Momentum in Energy Commodity Markets

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Agenda

- Motivation
- Aim of the paper
- Some literature
- Methodology
- The Data
- Preliminary Result
- Some conclusions

Motivation

Motivation

Energy markets have represented a major investment opportunity in the last decade.

Energy markets have been affected by crucial transformations and risks:

- Oil market: supply, demand, geo-political issues
- Shale Gas revolution since 2010
- LNG gas role: making the gas market global
- Deregulation of gas and electricity market
- EU fostering the creation of a single market
- Oil-to-Gas ratio
- The role of China and India
- Climate change and the role of RES
- ……..

…Motivation

Energy Prices dynamics have been exposed to different risk drivers:

- Crude oil **used to be** the only "Global " market price
- Natural gas prices driven by different risk factors
- Electricity prices not driven by fossil fuels
- Expected relationships between traditional energy sources no longer exist

Energy companies have been largely affected by these risk factors and the stock performance has affected investor's choices.

....Motivation

Two important capital markets phenomena are the "Value effect" and "Momentum effect" to explain investor's choices.

On average:

value stocks outperform **growth stocks**

stocks **with high positive momentum outperform stocks with low positive momentum.** (C. *Asness, JoF 2013).*

- Every investor wants "to beat the market".
- Large debates are going on involving the Asset pricing studies and investor's aims.
- The **momentum effect** could work well for commodities and in particular for energy commodities.

Aims

Aims

- To analyse the price dynamics of energy commodities
- To investigate the relationship between energy commodity prices and show how different risk drivers have come into play.
- To measure how energy companies are exposed to energy commodity risks.
- To investigate the *momentum effect* of energy commodities.
- To test if the momentun effect could be used to provide information on energy company returns ….

Major Facts

Major Facts: Annual Energy Outlook 2019 (EIA)

The world is gradually building a different kind of energy system, but cracks are visible in the key pillars:

Affordability: The costs of solar PV and wind continue to fall, but oil prices climbed above $80/barrel in 2018 for the first time in four years; and hard-earned reforms to fossil fuel consumption subsidies are under threat in some countries.

Reliability: Risks to oil and gas supply remain, as Venezuela's downward spiral shows. One-in-eight of the world's population has no access to electricity and new challenges are coming into focus in the power sector, from system flexibility to cyber security.

Sustainability: After three flat years, global energy-related (CO2) emissions rose by 1.6% in 2017 and the early data suggest continued growth in 2018, far from a trajectory consistent with climate goals.

Major Facts: Annual Energy Outlook 2019 (EIA)

- The US are expected to become a net energy exporter in 2020
- Large increases in crude oil, natural gas, and natural gas plant liquids (NGPL) production coupled with slow growth in U.S. energy consumption.
- Natural gas and NGPLs have the highest production growth, and NGPLs account for almost one-third of cumulative U.S. liquids production during the projection period.
- Natural gas prices remain comparatively low during the projection period compared with historical prices, leading to increased use of this fuel across end-use sectors and increased liquefied natural gas exports.

Major Facts: Annual Energy Outlook 2019 (EIA)

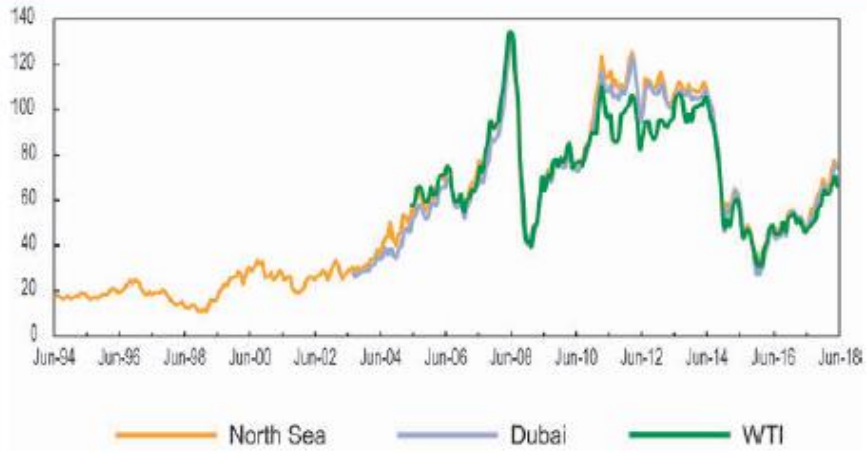
- The power sector experiences a notable shift in fuels used to generate electricity, driven in part by historically low natural gas prices. Increased natural gas-fired electricity generation; larger shares of intermittent renewables; and additional retirements of less economic existing coal and nuclear plants occur during the projection period.
- Increasing energy efficiency across end-use sectors keeps U.S. energy consumption relatively flat, even as the U.S. economy continues to expand.

Major Facts: Crude oil fundamentals

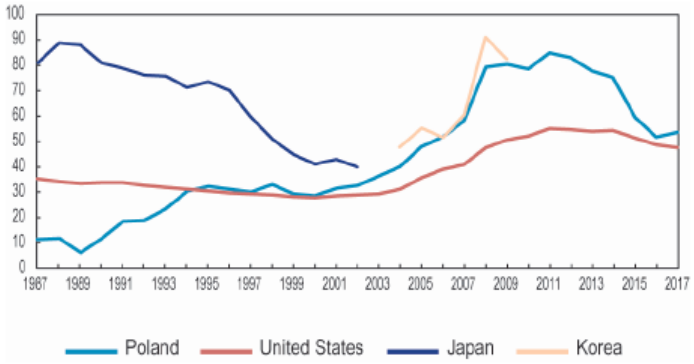
- The U.S. crude oil production continues to set annual records and remains greater than 14.0 million barrels per day (b/d). Onshore **tight oil** development continues to be the main source of growth in total U.S. crude oil production.
- On the supply side **geopolitical** events, the slump in Venezuelan output, and decisions by major exporters have also weighed on production prospects. Meanwhile, on the demand side, lower prices have pushed up oil consumption.
- **Volatility** the new name of the game: The forces of change in oil markets remain strong (shale sector; the cost of new upstream projects has come down; sales of electric cars continue to break records)

Energy Prices

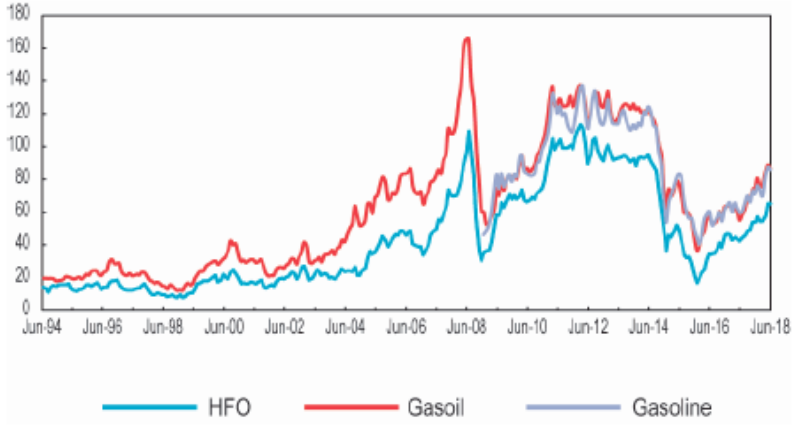
Average key crude oil spot prices in USD/barrel



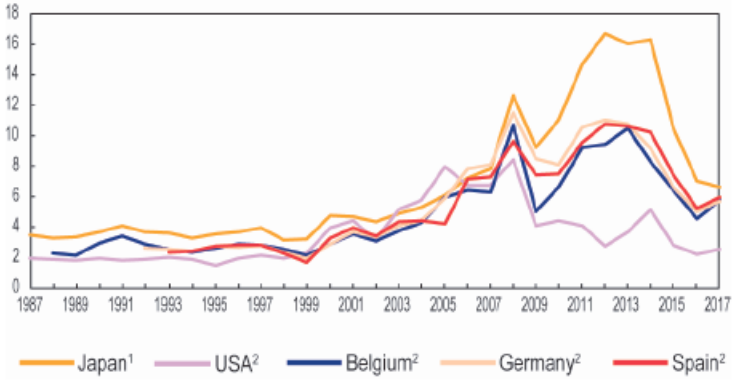
Average steam coal prices for electricity generation in USD/tonne



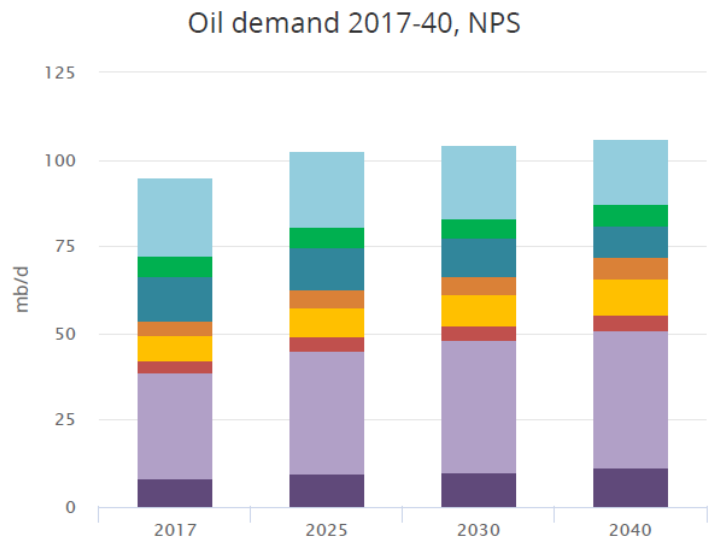
Average Rotterdam oil product spot prices in USD/barrel

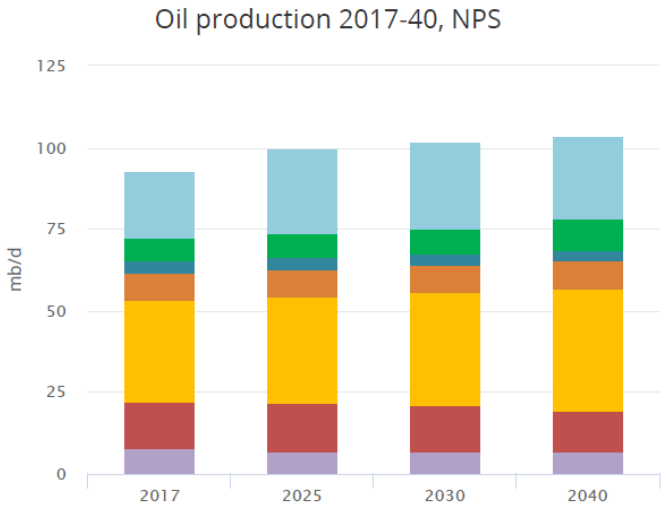


Average natural gas import prices in USD/MBtu



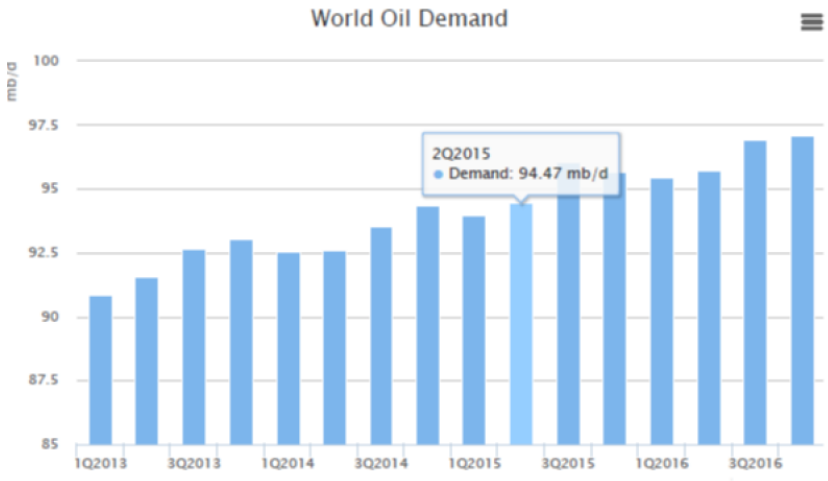
Major Facts: Crude oil fundamentals

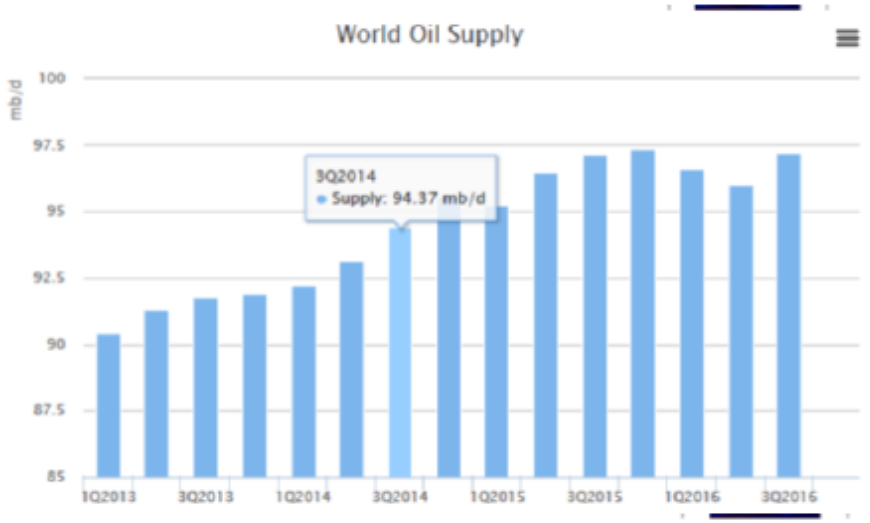


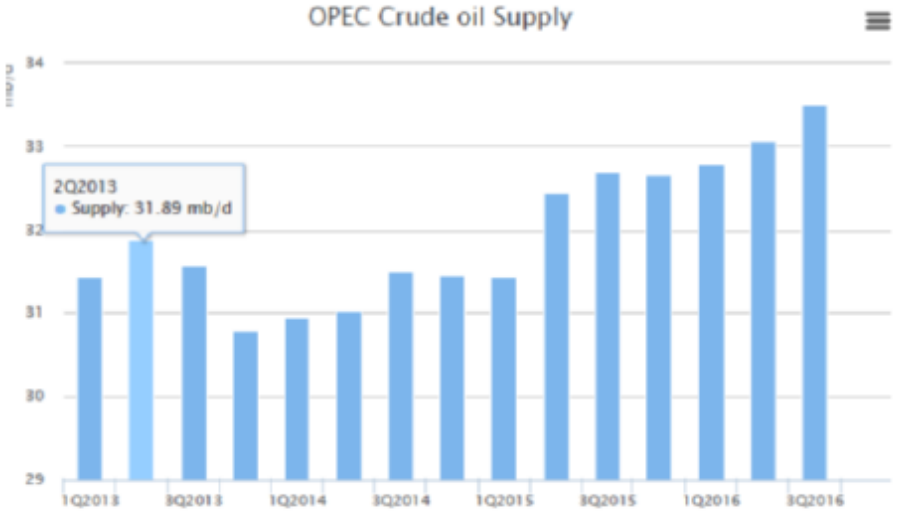


North America | Central and South America | Europe | Africa | Middle East | Eurasia | Asia Pacific | International bunkers

Major Facts: Crude oil





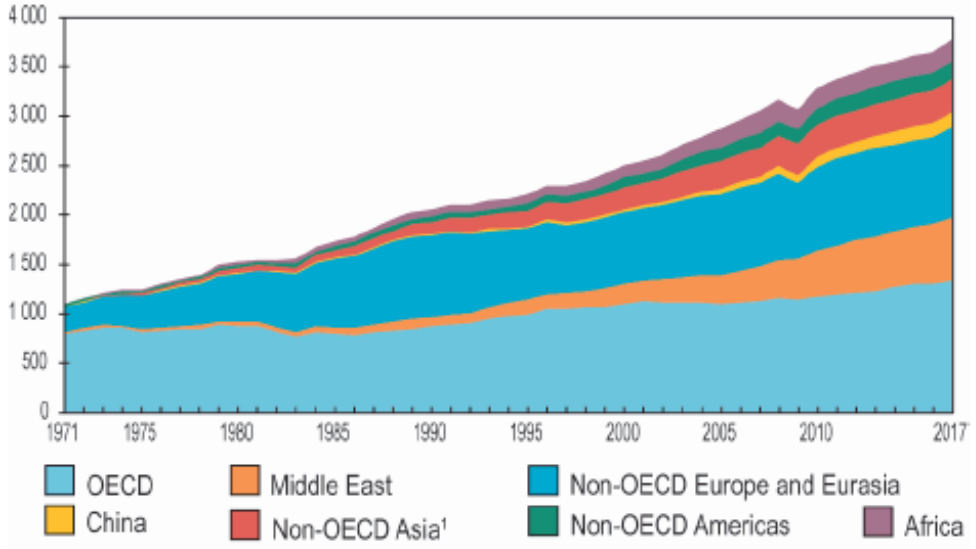


Major Facts: Gas markets

Producers	bcm	% of world total
United States	760	20.2
Russian Federation	694	18.4
Islamic Rep. of Iran	214	5.7
Canada	184	4.9
Qatar	169	4.5
People's Rep. of China	142	3.8
Norway	128	3.4
Australia	105	2.8
Algeria	94	2.5
Saudi Arabia	94	2.5
Rest of the world	1 184	31.3
World	**3 768**	**100.0**

2017 provisional data

World natural gas production from 1971 to 2017 by region
(billion cubic metres, bcm)



Major Facts: gas markets

- Unconventional gas accounts for almost half of the growth in global output and its development spreads well beyond North America, notably after 2020, making China and Australia major contributors to global production growth.
- LNG exports from the United States factor strongly in putting additional pressure on traditional oil-indexed mechanisms for pricing gas and in loosening the current rigidity of LNG contracting structures.
- Surging growth in the global gas trade – underpinned by the shale revolution in the United States and the rise of liquefied natural gas (LNG) – continues to accelerate the transformation of global gas markets.

Major Facts: gas markets

New sources of gas, both conventional and unconventional, bring additional diversity to global supply.

New contributors to conventional production include

- Iraq,
- East Africa,
- Brazil
- Eastern Mediterranean,

Net exporters	bcm
Russian Federation	217
Norway	123
Qatar	121
Australia	62
Canada	61
Turkmenistan	55
Algeria	54
Indonesia	29
Malaysia	28
Nigeria	27
Others	151
Total	928

Major Facts: gas markets distribution

Natural Gas Production

Billion cubic metres	2015	2016	Growth rate per ann 2016	Growth rate per ann 2005-15	Share 2016
US	766.2	749.2	-2.50%	4.10%	21.10%
Canada	149.1	152	1.70%	-1.30%	4.30%
Mexico	54.1	47.2	-13.00%	0.30%	1.30%
Total North America	969.4	948.4	-2.40%	2.80%	26.70%
Total S. & Cent. America	178	177	-0.80%	2.40%	5.00%
Total Europe & Eurasia	995.4	1000.1	0.20%	-0.30%	28.20%
Total Middle East	615.9	637.8	3.30%	6.70%	18.00%
Total Africa	210	208.3	-1.10%	1.70%	5.90%
Total Asia Pacific	561.9	579.9	2.90%	4.10%	16.30%
Total World	3530.6	3551.6	0.30%	2.40%	100.00%
of which: OECD	1284.5	1281.6	-0.50%	1.90%	36.10%
Non-OECD	2246.1	2270	0.80%	2.80%	63.90%
European Union #	119.8	118.2	-1.60%	-5.50%	3.30%
CIS	757.6	764.3	0.60%	0.40%	21.50%

Major Facts: oil and gas

- Crude oil and natural gas expected to be correlated
  - crude oil driving natural gas prices
  - crude oil and NG being highly correlated
- NG and Electricity correlation
- Fossil fuels and electricity being highly correlated
- Crude oil driving most of commodity prices
- Crude oil and financial market dynamic
- based on an energy equivalent basis, crude oil and natural gas prices should have a 6 to 1 ratio. …..

Value and Momentum

- **Value** strategies aim to capture the outperformance of underpriced stocks based on certain financial ratios, such as price-to-earnings, price-to-book, price-to-cash-flow. *Fama and French* (1992), *Lakonishok et al*. (1994), among others, find evidence of a value effect.

- **Momentum** is the empirically observed continuation in asset prices:
  - Assets that have risen in the past are more likely to continue rising in the near future
  - Assets that have underperformed in the recent past are more likely to continue underperforming. i.e., stocks with high past returns over the previous 6–12 months outperform stocks with low past returns (*Jegadeesh and Titman* (1993, 2001));

Some Literature

Some Literature on energy commodities

- Commodity showing negative correlation with financial assets:(Gorten and Rowenhorst, 2013), (Gorten and Rowenhoarst, 2006).
- Commodity providing an efficient diversification asset: (Abanomey and Mathur (2001), Georgive (2001), Nijman & Swinkels (2003) and Chan & Young (2006), Jenson et al. (2002), Nijman & Swinkels (2008) and Conover et al. (2009); Dasakalaki and Skiadopoulas (2011).
- Increased correlation after the financial crisis (financialization of commodities markets):Guo et al. (2011), Chen et al. (2011), Silvennoinen and Thorp (2013), Nissanke (2012) and Morana (2013); D'Ecclesia et Kondi 2017.
- Empirical evidence on financial speculation in driving commodity market prices: Gilbert (2010), Brunetti et al. (2011), Buyuksahin and Harris (2011), Juvenela & Petrella (2011) and Phillips & Yu (2011)

Some recent Literature on Momentum

- Early evidence on U.S. equities finds that value stocks on average outperform growth stocks (Stattman (1980), Rosenberg, Reid, and Lanstein (1985), and Fama and French (1992))
- Stocks with high positive Momentum (high 6- to 12-month past returns) outperform stocks with low M (Jegadeesh and Titman (1993), Asness (1994)).
- Fama and French (1998), Griffin, Ji, and Martin (2003), and Rouwenhorst (1998, 1999) show that V&M effects are present in country equity indices.
- Momentum is also found in currencies (Shleifer and Summers (1990), Kho (1996), LeBaron (1999)) and commodities (Erb and Harvey (2006), Gorton, Hayashi, and Rouwenhors(2008)).
- **Asness 2010** finds negative correlation between V&M.
- ***Asness et al.* (2013)** found V&M returns co-movements across equity markets worldwide but also across several asset classes, namely government bonds, equity indices, currencies, commodities futures.

Methodology

Methodology (1/3)

Commodity price relationships:

- Stationarity (ADF test)
- Structural break tests (Bai Perron)
- Volatility analysis (GARCH (1,1), EGARCH(1,1))
- Dynamic Conditional Correlation (DCC- GARCH)
- Structural breaks in DCCs

Methodology (2/3)

Momentun analysis

Returns: Daily excess return of the most liquid futures contract (the nearest to delivery contract), compounding it to a total return index in order to compute returns at a monthly horizon.(Bessembinder 1992, Koijen et al. 2012)

Momentum: past 12-month cumulative raw return on the asset from past monthly periods, skipping the most recent month's return, in line with the literature (Jegadeesh and Titman, 1993; Asness, 1994; Fama and French, 1996; Grnblatt and Moskowitz, 2004).

Methodology (3/3)

Momentum Portfolios

- We test how energy companies are affected by energy commodity risks
- We rank energy commodities in each area by Momentum.
- We investigate the relationship between momentum of energy stocks and energy commodities

- We build a momentum factor for the energy sector. S_{it} is the signal for every commodity, we weight commodities in proportion to their cross-sectional rank based on the signal minus the cross-sectional average rank of that signal.

DATASET

Data Used

Equity Markets *(Bloomberg)*

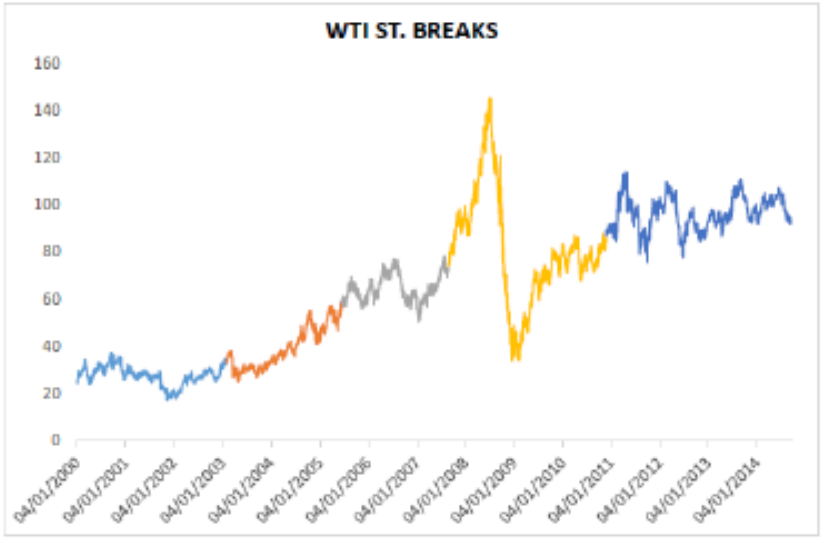
- Energy stocks traded on the AMEX, Nasdaq and NYSE: European, Asian, US companies and RoW companies from January 2000 to July 2018 (or the first date available).

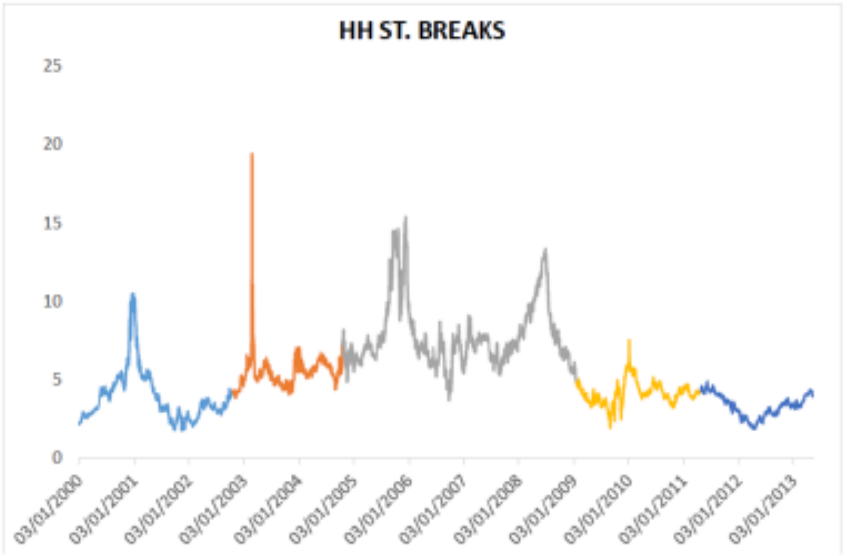
Energy commodities

- Commodity futures on first nearby contracts
  - US market: WTI Crude, RBOB Gasoline, Heating Oil, HH Natural gas;
  - Europe: Brent crude, NBP Gas, TTF natural gas, Gasoil.

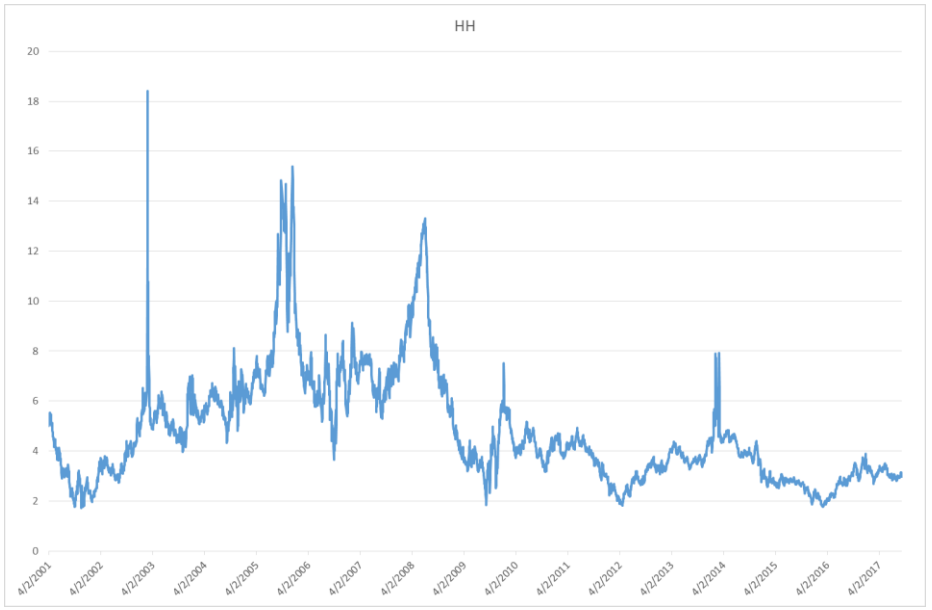
Some results

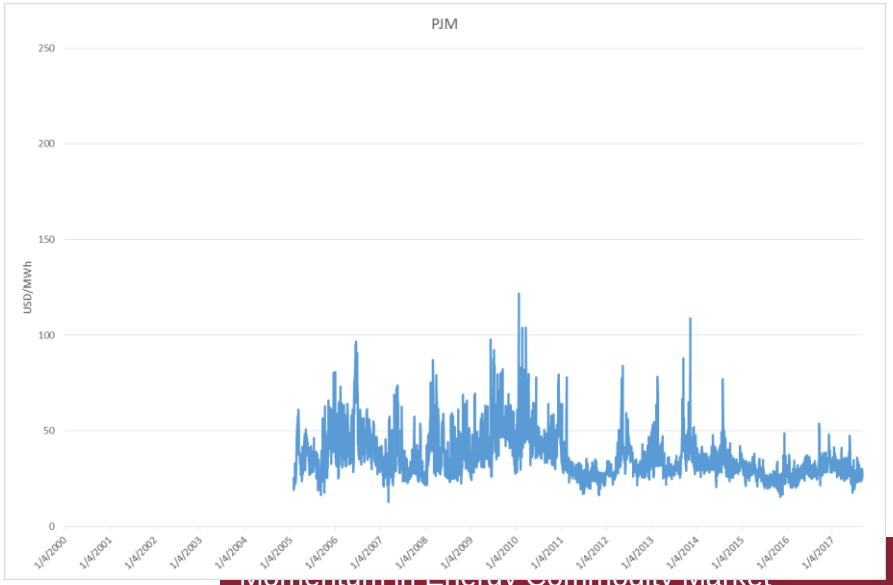
US Energy Markets



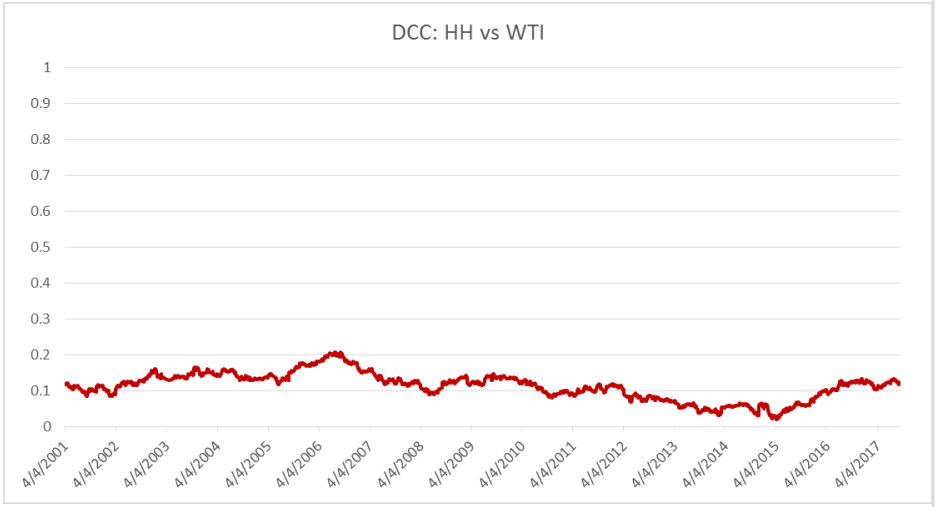


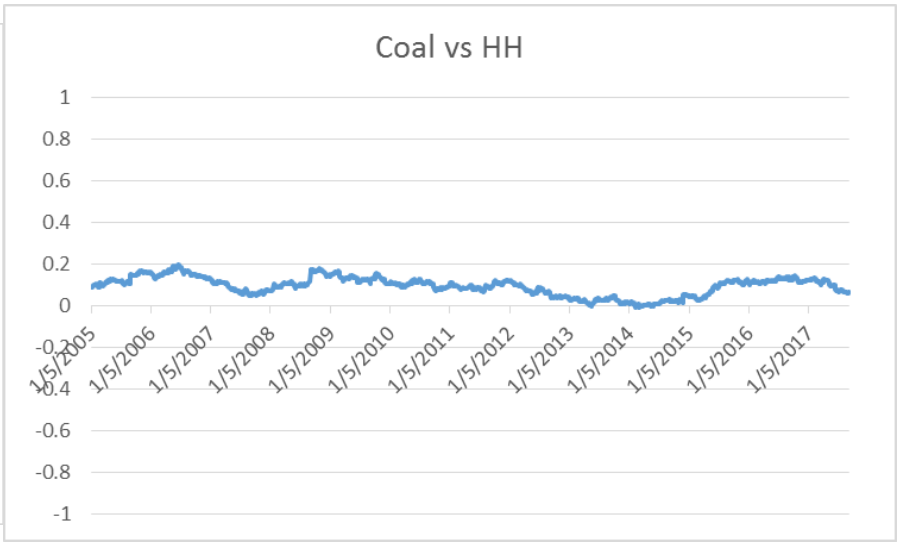
US Energy Markets: prices

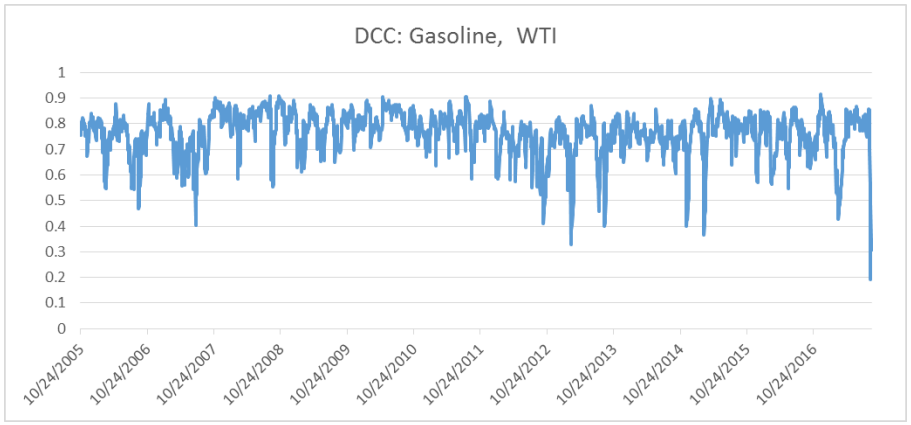


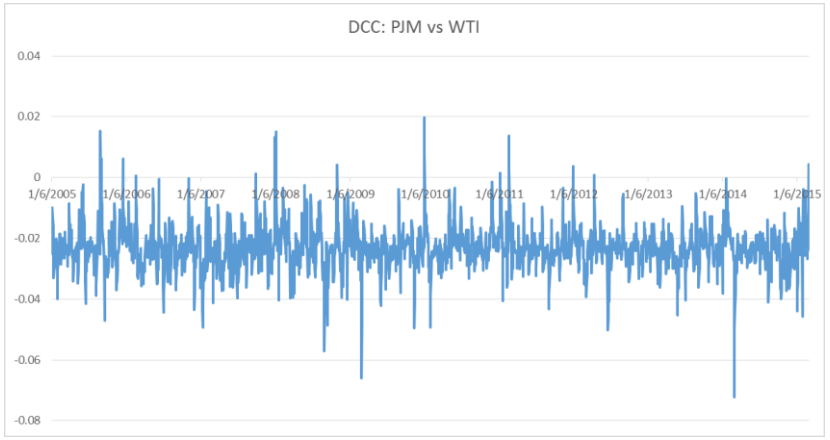


US Energy Markets: correlations

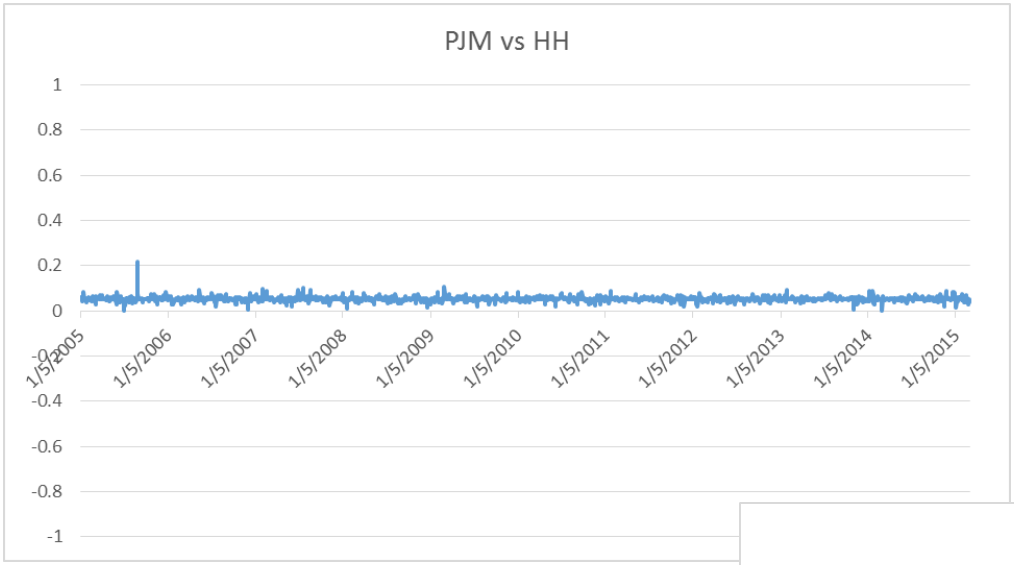


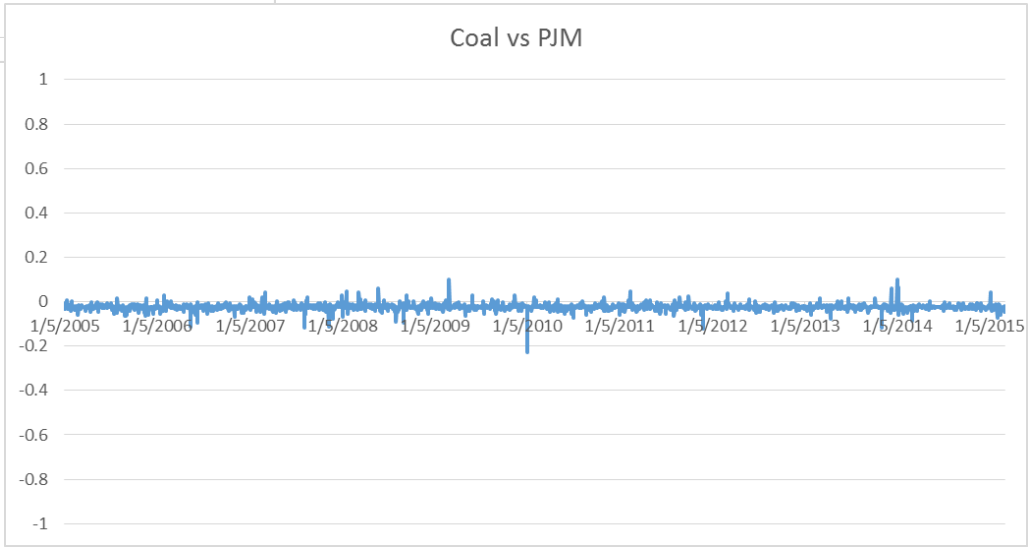




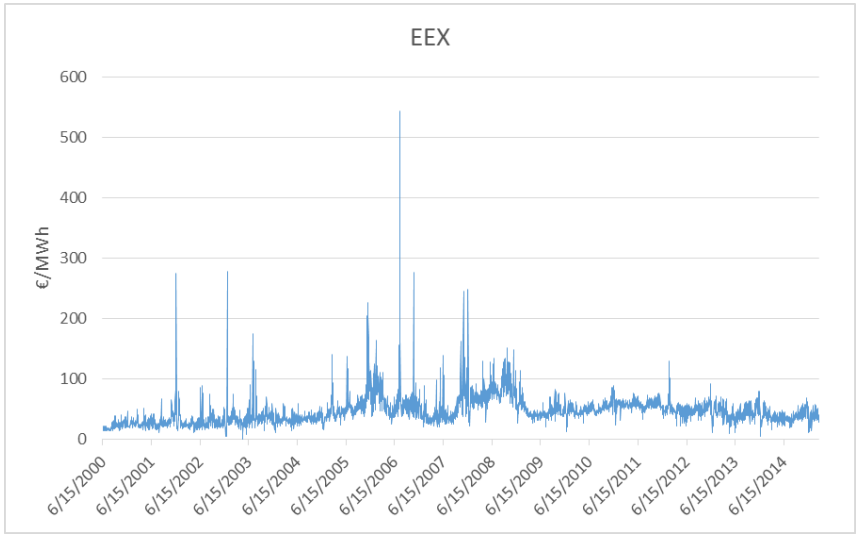


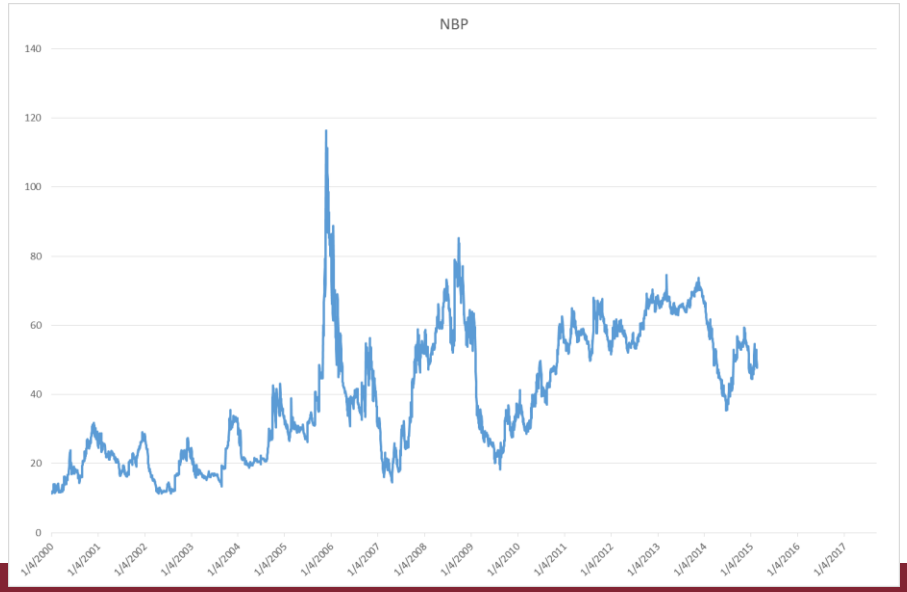
US markets: Correlations



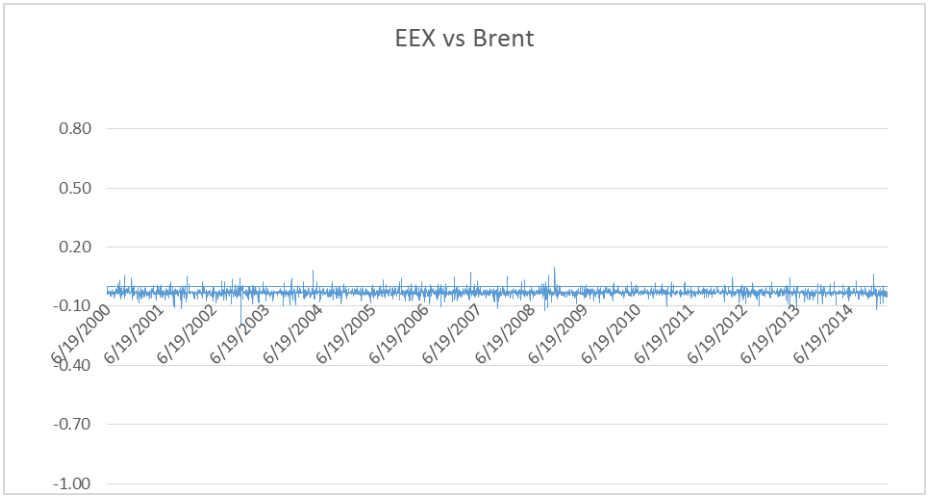


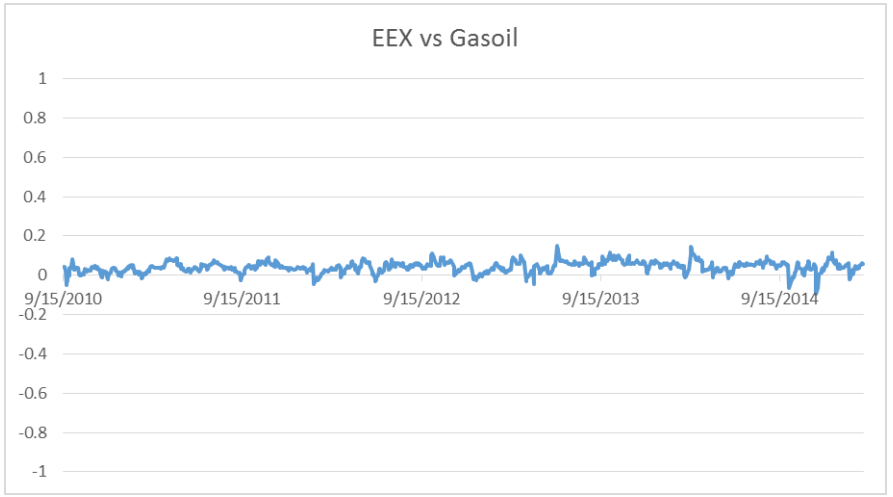
European Energy Markets

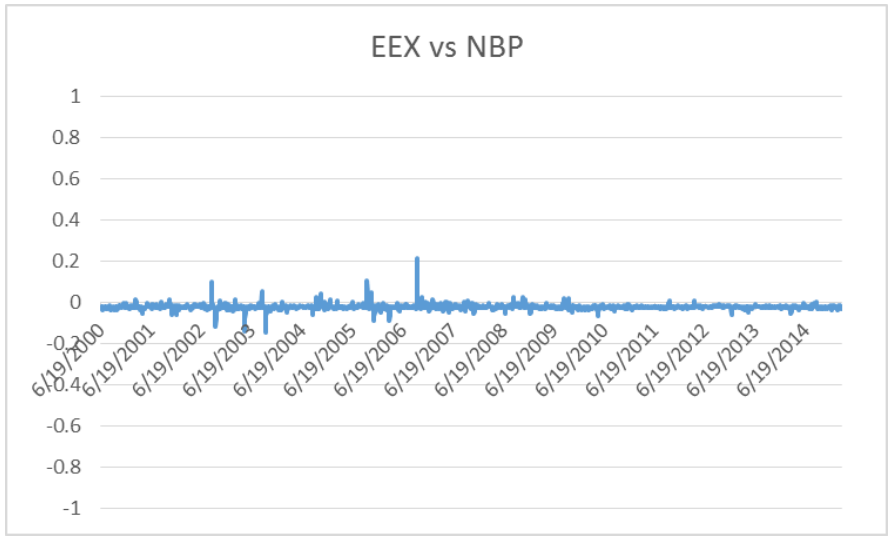


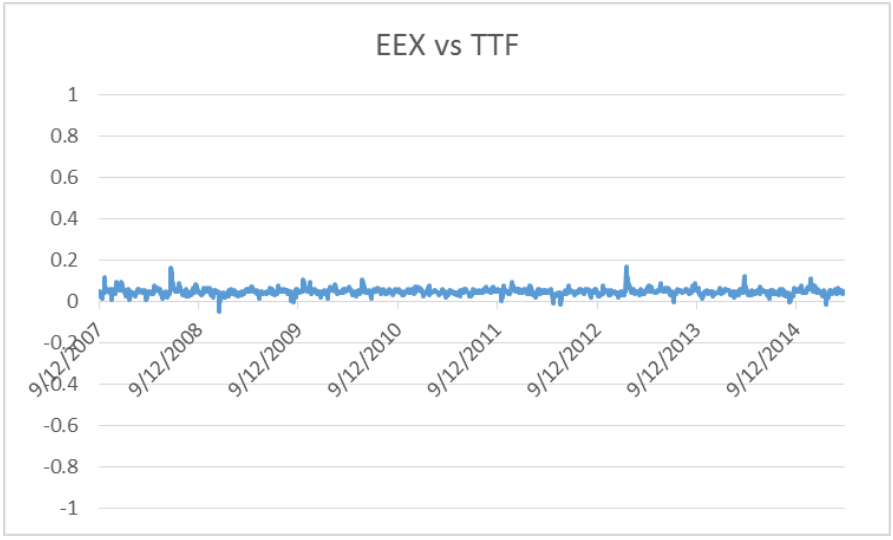


European Energy Markets: correlations









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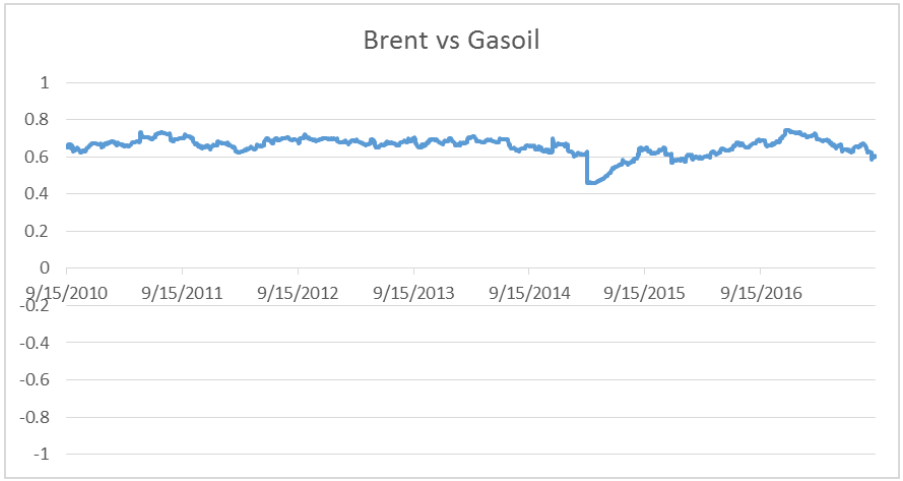
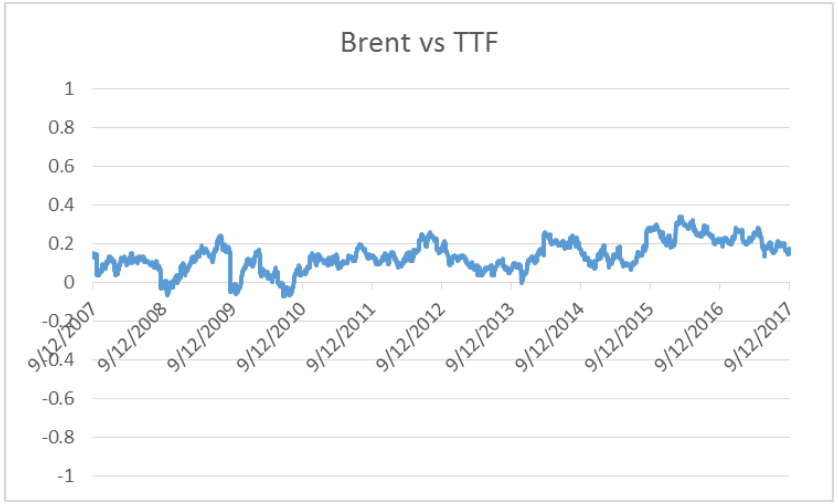
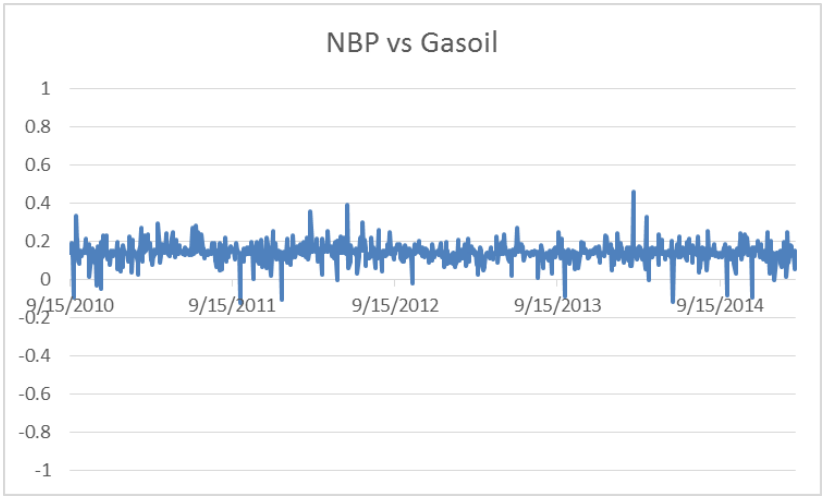






E(DCC) for US and Europe

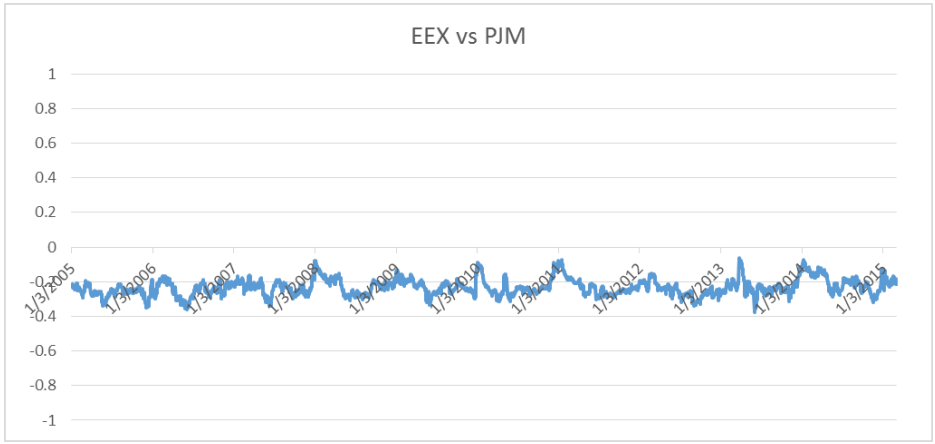
E(DCC) for US energy commodities

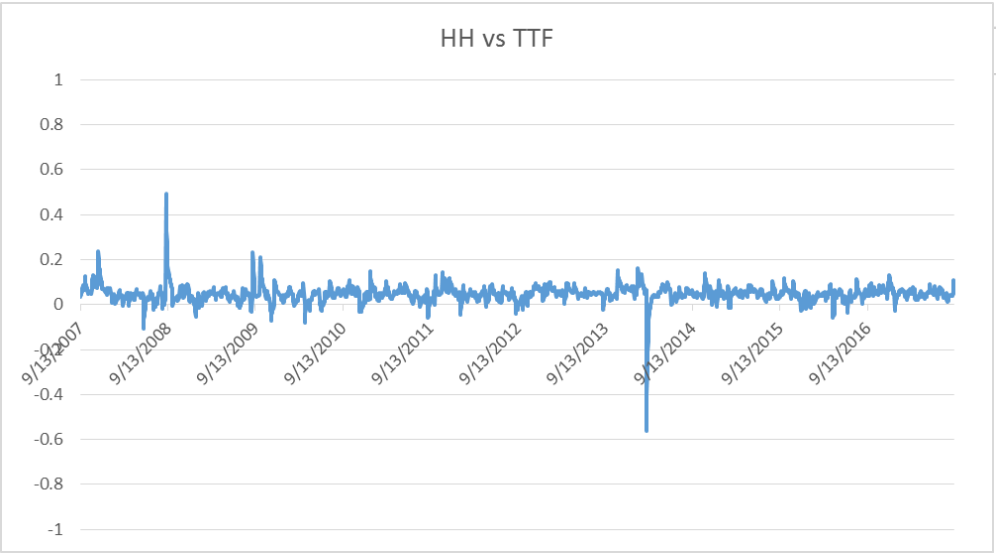
	WTI	HH	RBOB	PJM	HO	coal
WTI	1					
HH	0.11	1				
RBOB	0.76	0.2	1			
PJM	-0.02	0.09	0.01	1		
HO	0.9	0.09	0.79	0.03	1	
coal	0.03	0.23	0.11	0.1	0.13	1

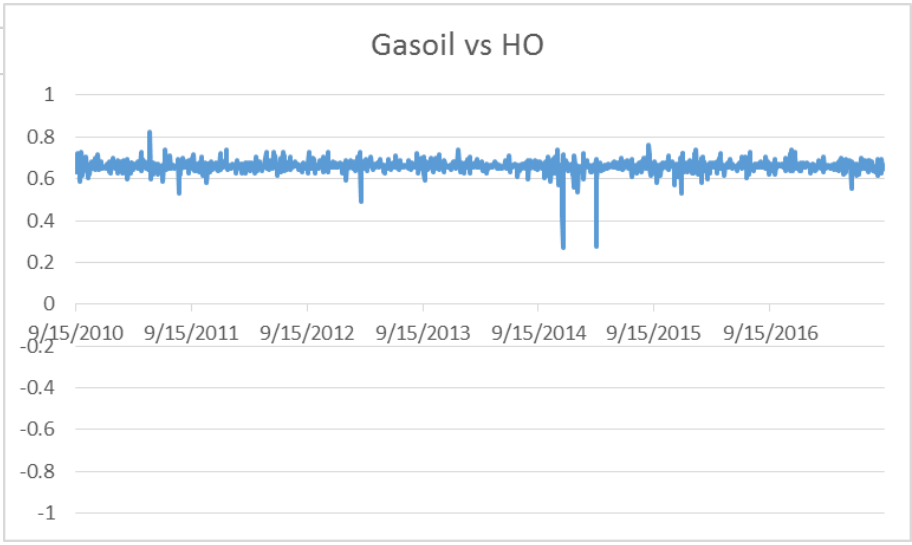
E(DCC) for EU energy commodities

	BRENT	NBP	TTF	EEX	GASOIL
BRENT	1				
NBP	0.221	1			
TTF	0.201	0.69	1		
EEX	0.032	0.09	0.08	1	
GASOIL	0.784	0.21	0.26	0.16	1

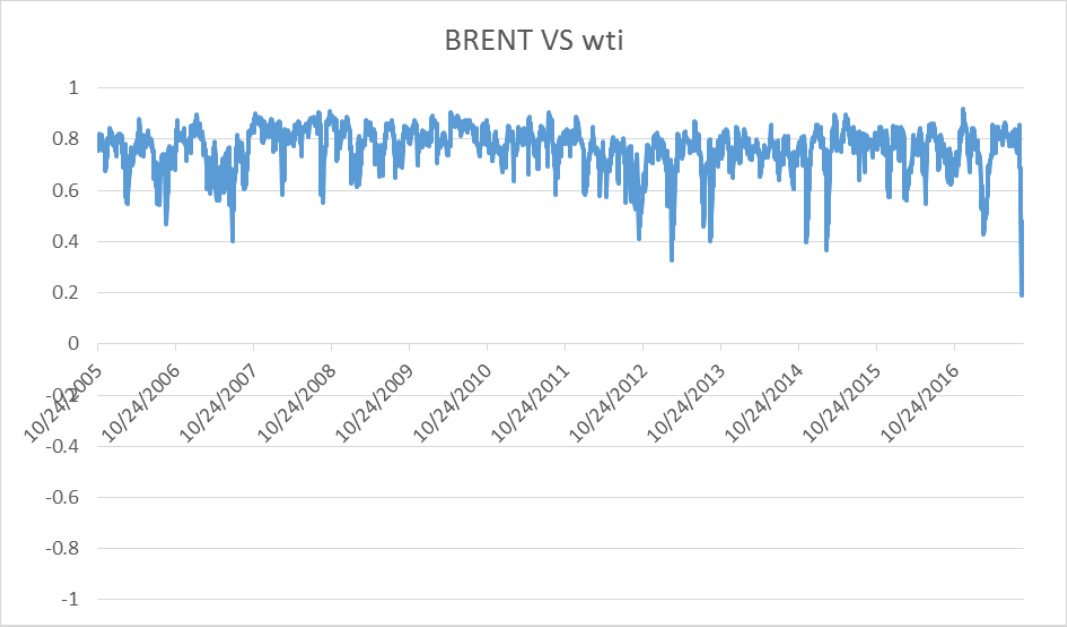
European vs US markets



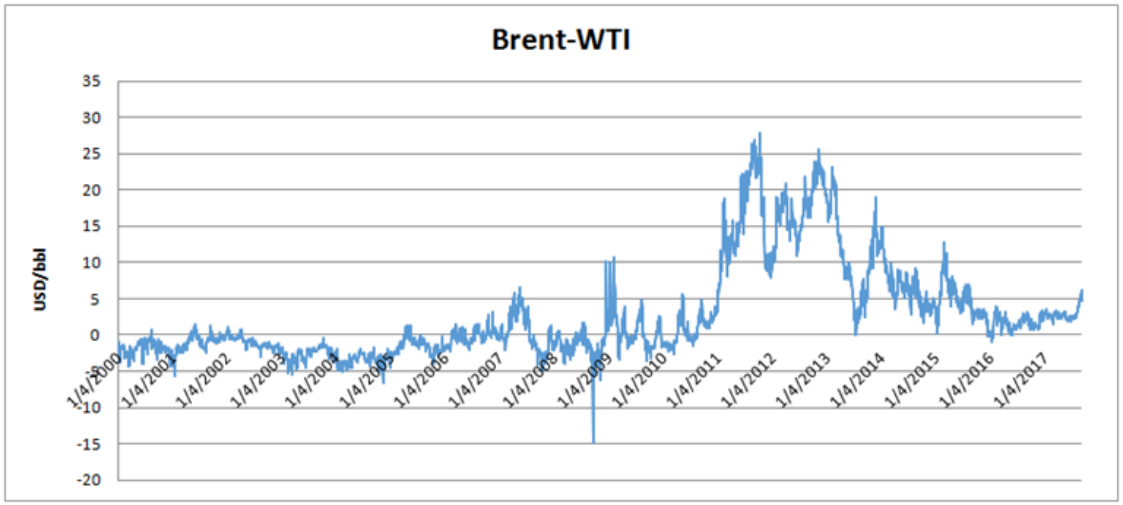




European vs US markets (crude oil and gas)



DCC (Brent, WTI)	
E(DCC)	0.86818714
Var(DCC)	0.00530102
min	-0.2312102
max	0.98917905
Structral break	
	5/5/2004
	1/6/2011
	10/1/2014



Main findings

US

- Natural gas and crude oil returns are uncorrelated
- Crude oil is correlated with Gasoline and Heating oil
- Main risk factors are represented by NG and Crude oil
- Electricity is not correlated to Natural gas or Crude oil

Europe

- Natural gas and crude oil returns are uncorrelated
- Natural gas prices are converging to a single market
- TTF price took over NBP as reference European gas price
- EEX does not seem to be affected by natural gas or Crude oil

Main findings

Global Energy markets

- WTI and Brent have shown a period of divergence (2009-2012) with Brent sold at a premium vs WTI
- Brent and WTI returns show a time varying correlation fluctuating around 0.8
- Gas markets in US and Europe do not show any relationship
- Gasoil (EU) and Heating Oil (US) show some significant correlations
- Electricity markets (US PJM) and EEX do not show any correlations.

Energy companies

Energy sector shares are assumed to be mainly exposed to energy commodity risks.

Testing how Energy sector are exposed to the main energy drivers (Crude Oil and Natural Gas) globally.

We consider 321 Energy sector companies traded on the US markets

	AMEX	NASDAQ	NYSE	Total
US	27	63	176	266
EUROPE	0	0	16	16
ASIA	0	2	4	6
Other	2	1	30	33
Total	29	66	226	321

Energy companies and energy risk

Energy companies exposed to CO(X) and NG(Y) risks

- simple DCC estimation
- estimation of

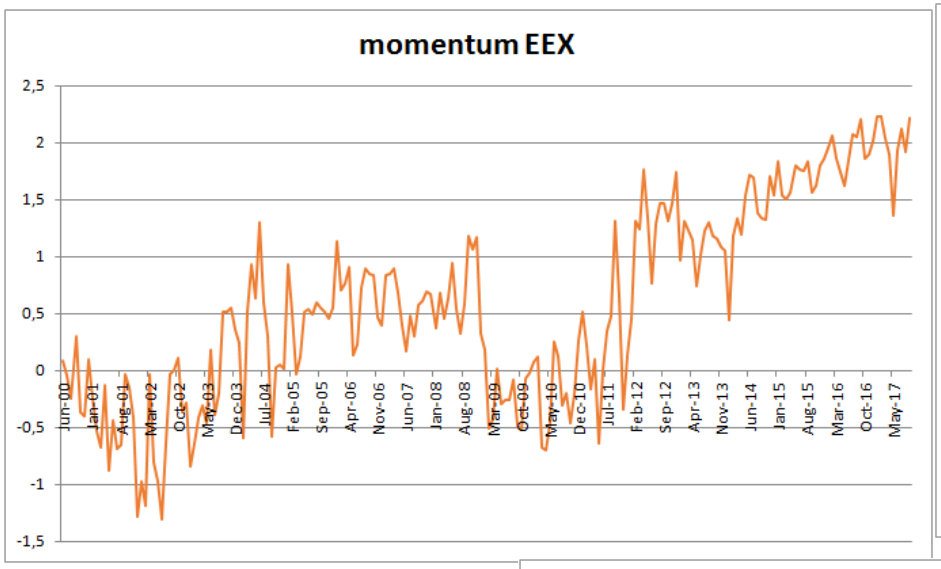
$$R_{it} = \alpha + \beta_{1i} X_t + \beta_{2i} Y_t + \varepsilon_t$$

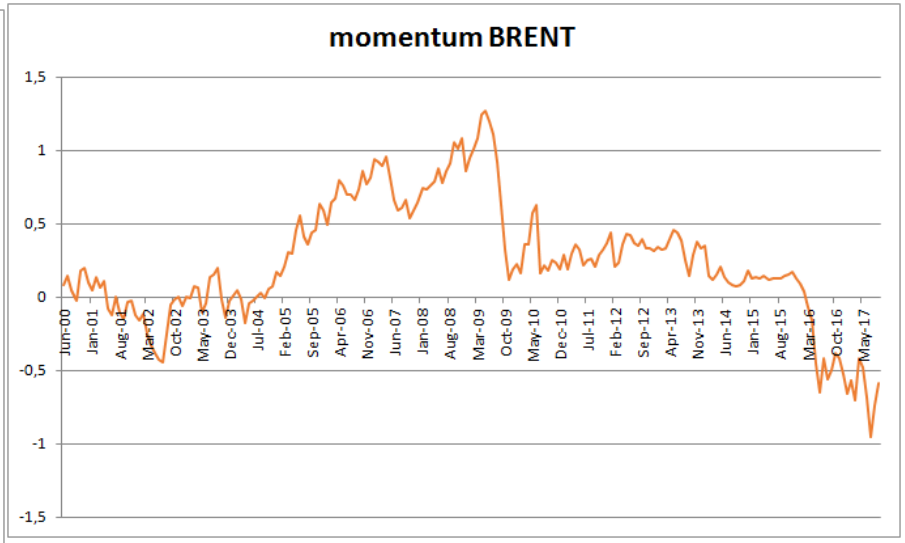
	α	t	β	t	β2	t
Ticker						
ANW	**0.5**	3.5	0.24	1.34	**1**	4.3
AHGP	**1.3**	5.67	**0.5**	3.6	0.34	1.23
ARLP	**0.9**	4.3	**0.1**	5.9	0.23	1.3
ENI	**0.4**	2.3	**0.7**	4.6	**0.02**	3.7
BAS	**1**	3.8	0.54	0.99	**0.4**	3.2
total	**0.9**	6.5	**0.3**	3.5	0.67	1.2
BPL	**0.7**	7.4	**0**	3.6	**0.2**	4.1
COG	**0.3**	4.3	**0.2**	4.2	**0.7**	3.2
CLMT	**0.2**	2.9	**0.1**	3.6	0.43	1.3
CPST	**0.6**	3.6	**0.2**	5.2	0.28	1.9
CRZO	**0.9**	2.98	0.54	1.2	0.3	2.1
CYD	**0.8**	4.23	0.27	0.9	**0.7**	3.5

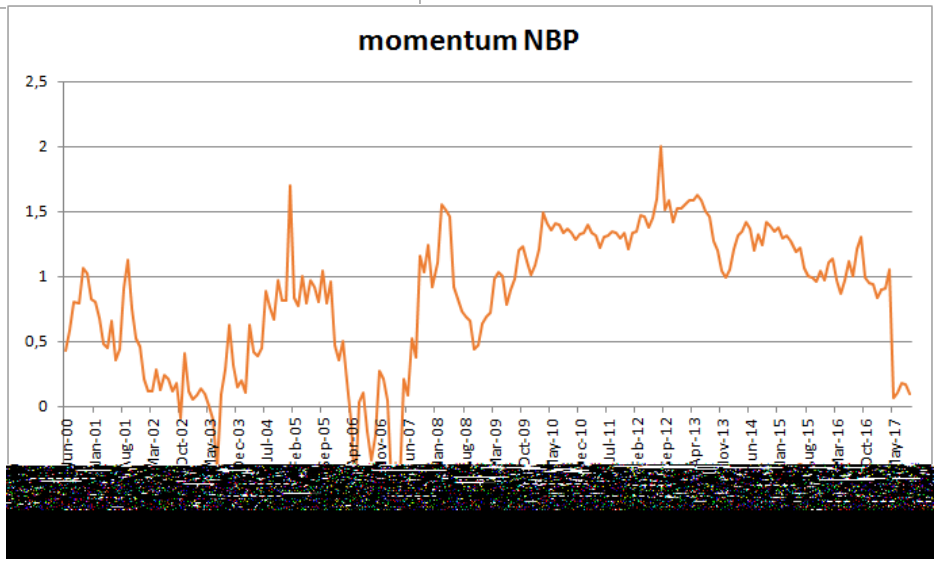
Energy companies and energy risk

Geographical area	Factor X (crude oil)	Factor Y (natural gas)	Combination
US	102 (45%)	67 (29%)	35 (13%)
EUROPE	5 (31%)	4 (25%)	5 (31%)
ASIA	0 (0%)	1 (16%)	0 (0%)

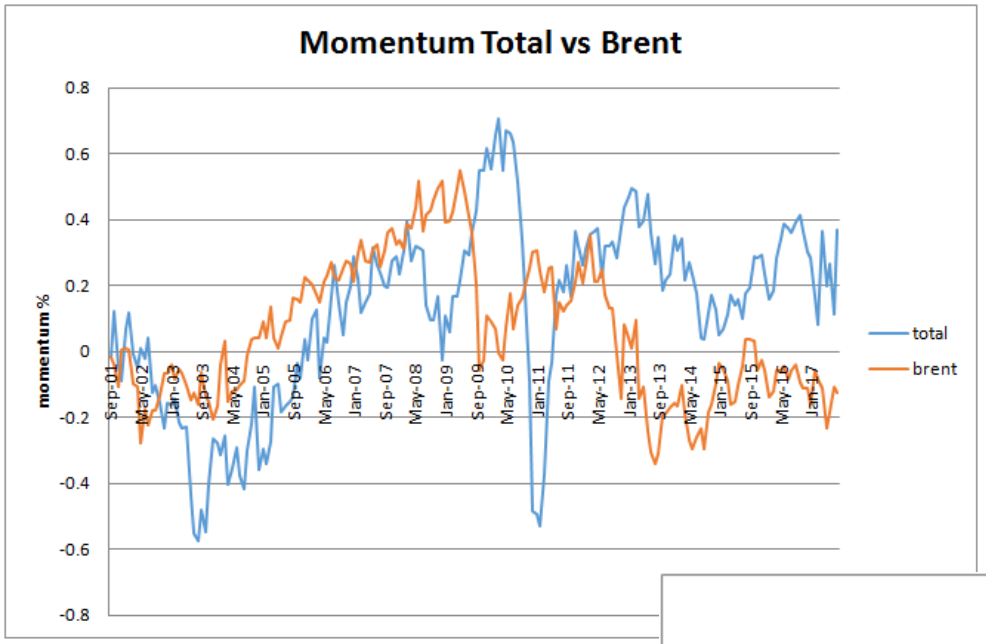
Energy Momentun in Europe



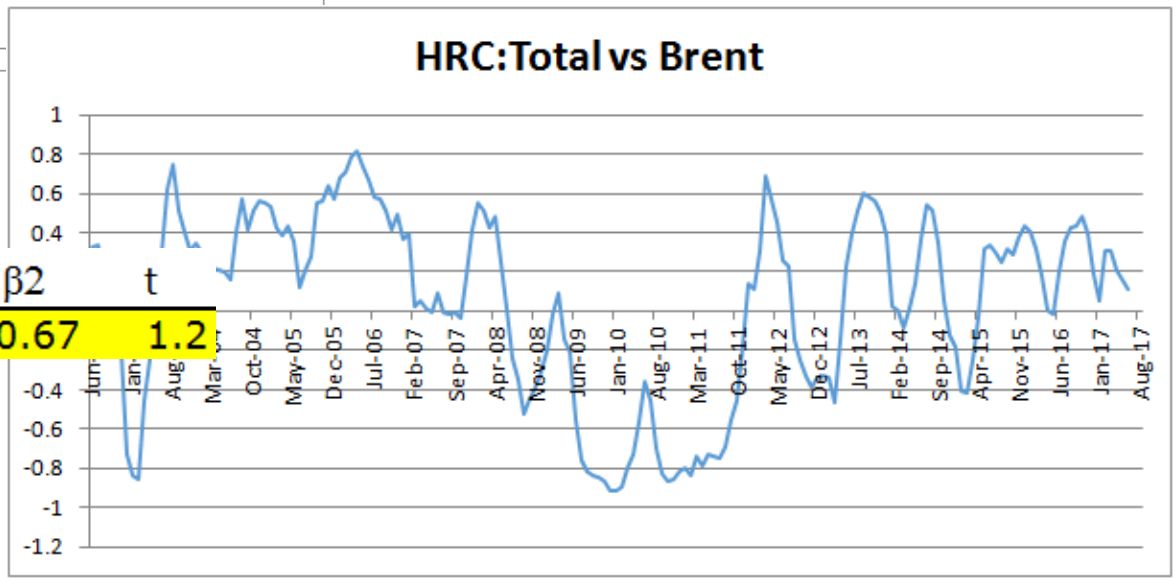




Momentun in Europe

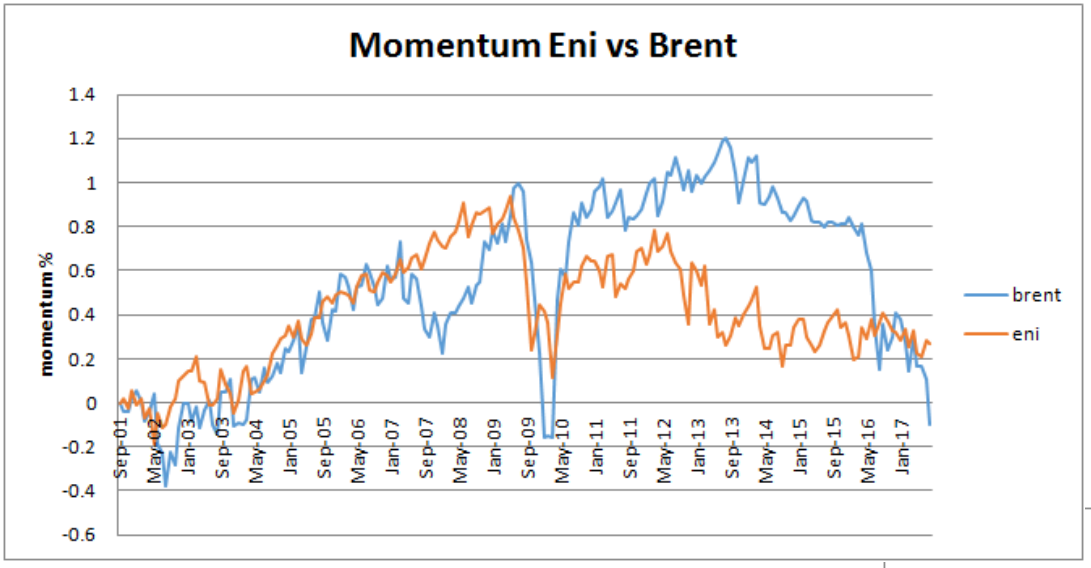


E[HRC] (Total, Brent) = 0.09



	α	t	β	t	β2	t
TOTAL	**0.9**	6.5	**0.3**	3.5	0.67	1.2

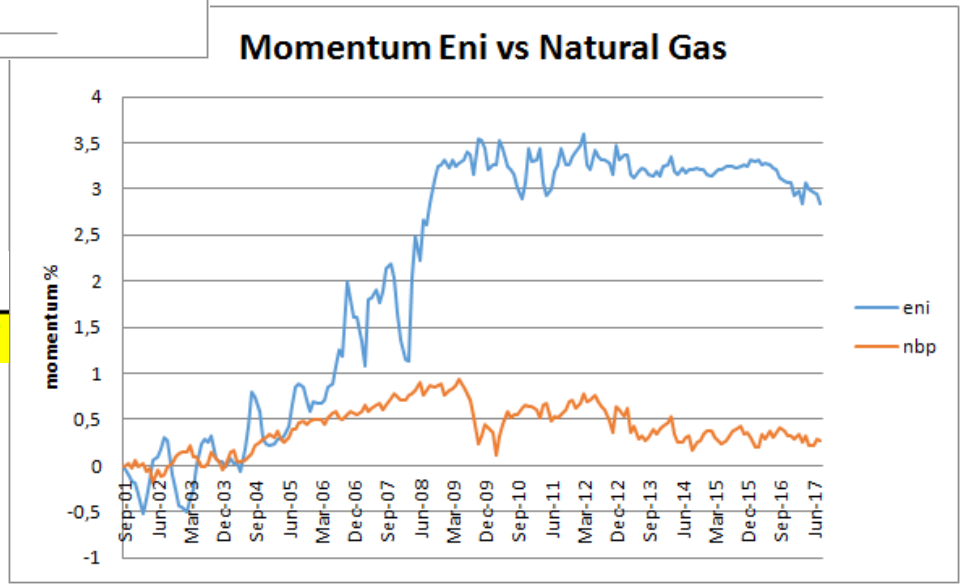
Momentun for European Companies



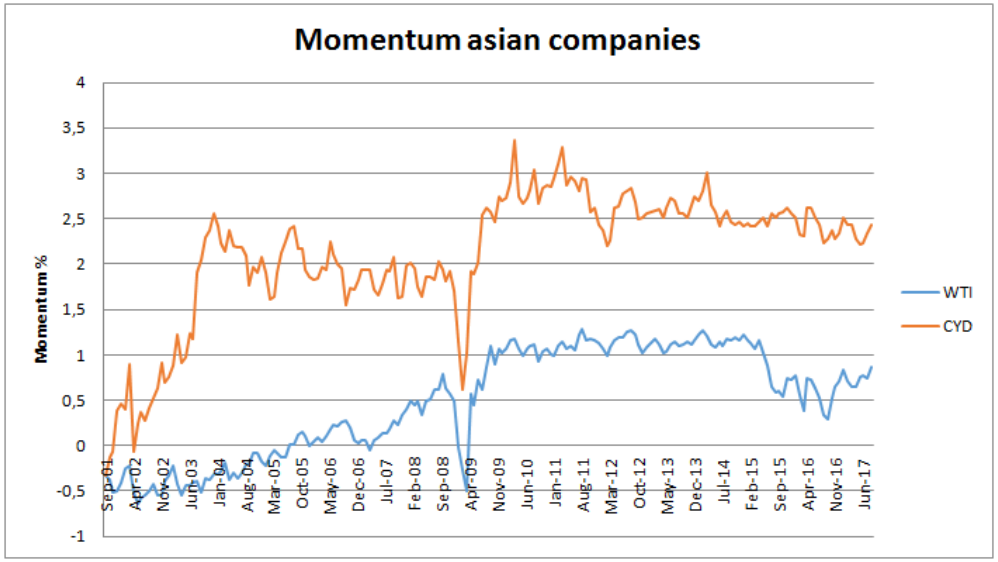
E[HRC] (Eni, Brent) = 0.335

E[HRC] (Eni, NBP) = 0.29

	α	t	β	t	β2	t
ENI	**0.4**	2.3	**0.7**	4.6	**0.02**	3.7

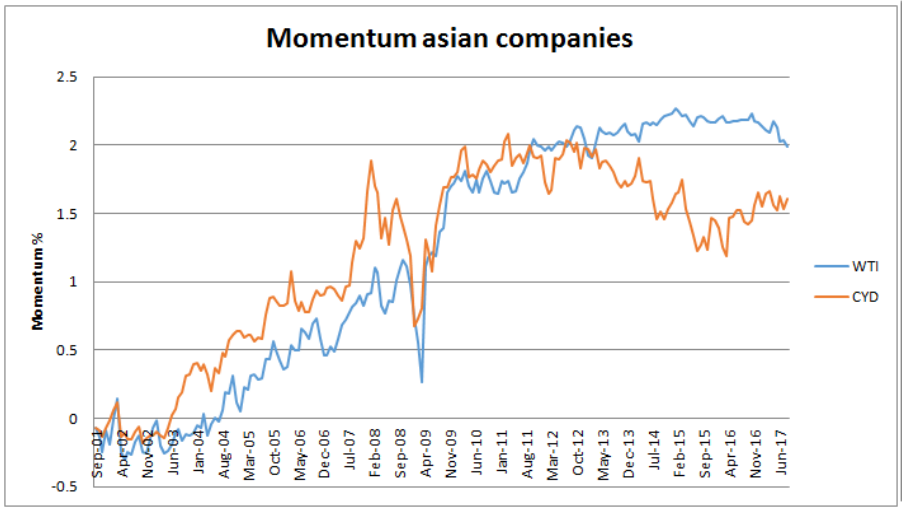


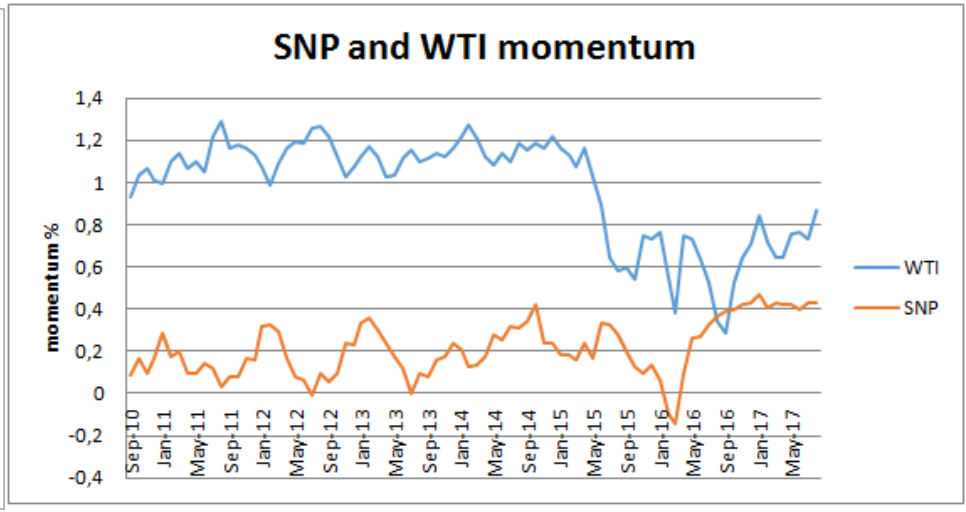
Momentun Asian Companies



E[HRC] (CYD, WTI) = 0.435
E[HRC] (CEO, BRENT) =0.24
E[HRC](SNP, WTI) =0.214

	α	t	β	t	β2	t
CYD	**0.3**	2.3	0.1	0.6	**0.34**	3.7
CEO	0.1	3.1	0.3	1.2	0.4	1.2
SNP	0.5	4.2	0.9	1.9	0.03	0.9





How to use the momentum effect

- We want to assess the economic significance of these patterns and how much of the return premia to momentum can be captured by these common variation.

So for each company

$$R_{it} - r_{f,t} = \alpha_i + \beta_i I_{MKT\,t} + \gamma_i MOM_t + \varepsilon_{it}$$

where
I is the market index proxied by MSCI World index
MOM are the equal-volatility-weighted across energy commodities momentum factors.

Conclusions

- Energy commodities have complex dynamics
- Structural breaks help to understand the risk drivers
- Main risk drivers: Crude Oil and Natural Gas which do not move together
- Energy sector companies do not seem to be directly affected by energy commodity risks
- Momentum in energy prices may provide useful tool for investment strategies
- Momentum in energy prices and in energy shares show puzzling relationships.

Still Working

- To assess the role of Momentum effect in explaining energy companies returns.
- Measure the relationship between Value (following Asness et.al. 2013) and Momentum for energy companies

- **Other suggestions?**

Some References

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Thank You