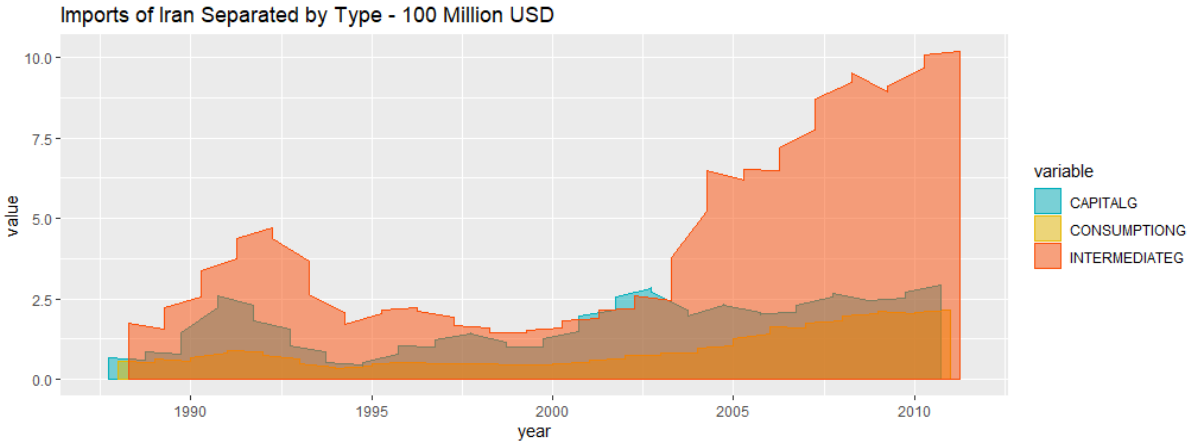

Figure 3: Imports separated by the type: import of capital good, consumption goods, and intermediate goods

The results for this model are provided in table 2. We can see that 100 billion Rials increase in government expenditures, increases the spillover effect of oil price uncertainty to industry and mine sector by 1.7 percent significantly. One unit increase in the inflation increases the contagion effect by %23.9 insignificantly. Capital goods and intermediate goods have significant and negative effect on the correlation between oil price and growth of industry and mine sector in Iran which is inconsistent with theory because – as explained before, imports seem to have a non-linear relationship.

Table 1: OLS estimation for model 1

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	0.0889	0.0224	3.97	0.0002
GR	0.0253	0.0062	4.08	0.0001
P	0.2533	0.1859	1.36	0.1768
REER	-0.0002	0.0001	-2.55	0.0126
POIL	-0.0003	0.0004	-0.71	0.4776
IM	-0.0106	0.0031	-3.36	0.0012

Table 2: OLS estimation for model 2

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	0.1129	0.0235	4.80	0.0000
dataset2$GR	0.0173	0.0048	3.60	0.0005
dataset2$P	0.2388	0.1781	1.34	0.1836
dataset2$REER	-0.0002	0.0001	-2.74	0.0076
dataset2$POIL	0.0004	0.0005	0.70	0.4843
dataset2$CAPITALG	-0.0287	0.0104	-2.76	0.0071
dataset2$CONSUMPTIONG	0.0766	0.0434	1.76	0.0817
dataset2$INTERMEDIATEG	-0.0237	0.0078	-3.05	0.0031

To capture the non-linear relation between the variables of interest, I estimate the Markov-Switching model with two regimes. The results for model 1 and model 2 are provided in table 3 and 4 respectively. The transition probabilities are also provided in these tables indicating that the regimes are stable and they will continue to remain with a probability higher than %90. Comparing these results with my estimations in my paper, I can say that they are not consistent that can be due to the specification; in the paper, my main equation had a linear part depending on oil price and real effective exchange rate that I could not apply it in R estimations for now. And the non-linear part included government expenditure, inflation, and the imports separated by types. The smoothed probability of the regimes for model 1 and model 2 are provided in figures 4 and 5 respectively. ALL AIC, BIC, and log-likelihood criteria improve in the second model indicating that separating total imports to its ingredients provides a better estimation of parameters.

References

Heidari, HASAN, Babaei, BALDERLOU SAHARNAZ, & Ebrahimitorki, MAHYAR. 2016. EFFECTS OF THE IMPORT OF CONSUMPTION, INTERMEDIATE AND CAPITAL GOODS ON TRANSMISSION OF CRUDE OIL PRICE VOLATILITY TO THE INDUSTRY AND MINING SECTOR IN IRAN.

Heidari, Hassan, Ebrahimi Torki, Mahyar, & Babaei Balderlou, Saharnaz. 2015. How Do Different Oil Price Shocks Affect the Relationship Between Oil and Stock Markets?

Table 3: Markov Switching Model 1

```
Markov Switching Model

Call: msmFit(object = model1, k = 2, sw = rep(TRUE, 7))

        AIC       BIC   logLik
  -368.2827 -284.2873 196.1414

Coefficients:

Regime 1
---------
                 Estimate Std. Error t value Pr(>|t|)
(Intercept)(S)     0.2115     0.0192 11.0156  < 2e-16 ***
dataset1$GR(S)    -0.0015     0.0061 -0.2459  0.80576
dataset1$P(S)      0.0112     0.1639  0.0683  0.94555
dataset1$REER(S)  -0.0002     0.0000    -Inf  < 2e-16 ***
dataset1$POIL(S)   0.0001     0.0005  0.2000  0.84148
dataset1$IM(S)    -0.0074     0.0039 -1.8974  0.05778 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.03259304
Multiple R-squared: 0.4818

Standardized Residuals:
          Min            Q1           Med            Q3           Max
-6.335531e-02 -8.309437e-03 -1.797773e-03 -2.066247e-06  6.368433e-02

Regime 2
---------
                 Estimate Std. Error t value  Pr(>|t|)
(Intercept)(S)     0.0509     0.0170  2.9941  0.002753 **
dataset1$GR(S)     0.0223     0.0033  6.7576 1.403e-11 ***
dataset1$P(S)      0.1476     0.1210  1.2198  0.222541
dataset1$REER(S)  -0.0004     0.0001 -4.0000 6.334e-05 ***
dataset1$POIL(S)  -0.0006     0.0001 -6.0000 1.973e-09 ***
dataset1$IM(S)    -0.0008     0.0013 -0.6154  0.538291
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.01552779
Multiple R-squared: 0.8964

Standardized Residuals:
          Min            Q1           Med            Q3           Max
-3.882325e-02 -9.476518e-04  5.484622e-05  5.819832e-03  3.139511e-02

Transition probabilities:
           Regime 1   Regime 2
Regime 1 0.93272267 0.07463911
Regime 2 0.06727733 0.92536089
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Table 4: Markov Switching Model 1

```
Markov Switching Model

Call: msmFit(object = model2, k = 2, sw = rep(TRUE, 9))

        AIC       BIC   logLik
  -391.8498 -279.8559 211.9249

Coefficients:

Regime 1
---------
                          Estimate Std. Error t value  Pr(>|t|)
(Intercept)(S)              0.0870     0.0089  9.7753 < 2.2e-16 ***
dataset2$GR(S)              0.0098     0.0018  5.4444 5.198e-08 ***
dataset2$P(S)              -0.0016     0.0664 -0.0241  0.980773
dataset2$POIL(S)            0.0013     0.0004  3.2500  0.001154 **
dataset2$CAPITALG(S)       -0.0163     0.0033 -4.9394 7.836e-07 ***
dataset2$CONSUMPTIONG(S)   -0.0101     0.0195 -0.5179  0.604528
dataset2$INTERMEDIATEG(S)  -0.0076     0.0019 -4.0000 6.334e-05 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.008675691
Multiple R-squared: 0.7738

Standardized Residuals:
          Min            Q1           Med            Q3           Max
-1.888833e-02 -1.357218e-04  4.158701e-20  1.516913e-03  1.740976e-02

Regime 2
---------
                          Estimate Std. Error  t value Pr(>|t|)
(Intercept)(S)              0.2791     0.0285   9.7930   <2e-16 ***
dataset2$GR(S)              0.0024     0.0050   0.4800   0.6312
dataset2$P(S)              -0.1452     0.1642  -0.8843   0.3765
dataset2$POIL(S)           -0.0005     0.0005  -1.0000   0.3173
dataset2$CAPITALG(S)       -0.0087     0.0121  -0.7190   0.4721
dataset2$CONSUMPTIONG(S)    0.0440     0.0727   0.6052   0.5450
dataset2$INTERMEDIATEG(S)  -0.0095     0.0125  -0.7600   0.4473
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.03125846
Multiple R-squared: 0.841

Standardized Residuals:
         Min           Q1          Med           Q3          Max
-0.064468728 -0.010653479 -0.002042805  0.004207281  0.075164023

Transition probabilities:
          Regime 1  Regime 2
Regime 1 0.8946761 0.0824183
Regime 2 0.1053239 0.9175817
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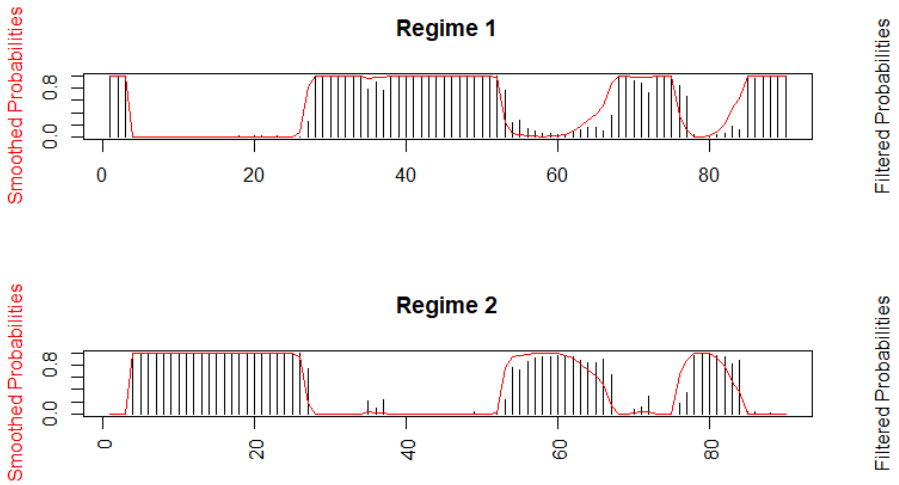

Figure 4: Smoothed transition probabilities for model 1

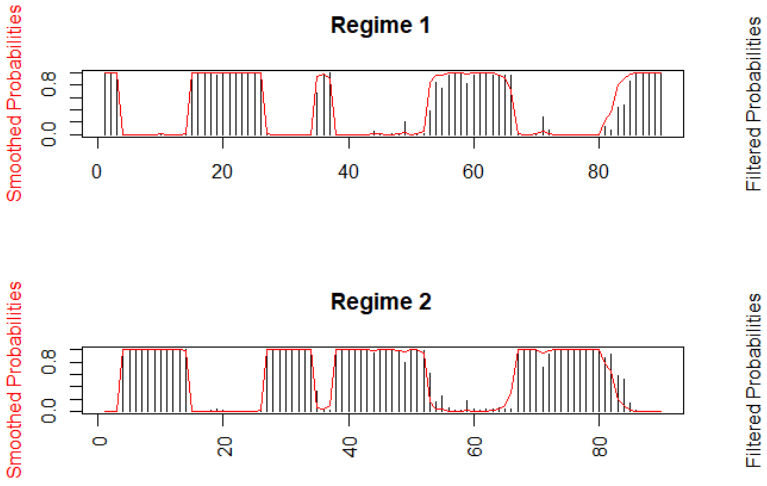

Figure 5: Smoothed transition probabilities for model 2