The Role of Financial Investors on Commodity Futures Risk Premium

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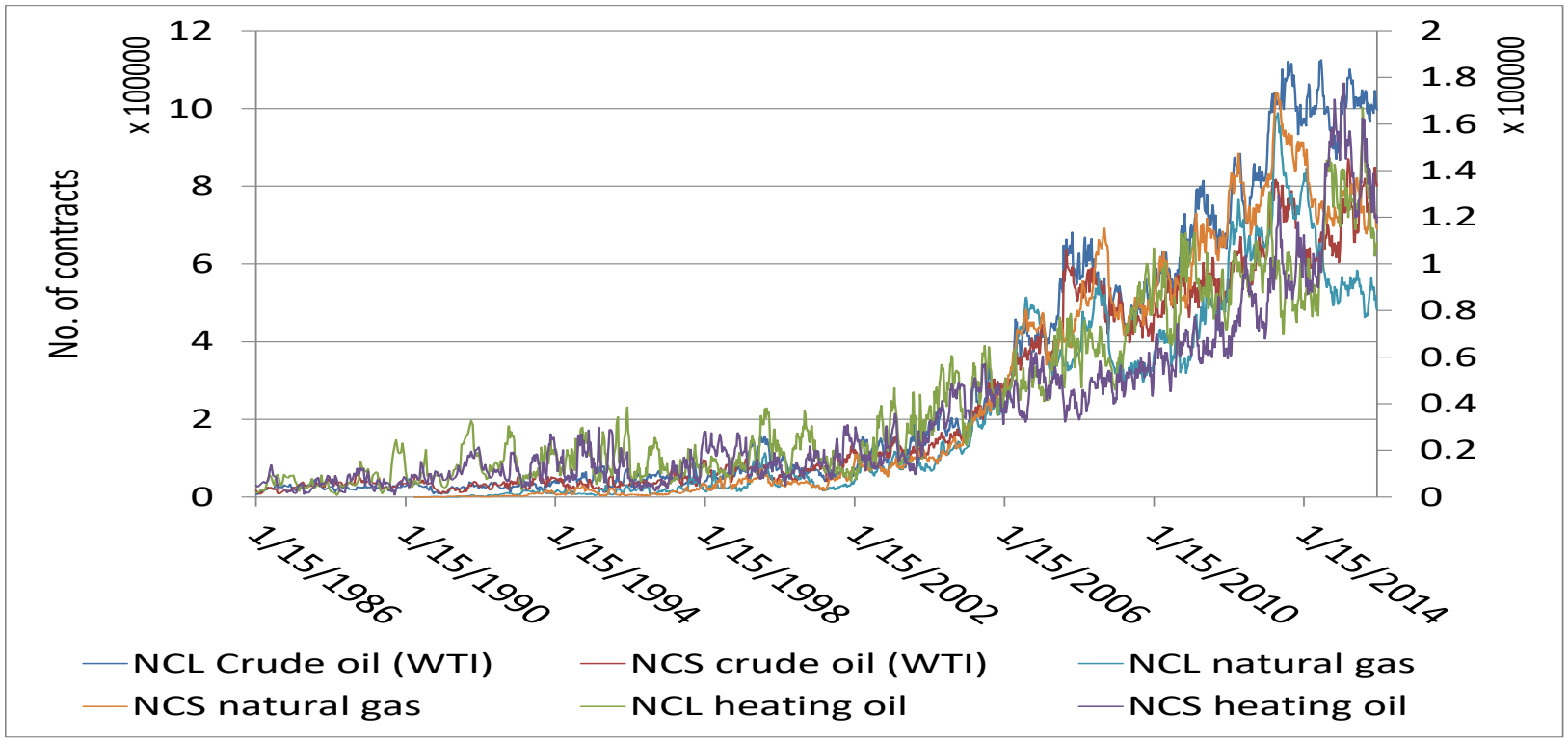
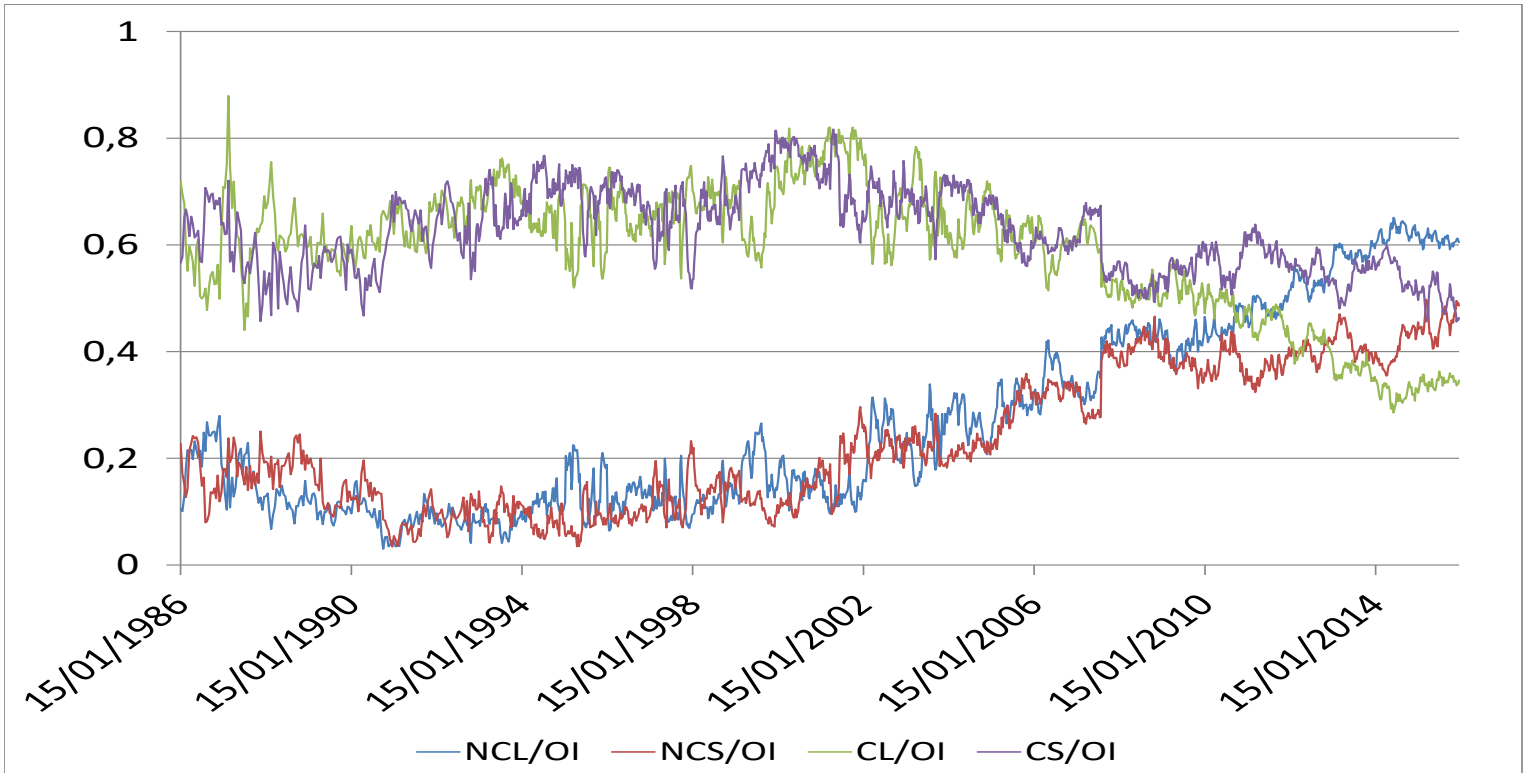
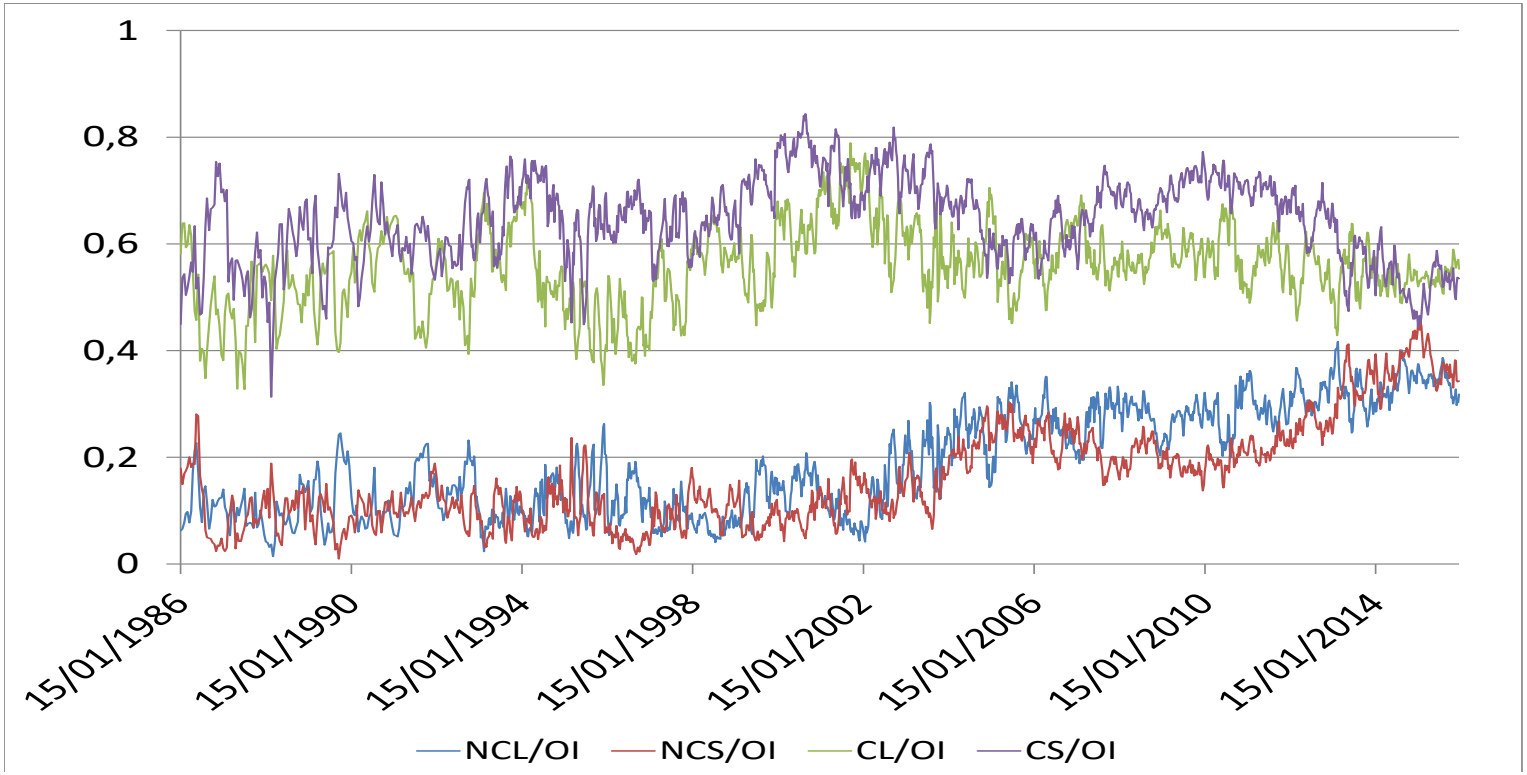
Commodity futures positions



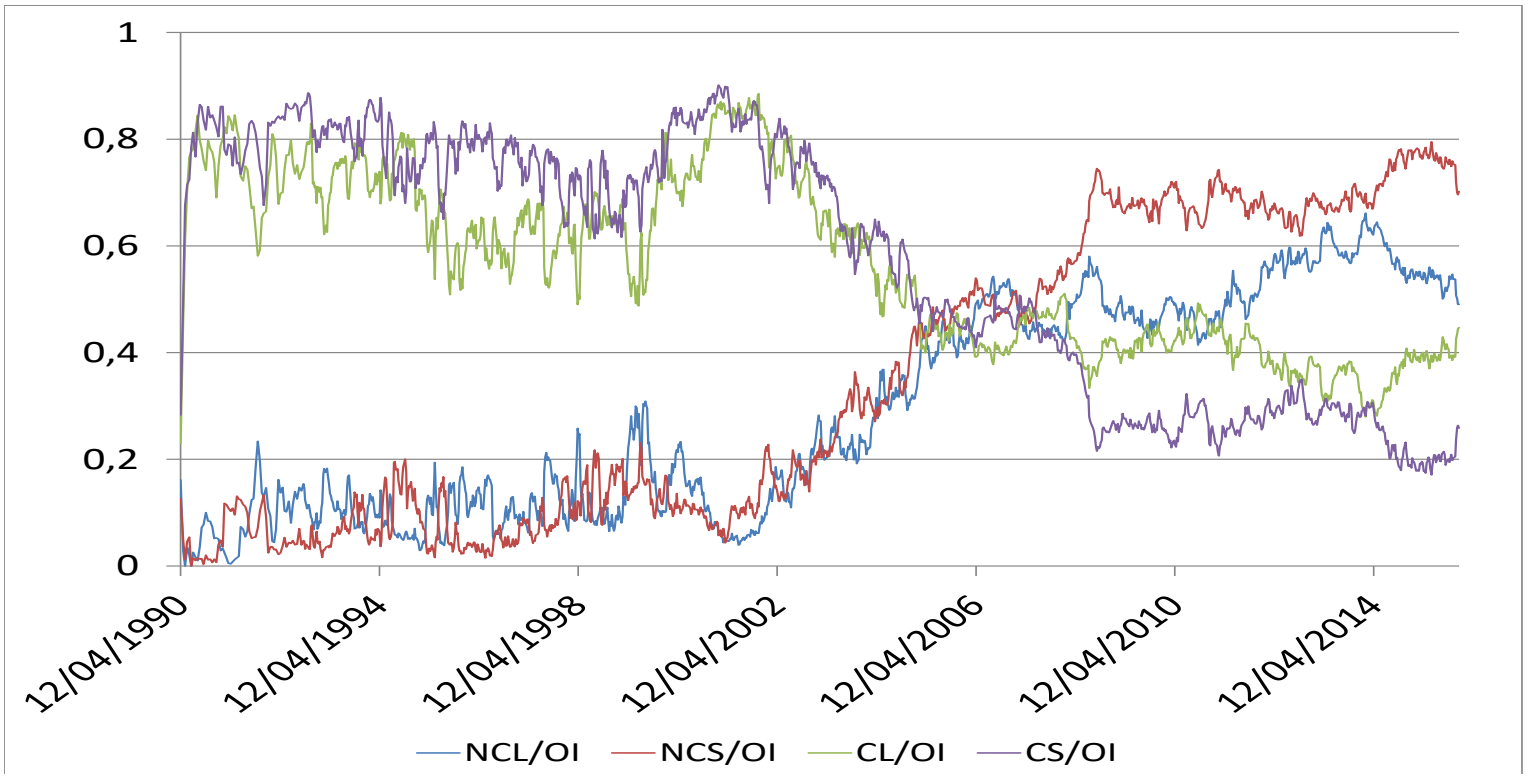
Com. and non-com. futures positions to total open positions (WTI)



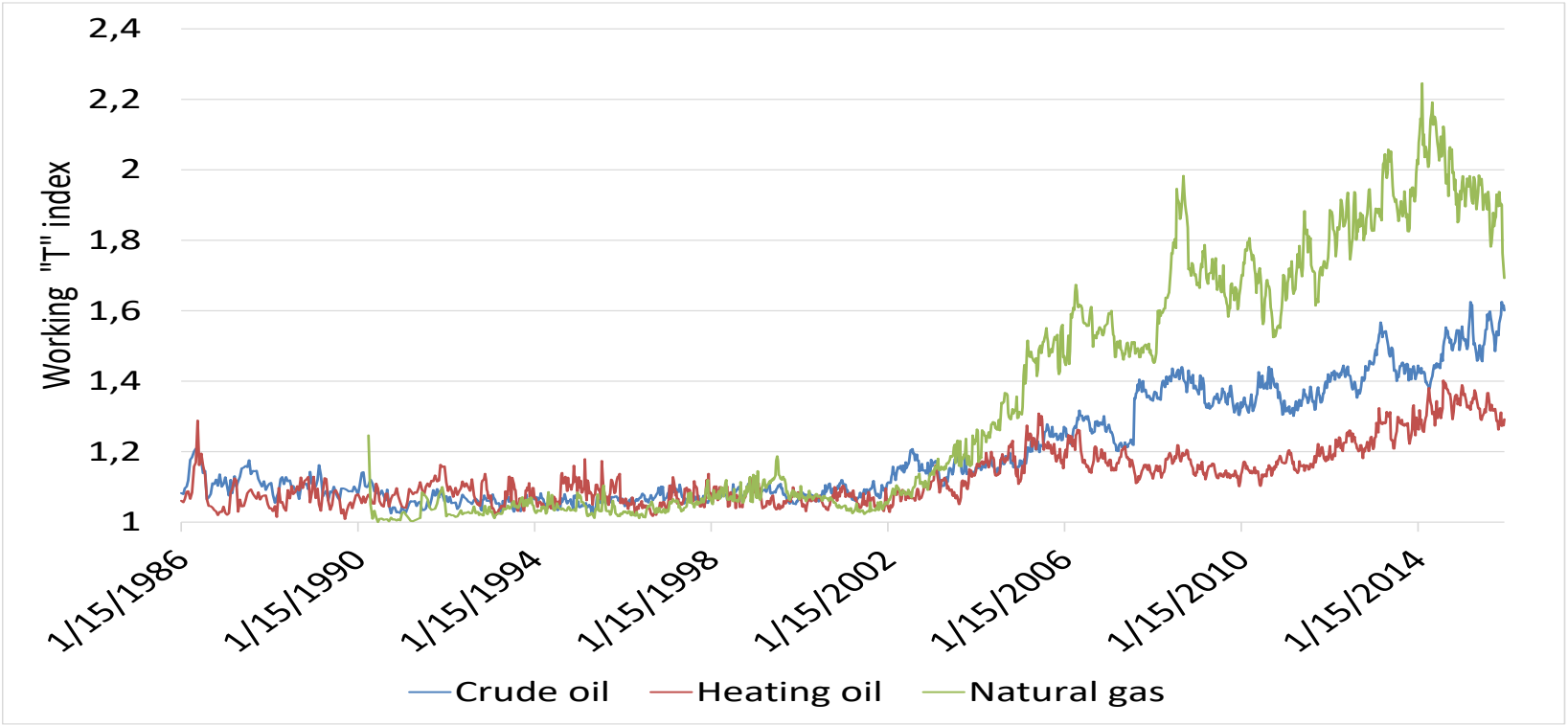
Com. and non-com. futures positions to total open positions (Heating oil)



Com. and non-com. futures positions to total open positions (natural gas)



Working (1960) "T" index



What has been learned so far?

‘

- Evidences on the impact of financialization?

No evidences	Evidences
Kilian and Murphy (2014)	Masters (2008)
Sockin and Xiong (2015)	Singleton (2014)
Brunetti and Buyukşahin (2009)	Henderson et al. (2015)
Buyukşahin and Harris (2011)	Hamilton and Wu (2015) (crude oil)
Hamilton and Wu (2015) (agr. com.)	Buyukşahin and Robe (2014a,b)
Bosch and Pradkhan (2015)	Tang and Xiong (2012)
	Boons et al. (2014)

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- Acharya et al. (2013) and Etula (2013) focus on the comparative statics between risk aversion and the futures risk premium.
- Hamilton and Wu (2014) show that the compensation for taking long positions became lower after 2005.
- Boons et al. (2014) find that about 70% of the cross spread in the average returns can be attributed to traditional hedging pressure and the remaining 30% to the stock market risk.

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- Some of them are theoretical such as Basak and Pavlova (2016).
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- What do I look for?
  - I look at the effect of financial investors on the futures risk premium for energy commodities.

Outline

The model

- I develop a model in the spirit of Ekeland et al. (2018)
  - The model studies the interaction between commodity (physical & futures) and stock markets.

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  - There is a single commodity.
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  - There are four types of agents:
    - Inventory holder (storer)
    - Processor
    - Financial investor
    - Spot traders

The model

- At t:
  - Storers buy the commodity physically at spot price P_t.
  - Processors decide the volume of the commodity that they want to buy at T at price $\tilde{P}_T$.
  - The spot traders effect appear in both demand and supply side in the physical market.
  - Both storers and processors hedge their physical positions in the futures market at futures price $F_{t,T}$.
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- At T:
  - The storers sell their inventory.
  - The processors deliver their demands from the commodity.
  - The spot traders appear on the demand and supply side in the physical market.
  - The futures contracts are settled implying a financial profit $\tilde{P}_T - F_{t,T}$.

Agents' profit

- The storer

$$\tilde{\pi}(x, f_I) = x(\tilde{P}_T - P_t) + f_I(\tilde{P}_T - F_{t,T}) - \frac{1}{2}Cx^2 \qquad (1)$$

Where x is the quantity bought by storer, f_I is the futures positions taken by storer and C is the cost of storage.

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- The processor

$$\tilde{\pi}(y, f_P) = (y - \frac{\beta}{2}y^2)Z - y\tilde{P}_T + f_P(\tilde{P}_T - F_{t,T}) \tag{2}$$

Where y is the quantity demanded by processor, f_P is the futures positions taken by processor, Z is the final good price and β is the cost of production.

Agents' profits

- Financial investor

$$\pi(k, f_S) = k(\tilde{V_T} - V_t) + f_S(\tilde{P_T} - F_{t,T}), k \geq 0 \tag{3}$$

Where f_S is the futures positions taken by financial investor, k is the financial investor's position in stock market, V_i is the value of the portfolio at time i $(i = t\&T)$.

Optimal positions

- Agents are mean-variance utility maximizers

$$E(\tilde{\pi}_j) - \frac{1}{2}\alpha_j Var(\tilde{\pi}_j) \tag{4}$$

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$$x^* = \frac{1}{C} max\left\{F_{t,T} - P_t, 0\right\}, \tag{5}$$

$$f_I^* = \frac{E[\tilde{P}_T] - F_{t,T}}{\alpha_I Var[\tilde{P}_T]} - x^* \tag{6}$$

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- The processor

$$y^* = \frac{1}{\beta Z} \max\left\{Z - F_{t,T}, 0\right\}, \tag{7}$$

$$f_P^* = \frac{E[\tilde{P}_T] - F_{t,T}}{\alpha_P Var[\tilde{P}_T]} + y^* \tag{8}$$

Optimal positions

- Financial investor

$$f_S^* = \left(\frac{1}{1-\rho^2}\right)\frac{1}{\alpha_S \sigma_P}\left[\frac{E[\tilde{P}_T] - F_{t,T}}{\sigma_P} - \rho\frac{E[\tilde{V}_T] - V_t}{\sigma_V}\right], \rho \neq \pm 1 \tag{9}$$

$$k^* = \left(\frac{1}{1-\rho^2}\right)\frac{1}{\alpha_S \sigma_V}\left[\frac{E[\tilde{V}_T] - V_t}{\sigma_V} - \rho\frac{E[\tilde{P}_T] - F_{t,T}}{\sigma_P}\right], \rho \neq \pm 1 \tag{10}$$

Where α is the agent's risk aversion and ρ is the commodity-equity correlation.

Markets clearing

- Physical market

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- Futures market

$$N_S f_S^\star + N_P f_P^\star + N_I f_I^\star = 0.$$

Where N_S is the total number of financial investors, N_I is the total number of storers and N_P is the total number of processor .

Market clearing

- Futures risk premium

$$\mathrm{E}[\tilde{P}_T] - F_{t,T} = \frac{\mathrm{Var}[\tilde{P}_T]}{\frac{N_P}{\alpha_P} + \frac{N_I}{\alpha_I} + \frac{N_S}{\alpha_S}\left(\frac{1}{1-\rho^2}\right)} \left(N_I x^* - N_P y^* + \frac{N_S}{\alpha_S} \rho \frac{E[\tilde{V}_T] - V_t}{\sigma_P \sigma_V (1-\rho^2)} \right) \tag{11}$$

Where:

- P_T is the commodity spot price at T.
- $F_{t,T}$ is the futures price at t when the maturity is at T.
- $\frac{N_i}{\alpha_i}$ is the number of agent i restricted to his risk aversion, and $i := P, I, S$. P: processor, I: storer and S: financial investor.
- ρ is the commodity-equity correlation.
- V_j is the value of the financial investor's portfolio in the stock market at time j, $j := t, T$.

- From the model to the empirical test

$$\mathrm{E}[\tilde{P}_T] - F_{t,T} = \beta_1 HP + \beta_2 \rho \left(E[\tilde{V}_T] - V_t \right) \tag{12}$$

Where, HP is the hedging pressure. $\beta_1 \& \beta_2$ are coefficients.

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Where, *HP* is the hedging pressure. β_1&β_2 are coefficients.

- ***Prediction*** *The futures risk premium of any commodity is determined by the hedging pressure of commercials agents and the stock returns adjusted by commodity-equity correlation. That implies:*
  1. *An increase in the net short hedging pressure causes an increase in the futures risk premium.*
  2. *An increase in stock returns, while the commodity-equity correlation is positive, causes an increase in the futures risk premium.*

Data

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- Three commodities: crude oil (WTI), natural gas, and heating oil.

Data		Source	Variable estimation	
Futures prices	18 maturities for WTI 18 maturities for Natural gas 16 maturities for heating oil	Datastream(the maturities were built by author)	futures returns	$\text{RFUT}_t = \frac{F_{t,T} - F_{t-1,T}}{F_{t-1,T}}$
Open interest positions (long and short)		CFTC	hedging pressure	$HP_t = \frac{Short_t - long_t}{Short_t + long_t}$
S&P 500 composite index		Datastream	stock returns	$\text{RSP500}_t = \frac{SP500_t - SP500_{t-1}}{SP500_{t-1}}$

Data (Dynamic Conditional Correlation)

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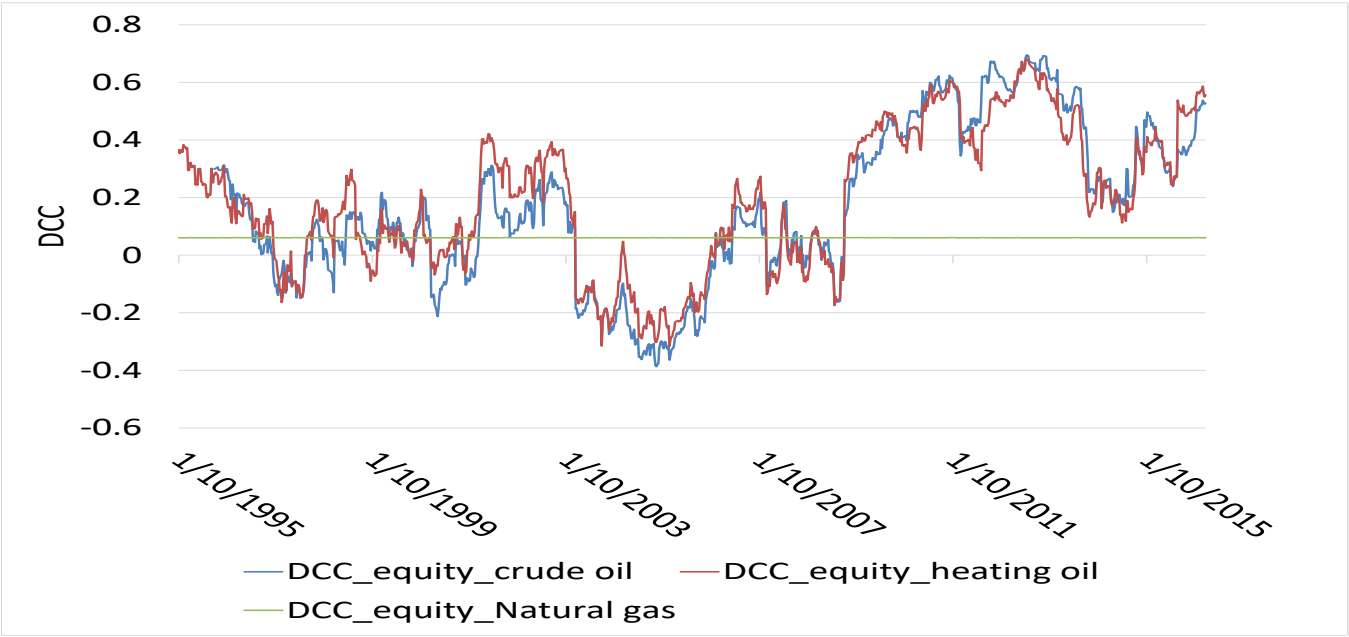
- I compute the dynamic conditional correlation (DCC) addressed by Engle (2002).



Data

- I construct an index of adjusted stock returns that identifies the effect of the stock market.

$$RPSP500adj_t := \rho_t \times RPSP500_t$$

Where ρ_t is the commodity-equity correlation, and $RPSP500_t$ is the stock returns.

Regressions

- I estimate the futures risk premium on the periods: 1995-2002, 2003-2008 and 2008-2015.

$$RFUTXM_t = \beta_1 CHP_t + \beta_2 RPSP500adj_t + \epsilon_t$$

Regression estimation for crude oil (WTI) on the periods 1995-2002, 2003-2008 and 2008-2015

	Panel A 1995-2002				Panel B 2003-2008				Panel C 2008-2016			
VARIABLES	CHP	RPSP500adj	Obs	R-squared	CHP	RPSP500adj	Obs	R-squared	CHP	RPSP500adj	Obs	R-squared
RFUT1M	0.946***	-0.0827	376	0.200	1.343***	1.483*	307	0.200	0.829***	2.097***	375	0.269
	(0.0981)	(0.574)			(0.156)	(0.860)			(0.185)	(0.213)		
RFUT2M	0.927***	-0.0915	376	0.258	1.276***	0.998	307	0.195	0.758***	2.172***	375	0.295
	(0.0817)	(0.477)			(0.149)	(0.823)			(0.175)	(0.201)		
RFUT3M	0.863***	-0.0320	376	0.267	1.212***	0.838	307	0.192	0.719***	2.163***	375	0.311
	(0.0743)	(0.434)			(0.143)	(0.790)			(0.166)	(0.192)		
						:						
						:						
						:						
RFUT12M	0.425***	0.246	376	0.171	0.754***	0.342	307	0.113	0.467***	1.960***	375	0.338
	(0.0493)	(0.288)			(0.121)	(0.671)			(0.136)	(0.156)		
RFUT13M	0.398***	0.254	376	0.160	0.720***	0.332	307	0.105	0.445***	1.938***	375	0.338
	(0.0482)	(0.282)			(0.120)	(0.665)			(0.133)	(0.154)		
RFUT14M	0.372***	0.251	376	0.148	0.688***	0.323	307	0.099	0.427***	1.914***	375	0.338
	(0.0472)	(0.276)			(0.119)	(0.659)			(0.131)	(0.151)		

Results

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  - Decrease when the maturity increases.
- $RPSP500adj(\beta_2)$ is
  - Significant.
  - Positive after 2008 financial crisis.
- The effect of the stock market has more influence than the effect of hedging pressure on longer maturities of WTI and heating oil.

Robustness check

- I test the theoretical findings by replacing the weekly data sets with monthly ones.
- I substitute the maturities from the *S&PGSCI* total return for the tested commodities.
- I divide the tested periods into shorter subperiods (Each subperiod represents 175 weeks).
- I replace the net short hedging pressure with the net long speculative pressure.

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- When the maturity increases, the adjusted stock market returns have stronger explanatory power than the hedging pressure.
- In natural gas case, the futures risk premium should be determined by extra explanatory variables.
- The effect of financial investors on the period of financialization and 2008 crisis is not as important to study as what happened after the 2008 crisis.

Thank you for your attention!

Questions?

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- We focus on the common case when the expected stock returns are positive.
- An increase in commodity-equity correlation $\Longrightarrow$ a decrease in the long positions (increase short positions).

$$\nearrow \rho \Leftrightarrow \searrow \text{ Long Positions}$$
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P_t	$F_{t,T}$	X	Y	$\tilde{P}_T$	$E(\tilde{P}_T) - F_{t,T}$
$\searrow$	$\searrow$	$\searrow$	$\nearrow$	$\nearrow$	$\nearrow$

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- When their net futures positions is long,
  - The demand on futures positions is high.
  - Hence, the futures prices increase $\Longrightarrow$ inventory levels increase $\Longrightarrow$ spot price increases.
  - On the contrary, the physical demand of the processors and the future spot price decrease.

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