

Return and Volatility Spillovers in Energy Markets

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Introduction

Motivation

- Electricity is considered to be as a strategic asset because of their extensive use by virtually all the sectors in modern economies.
- Apart from renewable generation sources, the most important fuels used to generate power are natural gas, oil and coal.
- These three latter are generally competitors in production of electricity, while the four commodities are substitutes in consumption, which may lead their prices to be somewhat linked.
- Additionally, since 2005, power generators and energy intensive industries from countries signatory to the Kyoto Protocol receive European Emission Allowances (EUAs) that can be traded.

Introduction

Motivation

- There seems to have been periods in which stable relationships between prices of these commodities are found, whereas during other periods, prices of some of these commodities seem to have completely decoupled from the rest.
- Given the globalization of energy markets, it is hardly difficult to unambiguously relate each commodity price series to a particular market area.

Introduction

Motivation

- It is especially interesting to embrace a thorough analysis, performing not only a pairwise comparison but also extending the work by providing a joint comparison of several commodities such as **electricity**, **natural gas**, **coal**, **oil** and **carbon** at an international level in order to discern the extent to which they are interconnected.

Introduction

Objective

The main **objective** is to assess the extent and evolution of the links between energy markets.

Research questions:

- Which is the total price/volatility spillover effect in energy markets?.
- Which is the evolving nature of price/volatility spillovers?
- Which markets are exporters (importers) of price/volatility to (from) other markets?
- Are price/volatility spillovers higher within or across energy sectors?
- Is there evidence of increasing European energy markets integration over time?

Data

- Daily data from November 2008 to June 2016.
- 17 series of prices from 5 sectors.

Electricity price series	Natural gas prices series	Emission Allowances	Oil price series	Coal price series
Germany (GER)	UK National Balance Point (NBP)	European Emission Allowances (EUA)	West Texas Intermediate (WTI)	API2 index
France (FR)	Belgian Zeebrugge (ZEE)		North Sea BFOE crude oil (BRENT)	Central Appalachian (CAPP)
Netherlands (NETH)	Dutch Title Transfer Facility (TTF)			
Italy (ITA)	Netconnect Germany (NCG)			
Nordic (NORD)	German Gaspool (GASP)			
Spain (SPA)	US Henry Hub (HH)			

Methodology

Spillover index approach: Diebold and Yilmaz (2009, 2014) statistics

- VAR(5) model
- Forecast horizon: ten steps
- Window length: 200 days

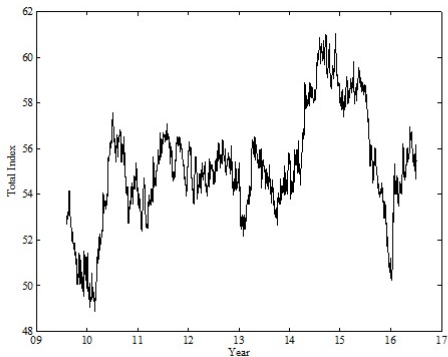
Results

Full Sample Volatility Spillovers

	Germ.	France	Nether.	Italy	Nordic	Spain	NBP	Zeebru.	TTF	NCG	GasP.	HenryH.	EUA	BRENT	WTI	API2	CAPP	Contribution from others
Germany	61.7	12.1	8.9	2.9	1.0	1.1	2.6	1.4	1.9	1.6	0.5	0.3	1.0	0.8	0.6	1.1	0.5	38.3
France	12.0	66.6	7.7	2.2	0.8	1.5	1.7	0.9	2.1	1.3	0.6	0.3	0.8	0.5	0.3	0.3	0.4	33.4
Netherlands	9.3	8.5	57.8	2.6	0.5	1.1	3.8	3.4	4.4	4.0	1.1	0.6	0.8	0.4	0.5	0.3	0.9	42.2
Italy	4.5	3.9	3.7	74.5	0.3	2.0	2.6	1.3	1.6	1.8	0.3	0.4	0.4	1.2	0.7	0.5	0.3	25.5
Nordic	1.1	0.8	0.4	0.4	92.1	0.2	0.6	0.4	0.4	0.3	1.5	0.2	0.3	0.3	0.1	0.8	0.1	7.9
Spain	1.7	2.6	1.1	1.8	0.3	86.3	1.0	0.6	1.1	0.6	0.6	0.1	0.7	0.1	0.2	0.4	0.6	13.7
NBP	2.1	1.4	2.6	1.6	0.3	0.4	47.2	12.7	15.0	10.7	1.7	0.3	0.5	0.8	0.5	0.9	1.3	52.8
Zeebrugge	1.0	0.8	2.3	1.0	0.3	0.3	13.2	52.0	13.0	10.6	2.0	0.3	0.4	0.5	0.3	0.7	1.1	48.0
TTF	1.0	1.8	2.1	1.3	0.2	0.3	14.4	11.6	45.3	15.9	2.7	0.3	0.7	0.5	0.4	0.6	0.9	54.7
NCG	1.0	1.1	2.6	1.0	0.1	0.4	11.1	9.9	16.7	50.6	2.0	0.3	0.5	0.8	0.4	0.9	0.6	49.4
GasPool	0.4	0.6	1.2	0.5	1.3	0.5	3.5	2.8	4.9	4.0	78.3	0.1	0.4	0.1	0.4	0.6	0.2	21.7
Henry Hub	0.3	0.3	0.3	0.5	0.2	0.4	0.4	0.3	0.7	0.5	0.3	87.6	0.5	0.9	2.5	0.7	3.7	12.4
EUA	0.9	0.8	0.6	0.3	1.2	1.1	0.9	0.9	1.5	0.9	0.7	0.5	87.5	0.6	0.4	0.8	0.4	12.5
BRENT	0.5	0.4	0.3	1.2	0.5	0.1	1.1	0.5	0.5	0.9	0.2	1.1	0.4	63.9	25.9	1.4	1.1	36.1
WTI	0.4	0.1	0.1	0.6	0.1	0.3	0.5	0.3	0.4	0.6	0.5	2.1	0.3	24.1	66.3	1.1	2.3	33.7
API2	1.7	0.7	0.5	0.6	0.6	0.6	2.0	1.6	2.5	2.4	1.2	0.6	0.9	2.4	1.9	74.4	5.3	25.6
CAPP	0.1	0.4	0.2	0.1	0.2	0.1	0.4	0.9	1.0	0.9	0.3	3.6	0.3	1.2	3.0	4.1	83.1	16.9
Contribution to others	38.0	36.1	34.6	18.7	8.0	10.3	59.9	49.5	68.0	56.8	16.4	11.2	9.1	35.4	38.1	15.2	19.6	Total spillover = 30.9
Net contribution	-0.3	2.7	-7.6	-6.8	0.1	-3.4	7.1	1.5	13.3	7.4	-5.3	-1.2	-3.4	-0.7	4.4	-10.4	2.7	

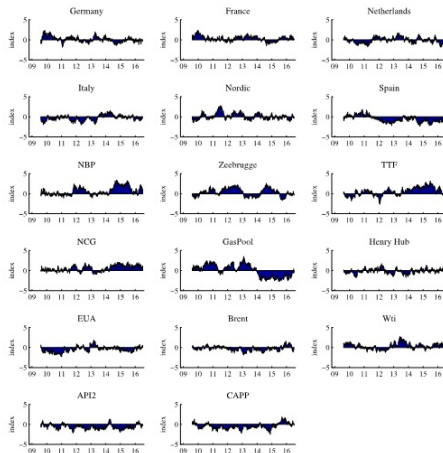
Results

Rolling Total Volatility Spillover Index



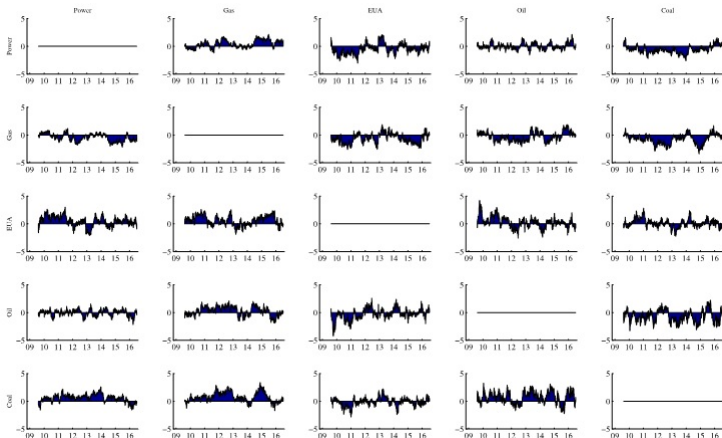
Results

Net volatility spillovers from the market i to the total



Results

Net volatility spillovers between sectors



Conclusions

- Own-sector volatility spillovers explain the highest share of forecast error variance.
- Among all the commodity series, TTF natural gas, Nordic electricity, Henry Hub natural gas and European emission allowances are the most disconnected from the others.
- The highest observed pair-wise spillovers are observed between crude oil series.
- BRENT is shown to be the crude oil benchmark for European electricity, natural gas, coal and emission allowances, whereas WTI is so for US natural gas and coal.

Conclusions

- The linkages between natural gas prices and the rest of commodity prices are shown to be the greatest.
- Regarding the level of integration, the most integrated markets appear to be Germany, France and the Netherlands, followed distantly by Italy, Spain and the Nordic Market.
- Natural gas seems to be overtaking crude oil as a global benchmark for energy commodities.
- TTF is on the way to become the benchmark price for natural gas in Europe, overtaking NBP.
- Spillovers are time-varying, seem to increase with economic growth as well as during turmoil periods

Thank you for your attention!