Available online at www.sciencedirect.com

ScienceDirect

Procedia Economics and Finance 38 (2016) 280 – 286

Procedia Economics and Finance

www.elsevier.com/locate/procedia

Istanbul Conference of Economics and Finance, ICEF 2015, 22-23 October 2015, Istanbul, Turkey

BDI, Gold Price and Economic Growth

Melike Bildirici[a*], Fazıl Kayıkçı[b], Işıl Şahin Onat[c]

[a]*Yildiz Technical University, Department of Economics, Davutpaşa Campus, İstanbul, Turkey*
[b]*Yildiz Technical University, Department of Economics, Davutpaşa Campus, İstanbul, Turkey*
[c] *ING Bank , Risk Management, İstanbul, Turkey*

Abstract

Since its establishment, the Baltic Dry Index has become one of the foremost indicators on the cost of shipping as well as an important barometer on the volume of worldwide trade and manufacturing activity. In this paper, the MSIH(3)-VAR(3) model is selected to analyse the relationship between BDI, Gold prices and economic growth for the United States. The BDI, gold prices and GDP are cointegrated for the United States. The crisis regime tends to last 1 years on average, while Regime 2 is comparatively more persistent with 6.46 years. Finally, Regime 3 which corresponds to high growth tends to last 1.16 years, on average. The crisis regime of the economy is the most persistent regime in the US. Thus, the BDI and gold prices can be used as an indicator of crisis in GDP growth for the United States.

Peer-review under responsibility of the Organizing Committee of ICEF 2015.

Keywords: BDI, Gold prices, Economic Growth, MS-VAR

1. Introduction

Investors are always looking for practical economic indicators they can use to make informed investment decisions. Recently, the Baltic Dry Index has been used as an economic indicator on a global scale. In addition, the BDI depends on the volatility of crude oil prices and port and docking fees which make the BDI sensitive to global demand and manufactured goods (*Economic SYNOPSES). The BDI is a measurement to determine the cost of raw materials around the world such as iron, coal, cement and grain. The average price of 22 different shipping routes around the world is compiled daily to form the Baltic Dry Index. Economic indicators such as unemployment rate, inflation and oil prices can be manipulated or influenced by governments and speculators, however, the Baltic Dry Index is difficult to manipulate because it is driven by clear forces of supply and demand. One of the reasons for the

* Corresponding author. Tel.:+90-212-383-6817
E-mail address:melikebildirici@gmail.com

Peer-review under responsibility of the Organizing Committee of ICEF 2015.
doi:10.1016/S2212-5671(16)30200-3

BDI to be difficult to manipulate and influence is that the number of ships around the world is limited; in order to manipulate and increase the supply, more ships need to be built which would be very costly.

When we look at the composition of the BDI it supplies investors tools and indicators in four different sub-index. Panamax (BPI) in 1998: is calculated according to four available routes for a Panamax dry bulker, each route is calculated with the same weight (25%). Capesize (BCI) in 1999: is according to shipping costs of 10 available route for Capesize dry bulker in which each route is weighted based on its importance against to nine others. Handysize (BHSI) / Handymax Index (BHMI) in 2000: Handysize carries up to 60.000 tons. There are 2000 unit in service totally about 43 million tons. They are flexible because their size allow them to enter smaller ports. Handysize and Handymax differ by capacity and size of the cargo. Supramax (BSI) in 2005: vessels have three voyage charter and six trip charter routes, but the Baltic Supramax Index (BSI) has only six trip charter routes.

After economic recessions and during economic growth, demand for raw materials increases as production and investment also increase. As a result, transportation volume grows accordingly. On the other hand, during economic slowdowns, demand for raw material decreases which creates utilized capacity (Oomen, 2012). Global factors also play an important role in the supply and demand of the BDI. The BDI and global markets have common economic and financial movement due to market supply and demand which is a result of turmoil and crises. Iron ore, coal, phosphate, grain and alumina are the main goods of dry bulk transportation. These goods are mostly from the construction and energy sector. Moreover, the freight rate is determined by raw material demand as transportation needs continue to remain the same.

In this sense, our work is related to, among others, Korajczyk and Viallet (1989), Cutler, Poterba, and Summers (1991), Harvey (1991, 1995), Bekaert and Hodrick (1992), Campbell and Hamao (1992), Ferson and Harvey (1993), Heston and Rowenhorst (1994), Bekaert and Harvey (1995), Dumas and Solnik (1995), De Santis and Gerard (1997), Fama and French (1998), Griffin and Karolyi (1998), Rowenhorst (1998), Bossaerts and Hillion (1999), Jorion and Goetzmann (1999), Rangvid (2006), Guidolin and Timmermann (2008), Bekaert, Hodrick, and Zhang (2009), Pakthuanthong and Roll (2009), Rapach, Strauss, and Zhou (2009), Hjalmarsson (2010), and Henkel, Martin, and Nardari (2010).

In addition to this BDI and/or Gold prices relationship with economic condition had investigated; Sarac, Zeren and Basar (2015) analysed the relationship between the global gold price changes and the U.S. Supplemental Nutrition Assistance Program (SNAP) Expenditures, along with Baltic Dry Index (BDI). Based on the ARDL Bounds cointegration analysis indicates that the global gold prices are significantly and positively related with SNAP expenditures both in short and long term, while it is positively yet much less significantly related with BDI only in the short term. Toda-Yamamoto Test indicates one-way causality from SNAP to gold prices. Toraman, Basarir and Bayramoglu (2011) studied which is to determine factors affecting the gold prices. They used MGARCH (Multivariate GARCH) model and CCC (Constant Conditional Correlations). According to their emprical findings, highest correlation is found between gold prices and USA exchange rate negatively and they found a positive correlation between gold prices and oil prices. Koutsoyiannis (1983) studied the gold prices were affected by the USA economy. Gold prices is expressed in US dollars and raw oil prices are quoted in US dollars. He found a negative relationship between US dollar and gold prices.

Gold is a precious metal which is used both as a property and as a financial asset. Importance of gold from past to present, increasing its value and the area of usage. Gold was the fundemantal of the monetary policy system in the past and then became a reserve tool pegged to Dolar following the Bretton Woods. Gold is reliable in politically and economically uncertain environments. Gold has become a major element of international reserve assets for countries.Demand of gold tends to increase in the recent years, after the financial crises and individuals need for more secure investment tools. Consequently, price of gold boomed once again under this condition.

This study aim which may be found relationship between gold prices and BDI affected on US GDP. In this paper, the MS-VAR model is selected to analyse the relationship between the BDI and economic growth for the United

States. Although this study can be defined as complementary to previous empirical papers, it differs from the existing literature in some aspects. Firstly, to distinguish it from previous works, it employs the Markov Switching VAR method. Secondly, it uses Markov Switching Granger Causality analysis. The MS-Granger Causality approach allows analysis of Granger Causality in different regimes of a business cycle.

1. Data

In this study, the relationship between BDI (BDI=ln(bdit/bdit-1), Gold Prices (Gold=ln(Goldt/Goldt-1) and economic growth (Y=ln(GDPt/GDPt-1) is investigated by MS-VAR method. The BDI , Gold and GDP are subject to log transformation based on ln(BDI), ln(Gold) and ln (GDP) with first differenced after unit root analysis. The data first transformed and first differences are denoted. Quarterly data covers the period of 1985(1)–2015(3) for the United States. The data is taken from Bloomberg.

2. Methodology

2.1. MS-VAR Method

Hamilton (1989) proposed a simple nonlinear framework for modeling economic time series with a permanent component and a cyclical component as an alternative to a stationary linear autoregressive model. Clements and Krolzig (2002), Holmes and Wang (2003), Cologni and Manera (2006) and Bildirici, Alp and Bakırtaş (2011) used the MS-AR and MS-VAR models to test the impact of oil shock on GDP. Falahi (2011) and Bildirici (2012 a, b) used the MS-VAR model for analysis of the relationship between energy consumption and economic growth.

MSI(.)-VAR(.) model is $$y_t = \mu(s_t) + \sum_{k=0}^{q} A_i(s_t) y_{t-1} + u_t, \qquad (1)$$

$u_t / s_t \sim NID\left(0, \sum(s_t)\right)$. Ai (.) shows the coefficients of the lagged values of the variable in different regimes and $\sum$ shows the variance of the residuals in each regime.

$\mu(s_t)$ defines the dependence of the mean μ of the K – dimensional time series vector on the regime variable st.

In an MS-VAR model, st is governed by a Markov chain and

$$P_r\left[s_t \left| \{s_{t-1}\}_{i=1}^{\infty}, \{y_{t-1}\}_{i=1}^{\infty} \right. \right] = P_r\left\{ s_t \left| s_{t-1}; \rho \right. \right\} \qquad (2)$$

where p includes the probability parameters. That is, the state in period t would depend only on the state in period t-1. On the other hand, the conditional probability distribution of y_t is independent of s_{t-1}, that is, $P(y_t | Y_{t-1}, s_{t-1}) = P_r(y_t | Y_{t-1})$

It is assumed that s follows an irreducible ergodic M state Markov process with the transition matrix defined as,

$$\mathbf{P} = \begin{bmatrix} p_{11} & p_{12} & \cdots & p_{1M} \\ p_{21} & p_{22} & \cdots & p_{2M} \\ \vdots & \vdots & \cdots & \vdots \\ p_{M1} & p_{MM} & \cdots & p_{MM} \end{bmatrix} \qquad (3)$$

The Markov chain is ergodic and irreducible; a two-state Markov chain with transition probabilities pij with unconditional distribution is presented in the above equations. To make inferences, an iterative method was used for t = 1, 2, …, T, while taking the previous value of this probability $\xi_{it-1} = P_r\left[s_{t-1} = i \middle| \Omega_{t-1}; \theta\right]$ as input.

3. Empirical Results

3.1. Unit Root Tests

The integration order of Y and BDI was determined by using the test of Ng and Perron (2001). The results of the unit root tests are given in Table 1. The results indicate that Y, Gold and BDI appear to be stationary. After the unit root test, the Johansen procedure was used to determine the possible existence of cointegration between BDI, Gold and Y. The Johansen Cointegration result in Table 1 shows that the null hypothesis of no cointegration is rejected. If the variables are cointegrated, they can be used to test for MS- Granger Causality.

Table 1: Unit Root Test Results

	MZa	MZt	MSB	MPT
Y	-30.200	-3.718	0.123	1.328
BDI	-48.907	-4.929	0.101	0.541
1%*	-13.800	-2.580	0.174	1.780
5%*	-8.100	-1.980	0.233	3.170
10%*	-5.700	-1.620	0.275	4.450
Johansen Cointegration Test Rresult				
	r=0 0.097 r≤1 0.002		r=0 11.146 r≤1 0.183	

* Asymptotic Critical Values

The MSIAH(3)- VAR(4) model was selected based on Akaike Information Criteria (AIC) and the Likelihood Ratio (LR) test. In selected models, in order to determine the number of regimes, first of all, a linear *VAR* model is tested against an *MSVAR* model with 2 regimes, and the H_0 hypothesis, which hypothesizes linearity, was rejected by using *LR* test statistics. Since it was observed that models with two regimes overruling the linear model are insufficient to explain the relationships between the variables, then models with 3 regimes were considered. Therefore, secondly an *MSVAR* model with 2 regimes was tested against an *MSVAR* model with 3 regimes; the H_0 hypothesis, which specifies that there are 2 regimes, was rejected and the *MSVAR* model with 3 regimes was accepted as the optimal model because the LR statistic was greater than the 5% critical value of χ^2.

The transition probability matrix is ergodic and cannot be irreducible. The ergodic transition probability matrix confirms stationarity of the regime. As detailed in Hamilton (1994) and Gallagher (1996), the ergodic transition probabilities matrix is always covariance-stationary.

MSIH(3)- VAR(3) model was selected based on the Akaike Information Criteria (AIC) and LR test. In selected models, in order to determine the number of regimes, first of all, a linear VAR is tested against a MSVAR with 2 regimes, and the hypothesis, which hypothesizes linearity, was rejected by using the LR test statistics.

Since it was observed that two regime models overruling the linear model are insufficient in explaining the relationships between the mentioned variables, and models with 3 regime are considered. Therefore, secondly a MSVAR model with 2 regimes is tested against a MSVAR model with 3 regimes; Ho hypothesis, which specifies that there are 2 regimes, was rejected and MSVAR with 3 regimes was accepted as the optimal model because of the LR statistic was greater than the 5% critical value of square of X.

The MSIH(3)-VAR(3) model was estimated for the United States and the results were given in Table 2. Regime 1 is a recession or crisis regime. The moderate growth regime is Regime 2 and the high growth regime is Regime 3. The results signify the presence of asymmetries for the business cycles experienced by the United States.

The first regime tends to last 1years on the average, while the Regime 2 is comparatively more persistent with 6.46 years. Finally, Regime 3 which corresponds to the high growth tends to last 1.16 years on the average. Crisis regime of economy is the most persistent regime in the US.

As the calculated regime probabilities are Prob(st=1|st−1=1)=0.010, Prob(st=2|st−1=2)=0.845 and Prob(st=3|st−1=3)= 0.533, the persistence of each regime is significantly high. By moving from the conditions described above, the presence of important asymmetry in the business cycle in US is accepted.

The computed probability (i.e. Prob(st = 3|st−1=1) = 0.331) reflects the chance that a recession is followed by a period of high growth and the computed probability (i.e. Prob(st = 2|st−1 = 1) = 0.057) reflects the possibility of entering the crisis regime from moderate regime of economy is higher than the possibility of entering the crisis regime of high growth phase.

Table 2: MSIH(3)-VAR(3) Model Estimates for the USA

Estimation sample: 1985 – 2015											
Regime 1				***Regime 2***				***Regime 3***			
Variables:	***BDI$_t$***	***Gold$_t$***	***Y$_t$***	***Variables:***	***BDI$_t$***	***Gold$_t$***	***Y$_t$***	***Variables:***	***BDI$_t$***	***Gold$_t$***	***Y$_t$***
Regime –specific Intercept											
Constant	1.292 (2.262)	0.482 (2.849)	3.402 (5.094)	*Constant*	1.293 (2.336)	0.579 (3.899)	4.379 (6.667)	*Constant*	1.365 (2.438)	0.562 (3.826)	5.505 (4.910)
Regime –specific autoregressive coefficients											
Y$_t$	0.004 (0.312)	`-0.004 (-1.067)	`-0.028 (-1.878)	*Y$_t$*	0.030 (6.022)	0.005 (2.542)	0.084 (2.680)	*Y$_t$*	0.017 (1.592)	0.003 (0.884)	`-0.034 (-2.673)
BDIt	0.032 (0.361)	0.014 (0.772)	0.564 (5.286)	*BDIt*	`-0.169 (-1.859)	0.026 (1.860)	0.018 (0.173)	*BDIt*	0.054 (0.683)	0.019 (1.005)	`-0.238 (-2.534)
Gold$_t$	`-0.042 (-0.124)	`-0.201 (-3.126)	`-1.723 (-4.282)	*Gold$_t$*	0.175 (0.545)	0.253 (2.711)	`-1.477 (-3.903)	*Gold$_t$*	`-0.377 (-1.211)	0.314 (-1.081)	`-0.500 (4.128)
Regime- specific standart error											
SE	0.522	0.294	0.540	***SE***	0.771749	0.201	0.062	***SE***	0.353	0.0370	4.352
Regime properties: Duration and Probablities of regimes				Transition probabilities							
	nObs	***Prob.***	***Duration***		***Transition p.***	***Regime 1***	***Regime 2***	***Regime 3***			
Regime 1	12.9	0.108	1.00		***Regime 1***	0.0109	0.0007016	0.8993			
Regime 2	83.9	0.6916	6.46		***Regime 2***	0.057	0.8452	0.09476			
Regime 3	23.2	0.2004	1.16		***Regime 3***	0.3319	0.1345	0.5337			
log-likelihood : 4.4089 linear system : -169.1124 ; AIC criterion : 0.9265 linear system : 3.4185 LR linearity test: 347.0427 Chi(18) =[0.0000] ** Chi(24)=[0.0000] ** DAVIES=[0.0000] **											

4. Conclusion

The MSIH(3)-VAR(3) model was estimated for the United States and the results are given in Table 2. Regime 1 is the recession or crisis regime. The moderate growth regime is Regime 2 and the high growth regime is Regime 3. The model tracks fairly well the crises of 1990-1991, 2001, 2008 and recent slowdown. In the estimated MS-VAR model, the total time length of expansion period (Regime 2 and Regime 3) is longer than the total time length for the recession (Regime 1), as expected. The results signify the presence of a significant level of asymmetry for the business cycles experienced by the United States.

In this paper, MSIH(3)-VAR(3) model is selected to analyze the relationship between BDI and economic growth for the United States. BDI and GDP are co-integrated for the United States. The crisis Regime 3 tends to last 1.16 years on the average, while the Regime 1 is comparatively more persistent with 1 years which is high growth tends to last 1 year. Finally, Regime 2 which corresponds to the lowest growth tends to last 6.46 years on the average. The positive relationship between BDI and gold prices in the short term may be explained by the case that the liquidity as a result of economic reactivate might be an important indicator which is gold investment from past to present. Crisis regime of economy is the most persistent regime in the US. Thus, BDI can be used for an indicator of a crisis in GDP growth for the United States. According to our results, BDI index is very useful for term of crisis, can be used in policy-making.

References

Alziadeh, A. and Talley, W. (2010), Microeconomic determinants of dry bulk shipping freight rates and contract times, Transportation, 38, 561-579.

Anders Warne, (2000). Inference in Cointegrated VAR Systems, The Review of Economics and Statistics, MIT Press, 79(3), 508-511, August.

Bakshi, G. Panayotov, G. and Skoulakis, G. (2010), The Baltic Dry Index as a Predictor of Global Stock Returns, Commodity Returns, and Global Economic Activity.

Baltic Exchange, About Us, last accessed on 30 June 2014, from http://www.balticexchange.com

Baltic Exchange, last accessed on 30 June 2014, from http://www.learningmarkets.com/understanding-the-baltic-dry-index/

Bildirici, M., Aykaç Alp and E.,Bakırtaş, T., (2011), The Great Recession and The Effects of Oil Price Shocks and The U.S. Recession: A Markov-Switching and TAR-VEC Analysis, Journal of Energy and Development, 35(2).

Clements, M.C. and Krolzig, H.-M., 2002. Modelling Business Cycle Features Using Switching Regime Models, Economics Series Working Papers 9958, University of Oxford, Department of Economics, 1-17.

Cologni, Alessandro & Manera, Matteo, (2008). Oil prices, inflation and interest rates in a structural cointegrated VAR model for the G-7 countries, Energy Economics, 30(3), 856-888.

Duru, O. (2010) A fuzzy integrated logical forecasting model for dry bulk shipping index forecasting: An improved fuzzy time series approach, Expert Systems with Applications, 37 (7), 5372-5380.

Gallagher, N.B. and Wise, B.M. (1996), The Process Chemometrics Approach to Chemical Process Fault Detection and Supervision, J. of Process Control, 6(6), 329-348.

Geman, H. and Smith, W. (2012), Shipping Markets and Freight Rates: An Analysis of the Baltic Dry Index, The Journal of Alternative Investments,.1, 98-109.

Hamilton, J.D. (1989). A new approach to the economic analysis of nonstationary time series and the business cycle, Econometrica, 57, 357-384.

Hamilton, James D. (1994).Time Series Analysis, Princeton Unıversity Press, 257-291.

Holmes, Mark and Wang, Ping (2003). Oil Price Shocks and the Asymmetric Adjustment of UK Output: A Markov-switching approach, International Review of Applied Economics, 17(2), 181-192.

Ng, Serena and Perron, Pierre (2001), LAG Length Selection and the Construction of Unit Root Tests with Good Size and Power, Econometrica, 69(6), 1519–1554.

Nicholas, C.S. Sim, and Lin, Faqin (2013). Trade, Income and the Baltic Dry Index, European Economic Review, 59, 1-18.

Oomen, J. (2012,) The Baltic Dry Index: A predictor of stock market returns? Master Thesis, Tilburg University, Tilburg.

Psaradakis Z., Morten O.R. and Sola M. (2005), Markov-Switching causality and the Money-Output Relationship, Journal of Applied Econometrics, 665-83.

Sengupta, Rajdeep and Tam, Yu Man (2009). “Recent Movements in the Baltic Dry Index”, Economic SYNOPSES, Federal Reserve Bank of St. Louis, No: 12.

Zuccollo, Dino Roberto (2014). The Baltic Dry Index: A Leading Economic Indicator and its use in a South African context, Master Thesis, University of the Witwatersrand.

Appendix

Figure 1: Probabilities of regimes for BDI, Gold and GDP

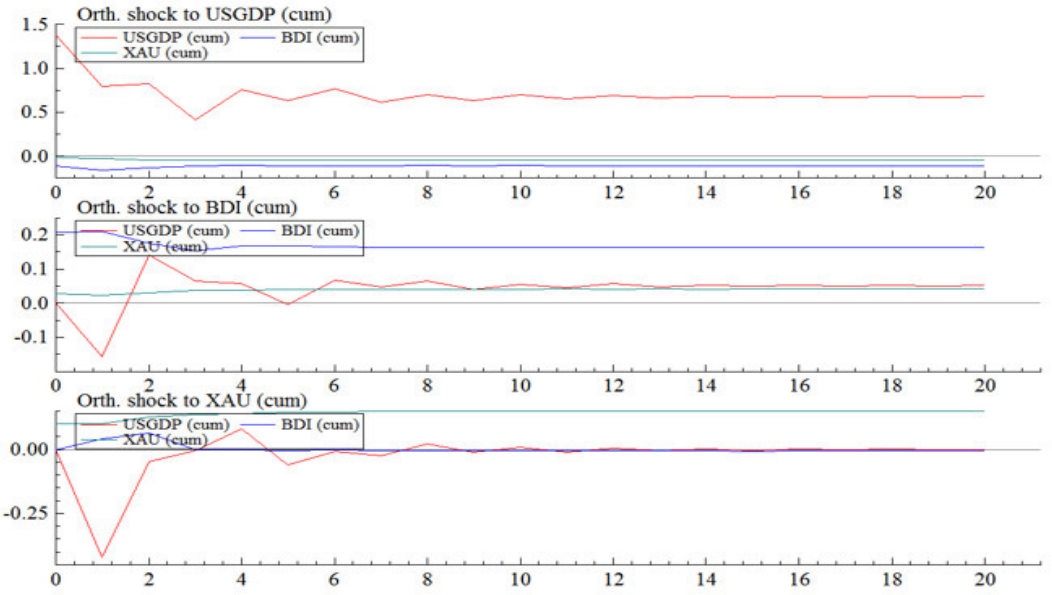

Figure 2: Predicted h-step probabilities of stability