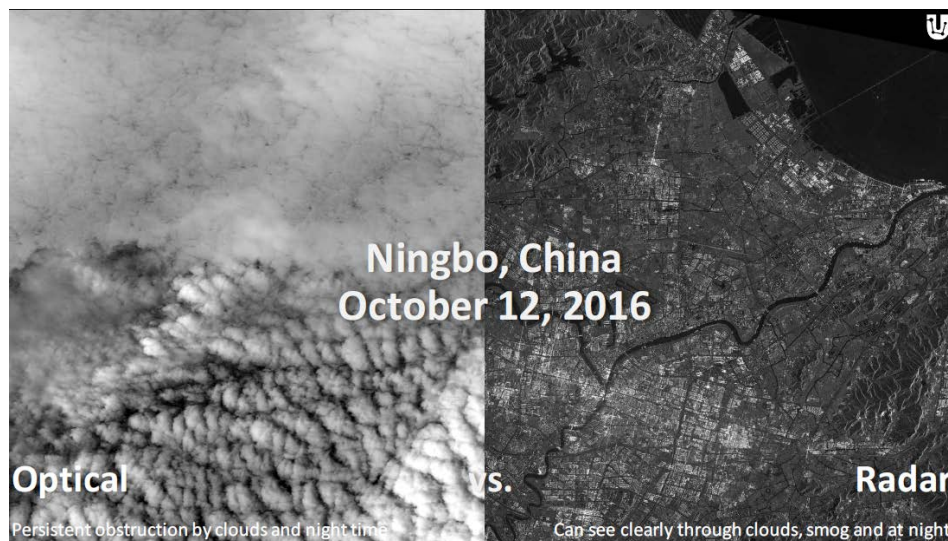


The Barebones

- Data on Chinese crude oil inventories have traditionally been intermittent and self-reported by government.
- Analyses of optical images taken by satellites can resolve the second problem but still struggle with reliability and accuracy issues, given the propensity of cloud cover.
- Radar-based satellite imagery resolves both problems. This technology can see clearly through clouds, smog, and at night. Measurements of any crude oil floating-top tank in the world can be taken as frequently as twice per day.
- Ursa Space Systems, an Ithaca-based startup, has begun publishing tank-level data for 150 tanks at Ningbo, a major storage depot southeast of Shanghai, plus four other sites in China. Ursa reports both commercial and SPR stocks.
- Blacklight is advising Ursa on priorities for tank selection as Ursa rolls out a global oil inventory tracking product. Data are available for Saudi Arabia, Venezuela, Iran, India, and other opaque regions.
- In our view, these data will displace the oil futures markets' traditional reliance on IEA, JODI, and self reporting for tracking crude oil inventory.

Ningbo crude storage is 81% full

First reliable satellite data on China's oil stocks



Credit Ursa Space Systems (images courtesy of Digital Globe and e-GEOS)

Ursa Space Systems' radar analysis tracks crude at tank level

A large shock to aggregate demand emerged in China in July 2015. Over the subsequent six months, this shock roiled all global markets as it unfolded. In hindsight, we now know this economic tsunami was among the most important macro events of 2015 and 2016. It affected the performance of all asset classes and significantly altered the monetary policy plans of all major central banks. Few instruments within equities, fixed income, commodities, and currencies were untouched.

But to this day there is much opacity and debate about what actually happened. Some traders still believe much of the damage in financial markets at year's start was an artifact of algorithmic trading and 'flash crashes' rather than authentic signals from the real economy.

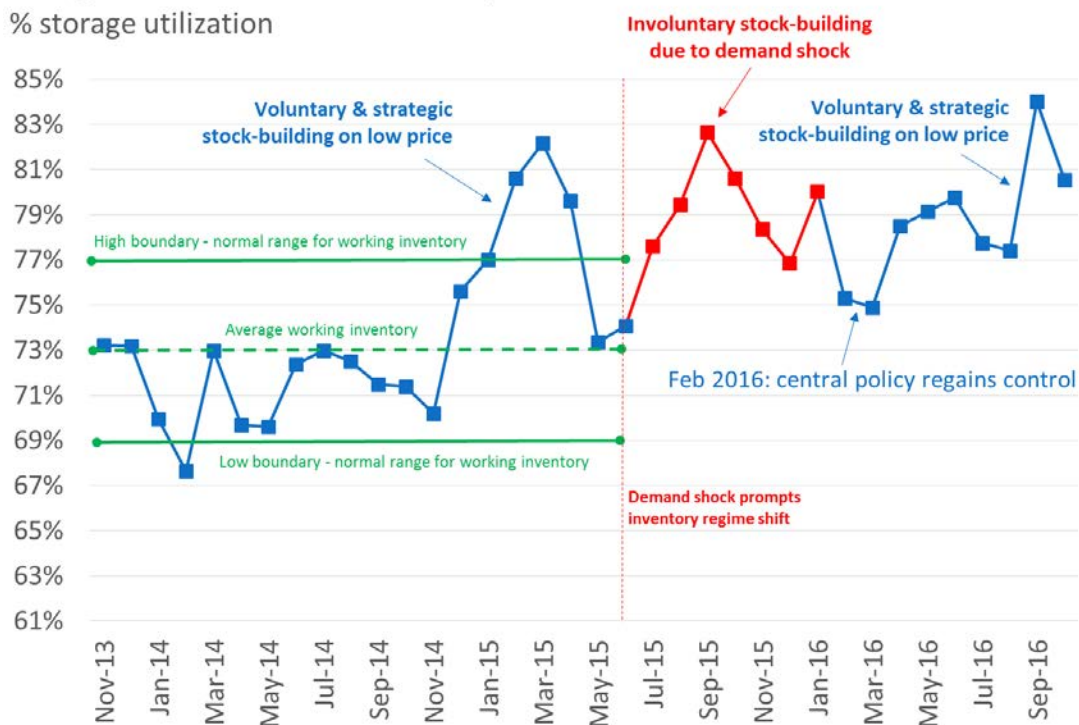
Last summer our research tracked this shock to the demand side and to China. In August 2015, when most people fervently believed the renewed slide in oil prices was attributable to a global oil supply glut exacerbated by dozens of rig restarts in the Permian Basin, I presented our alternative assessment of a Chinese economic recession in a [Bloomberg television segment](#). But in the absence of reliable Chinese oil inventory data, we had to rely on indirect data to make our case. Doubts were plentiful.

This is the data gap problem that satellite-based analysis is now resolving.



Ningbo crude oil inventory

% storage utilization



Source: Ursa Space Systems, Blacklight Research.

Ursa Space Systems Inc., an Ithaca-based startup, has begun publishing tank-level data for 150 tanks in the harbor at Ningbo, a major storage depot southeast of Shanghai. It is not a stretch to think of this location as China's version of Cushing, Oklahoma, given the volume of local oil inventories and proximity to refineries. Ursa also publishes data for four other sites in China: Dalian, Zhoushan, Tianjin, and Lanshan. Ursa's radar-based methodology resolves key problems of optical-based approaches, allowing for consistent measurements through clouds, smog, and darkness of night. Ursa reports estimates for both commercial and strategic petroleum reserve (SPR) stocks among these scores of tanks, though that is admittedly a fluid distinction in China.

This information is valuable. A risk manager in possession of Ursa's Ningbo crude oil data last summer would have been able to detect, quantify, and respond to the China demand shock in real time, ahead of the collapses in Chinese equity markets and other global markets.

The Ningbo data show that crude oil storage utilization suddenly increased from 73% in May 2015 to 83% in September 2015—a 10%-point increase in the space of just four months. Nearly four percentage points of this move happened in July 2015 alone (see chart above).

Because Ursa has reconstructed a couple years of data before the demand shock, we know this is an unusually swift and large move to an unusually high level of storage—a context unavailable from other data sources. In the prior 18 months, storage utilization at Ningbo had averaged 73% in about a +/- 4%-point range. Moreover, data analysis by Blacklight (which is advising Ursa in building its data) shows that deviations around Ningbo's average inventory level during those prior 18 months were a function of the oil price elasticity of import demand.



Those relationships broke down suddenly in July 2015—a fact that is clearly visible in the Ursa oil inventory data, but not in other data. The Ursa data are evidence of a large but unsurveyed drop in Chinese crude runs in the summer of 2015. We can also deduce from the Ursa data when crude runs recovered and by how much.

Now, the Ursa oil data show the Zhenhai SPR is approaching 90% capacity fill. This is consistent with [findings reported by Bloomberg](#) in September 2016 following a rare public disclosure by China's National Bureau of Statistics. But the Ursa data reveal more complexity to the story. Adjacent commercial storage is running closer to 60% utilization and is thus available for potential overflow. Also, Ursa's processing of satellite imagery can see that a 50-million-barrel SPR expansion at nearby Zhoushan came online in September and is just starting to be filled.

Overall, total storage capacity at Ningbo is presently about 81% full, by Ursa's calculations—higher than normal but nowhere near full.

Thus, the Chinese crude importers in the Shanghai region (i.e., Sinopec) hold a real option. If Brent and Dubai prices surge above \$50 per bbl, they have sufficient reserves not to feel much pressure to chase the breakout. But if prices break below \$30 per bbl on OPEC bickering over the would-be deal for supply cuts, then the Chinese buyers have ample room in their tanks to extend the opportunistic buying that has characterized their strategy for most of the past two years, especially when real time consumption of oil products has not been impaired.

Blacklight continues to believe that the Saudis will cut more than 1 million b/d of their own output in order to support the Aramco IPO in 2018. In our view, the Saudis will cajole their OPEC partners for as long as it makes sense, but in the end they will not foolishly impair their own economic and social stability as Deputy Crown Prince Mohammad bin Salman Al Saud implements Saudi Vision 2030. And when the Saudis cut their oil supply, the strategy will likely surprise markets and work spectacularly. Underestimate their intelligence and skill at your peril.

In early December, I plan to visit Hong Kong, Tokyo, and Singapore. There, like last year, I will advise Asian refiners to curb crude import purchases in order to test how low prices can go (see *The Great Suppression*, December 21, 2015). But, as I wrote nearly two months ago (*OPEC supply cuts likely to be much larger than indicated—and likely done by Saudi Arabia alone*, October 4, 2016) this time my advice will caution this strategy may not work as well as before.

Given these competing strategies between suppliers and users, real time data on crude oil storage in Saudi Arabia and China are presently among the most valuable information in markets. Ursa can track the paths of those levels reliably in a way—I am convinced—that no one else can at this moment. Ursa report calibration tests of their methodology on crude stocks at Cushing have an average tracking error of 1.1% against the EIA estimates, with a max error of 2.5%.

I have a minority financial interest in Ursa. But I have no managerial role in their company and see new inventory data points no sooner than their paying subscribers. As such, I encourage our readers to meet with Ursa and to decide for yourselves whether you wish to subscribe to their data. Ursa will be marketing in New York City during the week of November 28, 2016. Please send an email to colin.fenton@blacklightresearch.com if you wish to schedule an in-person meeting with them during that week or a meeting or a conference call at a date of your convenience. Never in my previous roles at investment banks could I so bluntly recommend a data vendor; but such is my freedom now that I am happy to make this important introduction for you. The Ursa team is impressive, and you should know them.



Average price forecasts, with estimated probabilities for alternative price scenarios around baseline

NYM WTI Crude Oil (\$ per bbl)						
		Price	<i>p10</i>	<i>p25</i>	<i>p75</i>	<i>p90</i>
1Q2016	Actual	33.63				
2Q2016	Actual	45.64				
3Q2016	Actual	44.94				
4Q2016	Forecast	46.47	38.17	41.09	48.63	52.54
1Q2017	Forecast	49.19	32.31	37.86	53.90	63.22
2Q2017	Forecast	51.28	29.15	35.98	57.49	70.99
3Q2017	Forecast	53.45	27.28	34.71	59.29	75.45
4Q2017	Forecast	55.93	26.13	33.87	60.35	78.25
2015	Actual	48.76				
2016	Estimated	42.67				
2017	Forecast	52.46	28.72	35.61	57.76	71.98
Forecasts as of: Thursday, November 17, 2016						

ICE Brent Crude Oil (\$ per bbl)						
		Price	<i>p10</i>	<i>p25</i>	<i>p75</i>	<i>p90</i>
1Q2016	Actual	35.21				
2Q2016	Actual	47.03				
3Q2016	Actual	46.99				
4Q2016	Forecast	48.70	39.95	42.56	48.97	52.19
1Q2017	Forecast	50.10	34.17	39.47	54.45	62.98
2Q2017	Forecast	52.37	31.80	38.29	57.96	69.86
3Q2017	Forecast	54.61	30.56	37.60	59.73	73.62
4Q2017	Forecast	57.41	27.90	35.66	61.68	79.04
2015	Actual	53.60				
2016	Estimated	44.48				
2017	Forecast	53.62	31.11	37.75	58.45	71.38
Forecasts as of: Thursday, November 17, 2016						



Average price forecasts, with estimated probabilities for alternative price scenarios around baseline

NYM Natural Gas (\$ per MMBtu)						
		Price	p10	p25	p75	p90
1Q2016	Actual	1.98				
2Q2016	Actual	2.25				
3Q2016	Actual	2.79				
4Q2016	Forecast	2.82	2.20	2.44	3.10	3.45
1Q2017	Forecast	3.18	1.90	2.28	3.42	4.10
2Q2017	Forecast	3.17	1.83	2.24	3.48	4.25
3Q2017	Forecast	3.33	1.73	2.16	3.58	4.49
4Q2017	Forecast	3.62	1.69	2.18	3.85	4.98
2015	Actual	2.61				
2016	Estimated	2.46				
2017	Forecast	3.32	1.79	2.21	3.58	4.45
Forecasts as of: Thursday, November 17, 2016						

NYM ULSD (cents per gal)						
		Price	p10	p25	p75	p90
1Q2016	Actual	108.41				
2Q2016	Actual	139.19				
3Q2016	Forecast	141.13				
4Q2016	Forecast	150.28	120.83	130.33	154.42	166.76
1Q2017	Forecast	152.56	103.66	120.13	166.87	193.54
2Q2017	Forecast	157.25	94.65	114.37	174.25	210.62
3Q2017	Forecast	165.39	92.33	113.76	180.95	222.98
4Q2017	Forecast	174.83	89.08	112.12	187.04	235.13
2015	Actual	165.92				
2016	Forecast	134.75				
2017	Forecast	162.51	94.93	115.09	177.28	215.57
Forecasts as of: Thursday, November 17, 2016						



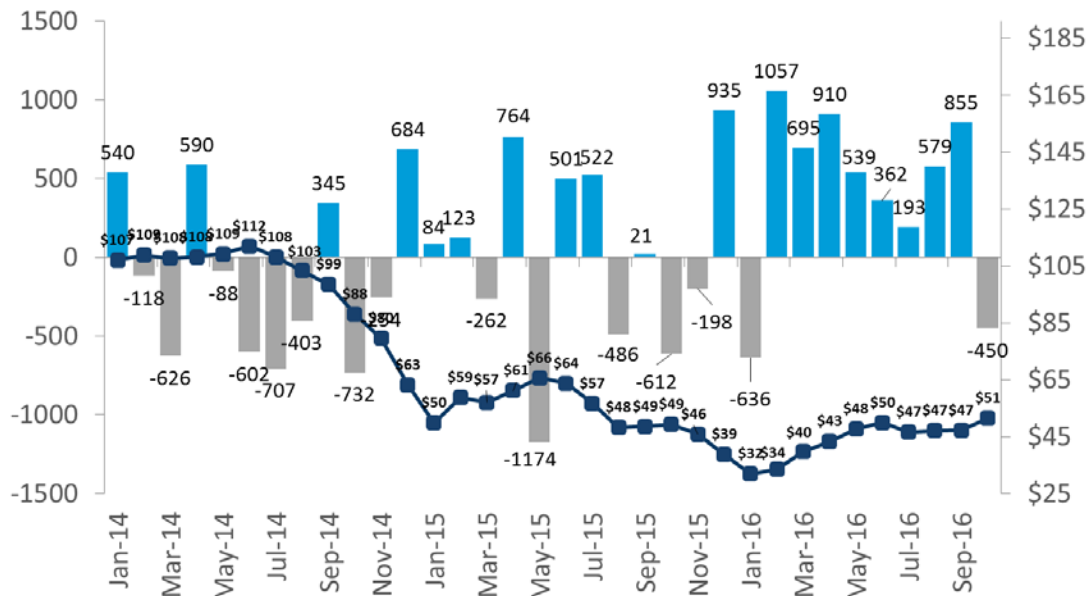
Average price forecasts, with estimated probabilities for alternative price scenarios around baseline

CMX Copper (cents per lb)						
		Price	p10	p25	p75	p90
1Q2016	Actual	211				
2Q2016	Actual	213				
3Q2016	Actual	216				
4Q2016	Forecast	235	219	232	265	282
1Q2017	Forecast	261	192	216	280	315
2Q2017	Forecast	266	172	202	290	342
3Q2017	Forecast	272	166	198	293	350
4Q2017	Forecast	280	161	195	296	357
2015	Actual	250				
2016	Estimated	219				
2017	Forecast	270	173	203	290	341

Forecasts as of: Thursday, November 17, 2016

China Crude Oil Imports Relative to Trend & Price

(Left) kbd above or below trend, (Right) avg Brent price, \$/bbl



Source: CGA, ICE, Blacklight.



Disclosures

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