

Relationship among oil price, economy and oil market in the U.S.

—Estimation of effective WTI price based on oil supply and demand and economic situation and applied analyses—

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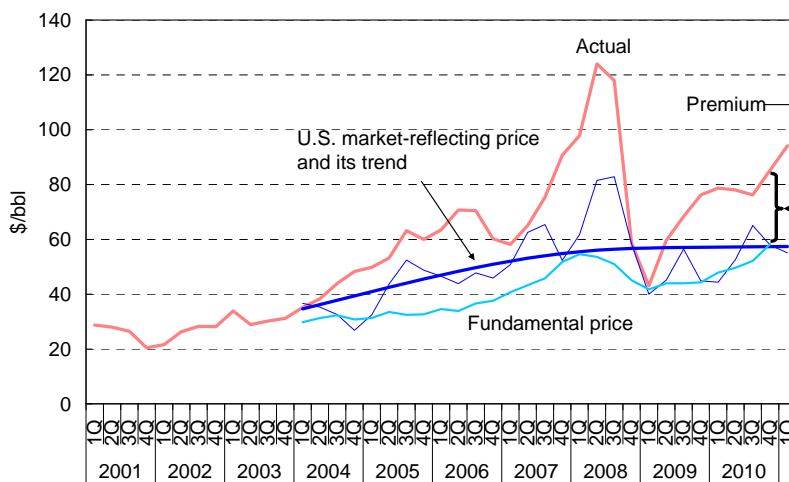
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Summary

Although the global economy seems to have returned to a stable growth pathway, there is still a lurking vulnerability, especially as oil price rise causes concerns for adverse effect on the global economy. As a background, the current oil price rise could be attributed to worries about supply disruption due to geopolitical risks in the Middle East, increasing oil demand in emerging economies, funds flowing to futures markets, etc. However, there are two contrary opinions — one is that the current price level reflects the supply and demand factors while the other is that other factors influence oil price and the effect is not small. If oil price is overshooting and/or will overshoot the price based on supply and demand balance, the prices can be a risk disturbing the steady step toward global economy recovery.

The “U.S. market-reflecting price,” the effective WTI price based on oil supply and demand and economic situation in the United States is estimated at around \$55/bbl in 4Q2010 and 1Q2011. Similarly fundamental price — price suggested by the global oil supply and demand — and premium in 4Q2010 are estimated at a little less than \$60/bbl and a little more than \$25/bbl, respectively.

WTI historical price, U.S. market-reflecting price and fundamental price



Between 2004 and 2010, the WTI historical price was higher by around \$18/bbl on the average than the U.S. market-reflecting price. It is estimated that the higher price slowed U.S. GDP growth by 0.4% point per annum and the cumulative effect for the seven years resulted in real GDP that is lower by 2.4% in 2010.

Keywords: Oil price, WTI, fundamentals, premium, oil supply and demand, GDP, economic growth

Introduction

Emerging economies and developing countries have return to pathway for economic growth earlier than expected from the recession brought about by the financial and economic crisis. Today these countries are facing big challenges in controlling inflation due to monetary easing and excess liquidity. Developed countries, on the other hand, are expected to be recovering towards the pre-crisis level barely this year. They face their own challenges and are far from complete recovery. Although the global economy seems to return to a stable growth pathway, there is still vulnerability. Price increases in agricultural and mineral products are considered as one of the risks to economic recovery. More especially, increasing oil price causes concern for adverse effects on the global economy. In April 2011 Brent futures (front month, settled) listed in ICE and WTI futures (ditto) listed in NYMEX have climbed above \$120/bbl and \$110/bbl, respectively. Oil prices are approaching the high levels recorded in 2008 (Figure 1).

Figure 1 WTI price



Source: U.S. Department of Energy, NYMEX

After the last oil price increases, collecting and disclosing relevant data have been promoted and studies on price mechanism have been carried out more than before. The understanding that the oil price levels until the first half of 2008 was inconsistent with the real oil supply and demand balance seems to be shared more today. However, this common understanding is still highly controversial.

As a background, the current oil price increases are attributed to worries about supply disruption due to geopolitical risks in the Middle East, increasing oil demand in emerging economies, funds flowing to futures markets due to monetary easing, etc. as what had happened before the recent financial and economic crisis. Likewise, there exists two contrary opinions — one is that current price levels reflect supply and demand balance while the other is that effect

of the other factors is not small. If oil price is overshooting and/or will overshoot the real price based on supply and demand balance, the price can be a risk disturbing the steady steps toward global economic recovery.

On current oil prices, it is remarkable that WTI prices have been less than those of the Brent. It is believed that the current WTI price is affected by easy supply and demand balance in the United States, especially the high stock levels in Cushing, the delivery point of WTI futures, and does not reflect the global supply and demand balance. On the other hand, it is also believed that Brent reacts excessively to worries about supply disruption due to the destabilisation in the Middle East.

Considering these circumstances, the WTI price implied by oil supply and demand balance and economic situation in the United States, or the effective WTI price, is estimated in this paper. The impact on the U.S. economy of the discrepancy between the market price and the effective WTI price is evaluated. Finally, the reverse price gap between WTI and Brent is evaluated.

Estimation of effective WTI price

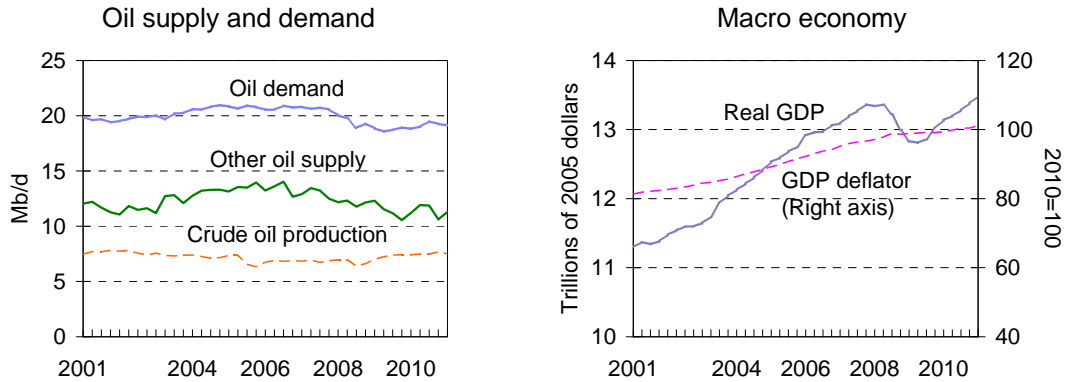
At first, the effective WTI price implied by oil supply and demand balance and economic situation in the United States is estimated in a similar way with estimating the fundamental price by Yanagisawa (2008a, 2008b). However, it may be a bit problematic to call the price based only on the situation in the United States “fundamental price” although WTI is one of the marker oils in the world. Therefore, we will call it “U.S. market-reflecting price” here.

Figure 2 Decomposition of WTI price



The model developed in estimating this “U.S. market-reflecting price” consists of WTI price, oil demand in the United States, crude oil production, other oil supply, real GDP and GDP deflator. See appendix for equations of the model.

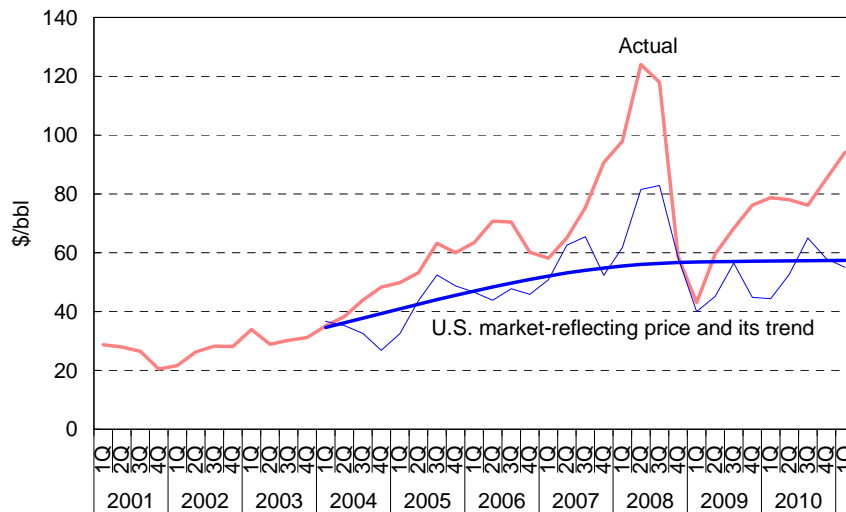
Figure 3 Oil supply and demand and economic situation in the United States



Source: U.S. Department of Energy (oil supply and demand), Department of Commerce (GDP)

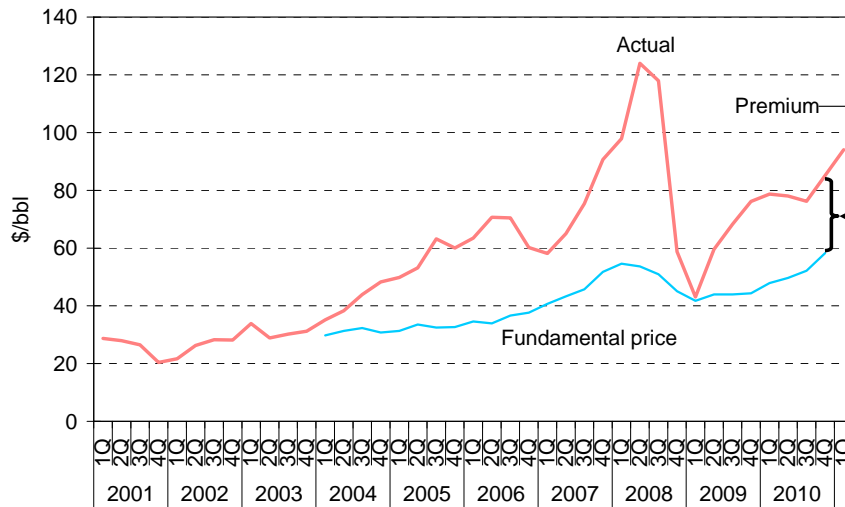
The estimated U.S. market-reflecting price is shown in Figure 4. In 4Q2010 and 1Q2011, the price is estimated around \$55/bbl.

Figure 4 WTI historical price and U.S. market-reflecting price



For comparison, fundamental price estimated by the global oil supply and demand is shown in Figure 5. The fundamental price has been in the range of \$30-60/bbl even after 2004 when oil price rose. It was a little less than \$60/bbl in 4Q2010. Premium, the difference between the actual price and the fundamental price, disappeared once in the beginning of 2009 as oil price fell after its peak in July 2008. It, however, has expanded again and is estimated to rise to a little more than \$25/bbl in 4Q2010.

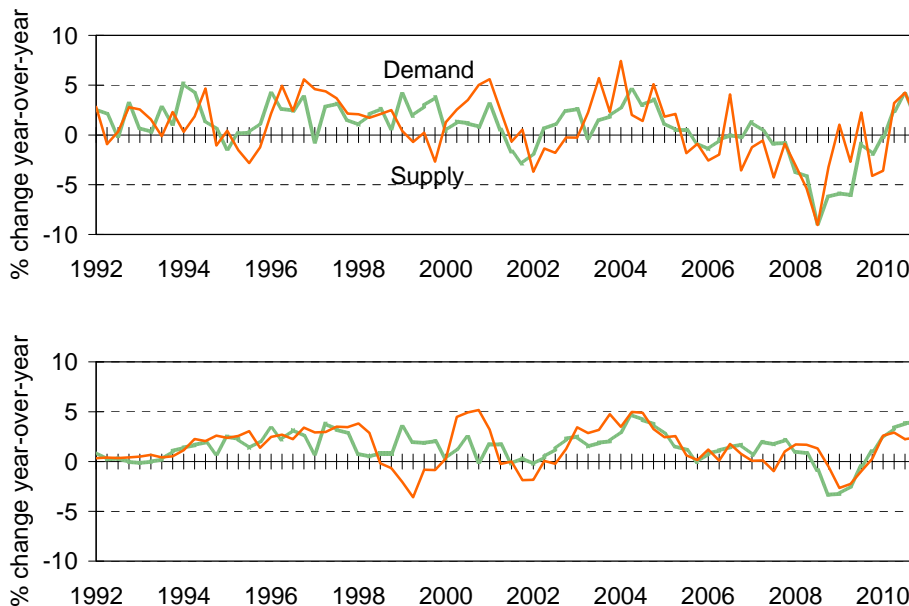
Figure 5 WTI historical price and fundamental price



Fluctuation of the U.S. market-reflecting price is large compared with the fundamental price. This is because of large fluctuation of oil supply and demand in the United States. This large fluctuation in the United States is remarkable compared with the global one especially in and after 2004 (Figure 6). Even though fluctuations of oil supply and demand in the regions are large, fluctuation in the global market is modest as those regional fluctuations offset each other.

The U.S. market-reflecting price tends to be higher than the fundamental price. This can be interpreted as the oil market in the United States has been tighter than the global average.

Figure 6 Oil supply and demand (Upper: United States, Lower: World)



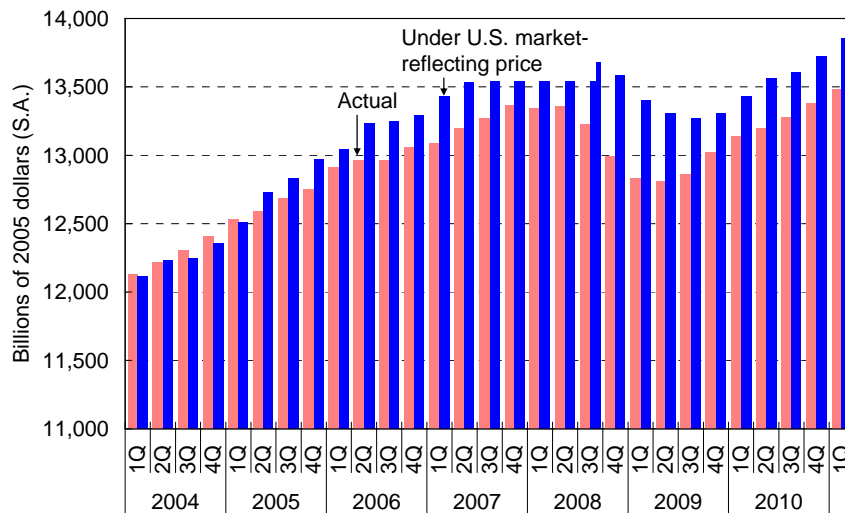
Source: U.S. Department of Energy (U.S.), International Energy Agency (world)

Economic impact of increasing oil price

Oil price is regarded as one of important factors influencing the global economy. Between 2004 and 2010, the WTI price was higher by around \$18/bbl on the average than the U.S. market-reflecting price. It is estimated that the higher price slowed down U.S. GDP growth by 0.4% point per annum and the cumulative effect for the last seven years resulted in lower real GDP growth by 2.4% in 2010 (Figure 7).

On the other hand, the GDP deflator in 2010 was pushed up by 0.3% and inflation rate in between 2004 and 2010 was faster by 0.04% point per annum, showing not a large impact. This is along with view of Federal Reserve Board that increases of commodity prices affect U.S. inflation with little degree.

Figure 7 U.S. historical GDP and estimated under the U.S. market-reflecting price



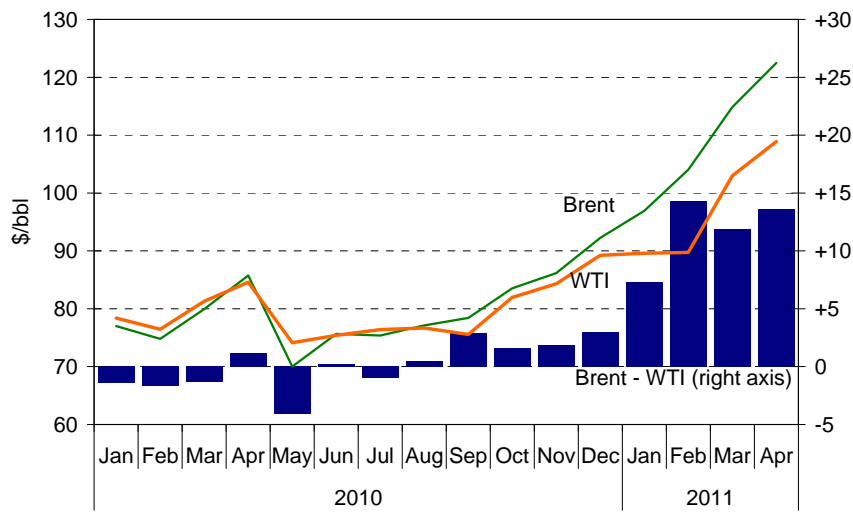
Expansion of reverse price gap between WTI and Brent

It had been usual that WTI is evaluated with higher price than Brent due to their respective properties. These days, however, WTI has been lower than Brent— a reverse price gap. In 2011, the reverse price gap expanded and reached to \$10-15/bbl recently (Figure 8).

As background following things are pointed out:

- (i) Easy oil supply and demand balance in the United States, especially oil stocks in Cushing, Oklahoma, the delivery point of WTI futures, pressures WTI price downward; and
- (ii) Destabilisation in the Middle East leading to worries about supply disruption pressures Brent price upward excessively.

Figure 8 WTI price, Brent price and price gap

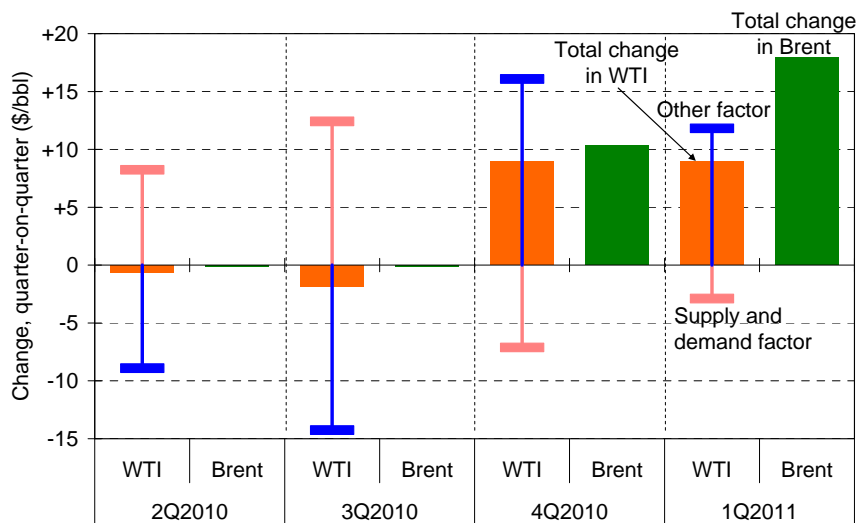


Source: U.S. Department of Energy, NYMEX (WTI), IntercontinentalExchange (Brent)

Although it might be hard to find positive reasons for the rise in WTI prices in the view of real supply and demand in 1Q2011, WTI rose by \$9/bbl compared with the previous period. On the other hand, Brent rose by \$18/bbl much more than WTI resulting in expansion of the reverse price gap.

During the same period, supply and demand factor in the United States pressured WTI price downward (Figure 9). The degree, however, was more or less -\$3/bbl, not so large compared with the other factors including geopolitical risks, etc.

Figure 9 Price changes in WTI and Brent and decomposition analysis of the changes



The expansion of the reverse price gap can be a result of the worries about supply disruption due to destabilisation in the Middle East that pressured Brent price upward much more strongly or excessively than the supply and demand factor that pulled down WTI prices.

In closing

Now, two years have passed after the previous oil price had settled down and had risen again. There are various opinions on the oil price levels. However, the analysis using a quantitative model suggests that current oil price is inconsistent from the real oil supply and demand and economic situation.

As changing the energy system takes time, its adjustment for skyrocketing oil price barely works. It is not easy to save and substitute oil demand and/or increase oil supply in the short-term. Still, or rather unremitting efforts to achieve a flexible energy system are required.

On the other hand, the degree of the effects of excessive inflow of funds and *worries* for supply disruption is not very clear. However, reform in relevant systems and building an environment to firm up the oil supply chain in the long-term can contribute to a certain extent.

Measures in both the energy and non-energy fields are essential to mitigate the adverse effect of oil price rise.

Appendix: equations of the model

		Equations (dependent variables)						
		WTI price	Oil demand	Crude oil production	Other oil supply	Real GDP	GDP deflator	
Independent variables	WTI price	(-1)	1.264 (0.145)	-0.023 (0.017)	-0.012 (0.029)	-0.108 (0.040)	-0.004 (0.006)	0.004 (0.002)
		(-2)	-0.625 (0.214)	-0.004 (0.025)	0.012 (0.043)	0.138 (0.059)	0.002 (0.009)	0.000 (0.003)
		(-3)	0.110 (0.221)	-0.001 (0.026)	-0.039 (0.045)	-0.059 (0.061)	-0.009 (0.009)	0.006 (0.003)
		(-4)	-0.299 (0.144)	-0.001 (0.017)	0.027 (0.029)	0.083 (0.040)	0.007 (0.006)	-0.005 (0.002)
	Oil demand	(-1)	2.242 (1.257)	0.298 (0.146)	-0.270 (0.255)	0.902 (0.347)	0.110 (0.053)	0.042 (0.018)
		(-2)	-1.770 (1.496)	0.099 (0.174)	0.099 (0.303)	0.255 (0.413)	0.123 (0.063)	-0.023 (0.022)
		(-3)	-0.375 (1.471)	-0.047 (0.171)	0.121 (0.298)	0.023 (0.406)	0.075 (0.062)	-0.020 (0.022)
		(-4)	0.466 (1.394)	-0.478 (0.162)	-0.272 (0.283)	0.680 (0.385)	0.030 (0.059)	-0.037 (0.020)
	Crude oil production	(-1)	0.243 (0.863)	-0.003 (0.100)	0.895 (0.175)	-0.630 (0.238)	0.020 (0.036)	-0.030 (0.013)
		(-2)	-0.117 (1.009)	0.134 (0.117)	-0.251 (0.204)	0.530 (0.278)	-0.035 (0.042)	0.027 (0.015)
		(-3)	0.519 (1.039)	-0.071 (0.121)	-0.174 (0.211)	-0.565 (0.287)	0.005 (0.044)	0.005 (0.015)
		(-4)	-0.570 (0.856)	-0.012 (0.100)	-0.076 (0.174)	0.243 (0.236)	-0.022 (0.036)	-0.015 (0.013)
	Other oil supply	(-1)	0.124 (0.562)	0.067 (0.065)	0.101 (0.114)	0.143 (0.155)	0.030 (0.024)	-0.005 (0.008)
		(-2)	0.059 (0.536)	-0.037 (0.062)	-0.076 (0.109)	-0.056 (0.148)	-0.062 (0.023)	0.008 (0.008)
		(-3)	-0.252 (0.519)	0.012 (0.060)	-0.044 (0.105)	0.071 (0.143)	0.004 (0.022)	0.010 (0.008)
		(-4)	-0.574 (0.416)	0.052 (0.048)	-0.015 (0.084)	-0.123 (0.115)	0.007 (0.018)	0.005 (0.006)
	Real GDP	(-1)	4.294 (3.570)	1.087 (0.416)	-0.173 (0.724)	0.773 (0.986)	0.989 (0.150)	0.043 (0.052)
		(-2)	-4.277 (4.658)	0.142 (0.543)	0.495 (0.944)	-0.015 (1.286)	-0.215 (0.196)	-0.009 (0.068)
		(-3)	-1.501 (4.530)	-0.809 (0.528)	-0.977 (0.918)	-1.154 (1.251)	-0.245 (0.191)	0.004 (0.066)
		(-4)	3.004 (3.197)	0.351 (0.372)	0.325 (0.648)	-0.200 (0.883)	0.045 (0.135)	-0.006 (0.047)
	GDP deflator	(-1)	-16.107 (12.108)	0.915 (1.410)	1.476 (2.454)	0.248 (3.343)	-0.330 (0.510)	0.575 (0.177)
		(-2)	26.129 (14.796)	2.468 (1.723)	1.428 (2.999)	-0.722 (4.085)	0.001 (0.623)	0.384 (0.217)
		(-3)	22.515 (13.657)	-2.276 (1.591)	-2.663 (2.769)	-6.196 (3.771)	0.097 (0.575)	0.202 (0.200)
		(-4)	-27.724 (10.832)	-1.088 (1.262)	-0.718 (2.196)	4.614 (2.991)	0.089 (0.456)	-0.266 (0.159)
	Constant		-0.088 (0.109)	-0.011 (0.013)	0.018 (0.022)	0.060 (0.030)	0.012 (0.005)	0.000 (0.002)
	R^2		0.86	0.74	0.69	0.72	0.93	0.94

The estimated VAR model consists of nominal WTI price, oil demand (apparent use) in the United States, crude oil production, other oil supply (net import, processing gain and bio-fuels), real GDP (seasonally adjusted) and GDP deflator (ditto). All of the variables are on a quarterly basis and are transformed into (logarithmic) percent changes year-over-year. Lag length of the model is four periods. The estimation period is from 1Q2002 to 1Q2011 but the data of 1Q2011 are the expected value except for WTI price.

Considering that the model consists of differential variables, determination coefficients are not so low. The model generally shows expected reaction in impulse analyses.

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