Crude Inventory Accounting and Speculation in the Physical Oil Market

Ivan Diaz-Rainey, Dept. of Accountancy and Finance, University of Otago, + 64 3 479 8117, ivan.diaz-rainey@otago.ac.nz
Helen Roberts, Dept. of Accountancy and Finance, University of Otago, + 64 3 479 8072, helen.roberts@otago.ac.nz
David Lont, Dept. of Accountancy and Finance, University of Otago, + 64 3 479 8119, david.lont@otago.ac.nz

Overview

The oil spike of 2008 has generated intense academic debate. Specifically, researchers have sought to ascertain what role, if any, speculation played in causing this spike. The majority of these studies have explored what impact financial institutions (non-commercial speculators) have played on price dynamics in the oil derivatives markets (principally oil futures). There is, however, considerable anecdotal evidence that big oil companies and commodity traders were speculating in physical markets through the 'Contango and Carry Trade'. Past research has explored the relationship between physical inventories and oil price (Hamilton 2009; Kaufmann 2011; Kilian and Murphy 2013; Singleton 2014; Ye *et al*. 2006a&b), however, these efforts have relied on two aggregate data sources (OECD inventories from the IEA and US inventories from the EIA). By way of contrast, this paper uses an alternative data source and asks the following research question: Can we infer from accounting inventory numbers whether companies involved in the physical oil market have been speculating in the run up to 2008? Our contributions are two fold; (1) we use an alternative data source that is more global and covers "oil at sea" (unlike IEA & EIA datasets) and (2) we explore individual company data and, therefore, can explore heterogeneity of company behaviour.

Methods

Using quarterly inventory data over the period 1990Q4 to 2012Q1 and an initial sample of 15 of the largest listed oil companies in the world (SIC Code 1311) we derive an Index of Scaled Physical Inventories (ISPI). ISPI takes account of exchange rate differences, the price of oil and the size of the company (as measured by sales). Our company level measure of scaled inventory is

$$V_{i,t}^{S} = (I_{i,t} / S_{i,t}) \tag{1}$$

where I is dollar reported inventory of company i at time t and S is the equivalent measure for sales. Therefore the ISPI is given by

$$\frac{1}{n}\sum_{i=1}^{n} V_t^S = \bar{V}_t^S \tag{2}$$

We employ three methods to explore the research question. ***Method 1*** - Descriptive evolution of ISPI over time and ± 1 SD of ISPI to explore heterogeneity of behaviour. ***Method 2 -*** Bai Perron multiple structural breaks test (GIC) on individual company time series and on ISPI time series. ***Method 3:*** Predictive model of profit using inventory as explanatory variable for the pre-speculation period (1990Q4 to 2004Q3) and the speculation period (2004Q4 to 2007Q4) with the latter defined by structural breaks in the oil price. The model employed is

$$\Delta R_{i,t} = \alpha_1 + \alpha_2 \Delta V_{i,t-1}^{S} + \alpha_3 \Delta P_t + \alpha_4 \Delta S_{i,t} + \varepsilon \tag{3}$$

where R is net income, P is the price of crude oil and S is sales

Results

Figure 1: The evolution of ISPI and ± 1 SD of ISPI (left axis) ***(Method 1)*** and oil price (right axis)

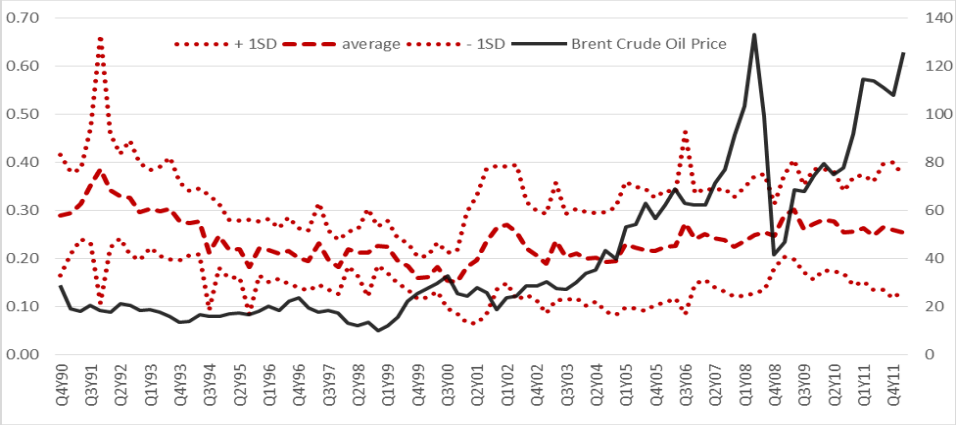

Table 2: BP structural break tests ***(Method 2)***

Time Series	Breaks	Pre-Speculation Period 1990 Q4 to 2004 Q2 (defined by Oil Structural Break)			Speculation Period	Post Bubble (2008 onwards)
Oil Price	2	1990Q4 - 2004Q2			2004Q3 - 2007Q2	2007Q3 - 2012Q1
Avg5_I_Sales	1	1990Q4 - 1994Q3	1994Q4 - 2012Q1			
Avg6_I_Sales	1	1990Q4 - 1994Q3	1994Q4 - 2012Q1			
BP PLC -ADR	3	1990Q4 - 1993Q4	1994Q1 - 1997Q3	1997Q4 - 2004Q4	2005Q1 - 2012Q1	
ROYAL DUTCH SHELL PLC	3	1990Q4 - 1994Q3	1994Q4 - 1999Q3	1999Q4 - 2005Q2	2005Q3 - 2012Q1	
STATOIL ASA	3	1999Q1 - 2000Q3	2000Q4 - 2006Q1		2006Q2 - 2008Q2	2008Q3 - 2012Q1
TOTAL SA	1	2000Q4 - 2004Q4			2005Q1 - 2012Q1	
CHEVRON CORP	3	1990Q4 - 1994Q3	1994Q4 - 2000Q1	2000Q2 - 2008Q3		2008Q4 - 2012Q1
CONOCOPHILLIPS	2	1990Q4 - 2001Q2	2001Q3 - 2004Q2	2004Q3 - 2012Q1		
EXXON MOBIL CORP	2	1990Q4 - 1995Q4	1996Q1 - 2004Q1	2004Q2 - 2012Q1		
VALERO ENERGY CORP	1	1990Q4 - 1994Q1	1994Q2 - 2012Q1			
ENI SPA	1	2000Q2 - 2008Q2				2008Q3 - 2012Q1
PETROBRAS BRASILEIRO	1	2001Q2 - 2005Q1			2005Q2 - 2012Q1	

Table 3: Impact of Inventories on Net Income ***(Method 3)***

	1990 Q4 to 2004 Q2								2004 Q3 to 2007 Q4								
	Intercept		Δ_I_Sales		Δ_Oil Price		Δ_Sales		Intercept		Δ_I_Sales		Δ_Oil Price		Δ_Sales		Speculative Structural Break
British Petroleum	-55.5		**-415.7**		129.8	***	0.080	***	-942.0		**10,737.8**		225.5	**	-0.044		Positive
Royal Dutch Shell	-118.4		**-16,027.5**	**	148.4	**	0.114	*	-484.2		**850.4**		297.8	**	-0.127		Positive
Statoil	-7.9		**-898.8**		6.4		0.088	**	-63.8		**19,137.4**	**	-24.0		0.141	***	Positive
Total SA	-113.9		**3,080.6**		150.9	***	0.033		-181.5		**-81.0**		65.3		0.085	***	Positive
Conoco Phillips	9.6		**-1,578.3**	**	0.2		0.061	*	54.6		**-7,237.9**		39.3		-0.046		Negative
Petrobras Brasileirc	-979.6	*	**-130.9**		215.3		1.675	*	-98.4		**-58.2**		-3.1		0.122		Negative
Chevron	0.2		**6,563.0**	*	97.8	**	0.113	**	-4.3		**34,144.7**		-58.4	*	0.153	**	None
Exxon Mobil	0.6		**-1,089.3**		29.6		0.085	***	113.3		**-522.6**		-56.7		0.184	***	None
Valero Energy	35.6	**	**-90.3**		-5.9		0.083	***	1,132.5	***	**3,126.3**		-18.0		0.031		None
Lukoil	325.7		**4,646.4**		-12.4		-0.479		-145.3		**-2,458.9**		-4.7		0.348	***	None
Average_6	-34.2		**-91.3**		56.0	**	0.103	***	-208.3		**10,116.0**		83.8	**	0.009		None
Average_5	-46.1		**-2,888.1**		63.9	**	0.123	***	-234.1		**4,900.2**		95.6	**	0.018		None

Conclusions

Method 1: Declining ISPI up to early 2000s is consistent with firms minimising inventory for efficiency sake, then ISPI starts to increase, suggesting physical inventories could have contributed to the run-up in oil price. This is consistent with Kaufmann (2011)'s evidence for the US. Also, the standard deviation (SD) of ISPI starts to increases around 2000 suggesting greater heterogeneity in inventory behaviour. ***Method 2:*** BP, Shell, Statoil and Total have positive structural breaks during speculation period (suggests speculation). The evidence for other companies suggest no speculation. ***Method 3:*** The switching in the coefficients of the change in scaled inventory variable over the two periods is consistent with evidence presented by Singleton (2014) but conclusion based on these models is that switching has not materially affected performance save for the cases of Shell and Statoil.