

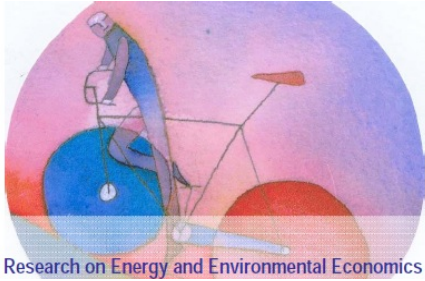
Long-term Contracts, Wholesale Trade and Competition in Gas Markets

Michele Polo (IEFE and Bocconi University)

"New EU natural gas markets", Paris Dauphine, CGEMP and CEEM

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Plan of the talk

- Fact:
 - The pre-liberalization environment of the natural gas industry is based on long-term contracts with take-or-pay obligations
- Research questions:
 - What is the effect of TOP on the development of retail competition?
 - How can wholesale gas markets ease the development of competition?
 - Which are the economic forces and the regulatory rules that help the development of gas hubs?



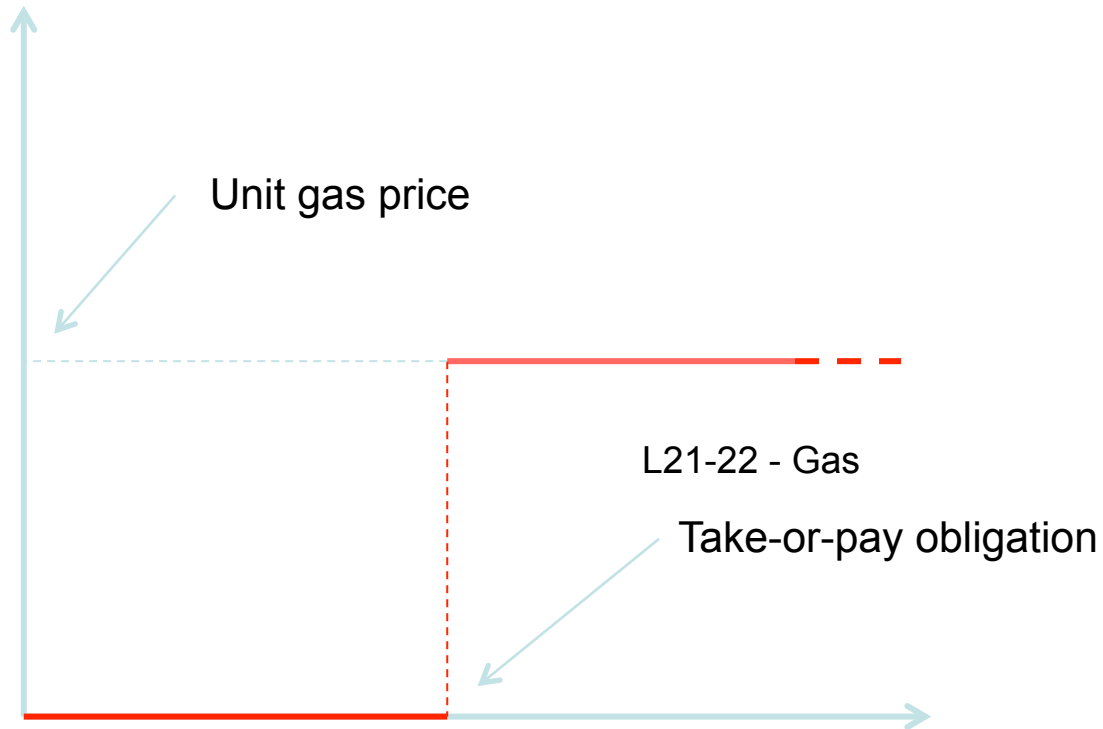
Take-or-pay contracts and retail competition

- The import of gas to the national gas system occurs for the most part through **long term contracts**:
 - Quantity restrictions: **take-or-pay obligations**
 - Price restrictions: **oil-indexation**
- Do take-or-pay obligations affect the possibility to develop retail competition?
- Take-or-pay obligations: transform a linear cost curve, with flat marginal cost, into a discontinuous cost curve with zero marginal cost up to the obligations and then a higher marginal cost equal to the marginal price.



Take-or-pay contracts and retail competition

Marginal cost with take-or-pay obligations





Take-or-pay contracts and retail competition

- The model (Polo and Scarpa IJIO 2013):
 - Two firms buying gas upstream under TOP, selecting the local markets to serve and competing in prices
 - Small entry costs in the local markets
 - Retail services horizontally differentiated (room for competition and liberalization)
 - Total TOP obligations = total demand

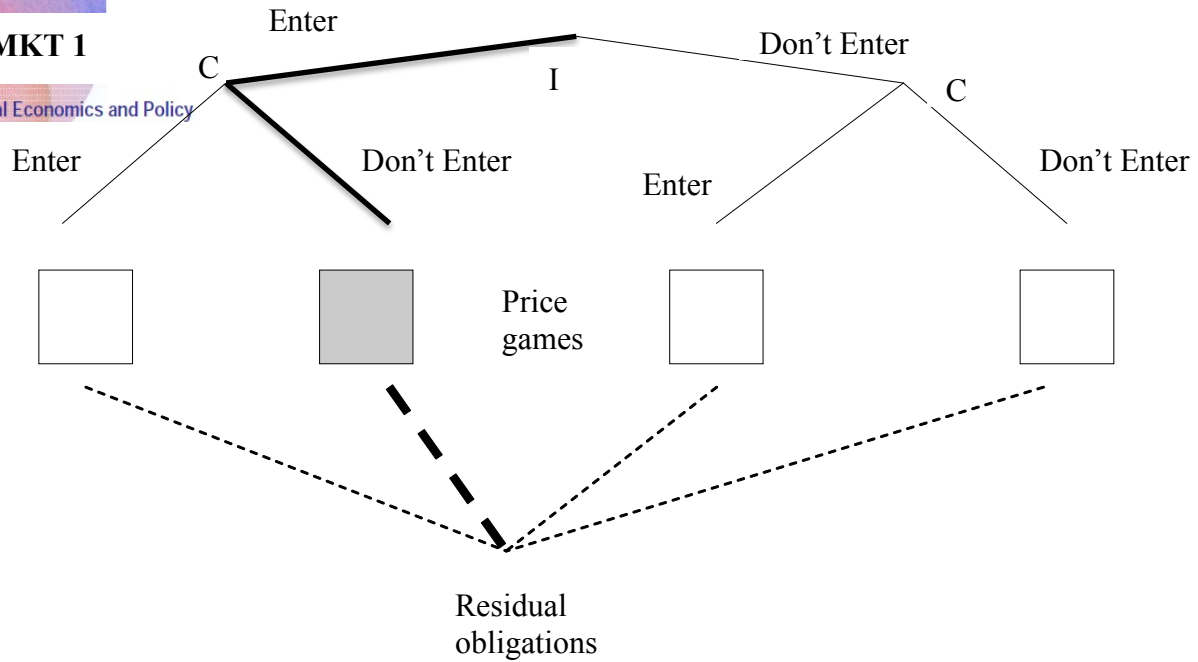


Take-or-pay contracts and retail competition

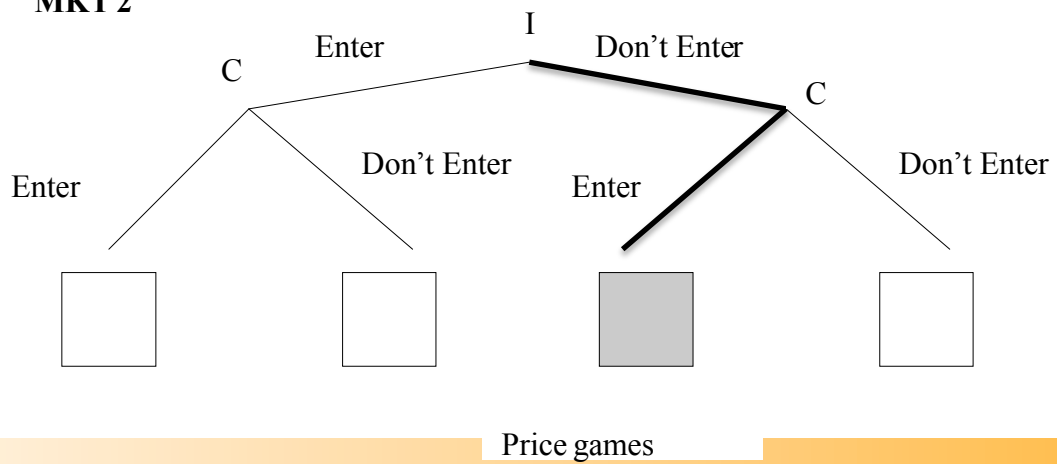
- Price competition:
 - If two wholesalers target the **same submarket**, they compete in prices: **low margins** due to competition, demand is shared and **TOP obligations not exhausted**
 - >> **need to enter additional submarkets**
 - >> **competitive entry and low margins in all submarkets**
 - If wholesalers enter **different submarkets**: each sets a **high price** and **exhausts its TOP obligations**, becoming a high MC competitor if further entry
 - >> **no incentive to enter additional submarkets**
 - >> **market segmentation and monopoly pricing**
- Entry equilibrium:
 - Each firm enters a submarket as large as its TOP obligation and set a monopoly price: **market segmentation, entry without competition**



MKT 1



MKT 2





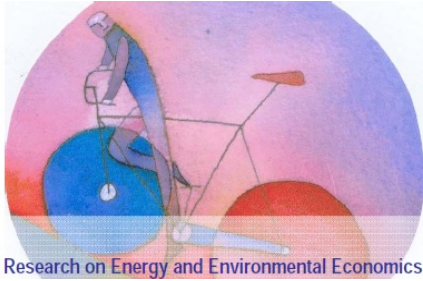
Take-or-pay contracts and retail competition

- If those that select which retail markets to serve bear TOP obligation, the equilibrium involves **market segmentation and monopoly pricing**
- Imposing **antitrust ceilings** modifies the allocation of market shares but does not break the segmentation equilibrium
- If those that bear TOP obligations sell gas in a **wholesale market**, where retailers buy gas and decide which retail markets to serve, then the equilibrium involves **generalized entry and competitive pricing**



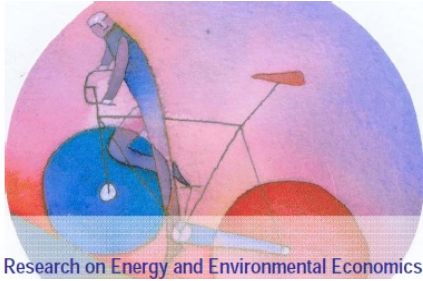
The creation of a wholesale gas market

- The first European Directive and the Italian liberalization plan did not consider the introduction of a wholesale gas market
- We argue that this market venue can create a separation between long term contracts with TOP obligations, beard by shippers that are active upstream, and a flat wholesale gas price paid by suppliers and retailers downstream
- In turn, when large operators provide gas to the system through long term contracts, the emergence of a parallel market venue where gas is traded is not easy
- Under which conditions a wholesale gas market can develop?



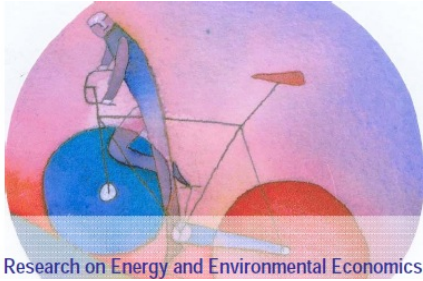
The emergence of gas hubs

- **Fact:** during the liberalization process several wholesale gas markets have developed in Europe, with very different volumes and liquidity.
- **Research question:** What determines the emergence of gas hubs? Is there a predictable pattern of development that helps interpreting the different situations as part of a common process?
- **This paper:**
 - We propose a **simple model** where wholesale trade represents a useful balancing tool in a liberalized market, and then, when liquidity increases, becomes a second source of gas in parallel with long term contracts
 - We compare the main predictions with the evolution of the gas hubs in the **UK, the Netherlands, Germany and Italy.**



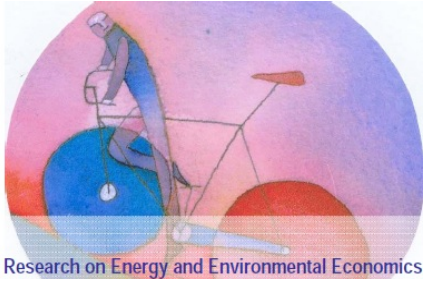
Balancing in a liberalized market

- Upstream (shippers) and downstream (suppliers, retailers) activities are run by **contracts**. In each contract, the amount of gas to be delivered and injected into the gas system is initially set according to the expectations on the demand of the buyers.
- Actual supply and demand, however, are hit by **shocks** that may make the contracted (injected) and actual (withdrawn) quantities different, creating physical and commercial **imbalances**.
- Individual shippers may compensate some shocks **within** their portfolios of contracts and (part of) their net imbalance by **trading** with other shippers with opposite positions
- The residual individual imbalances not cleared this way add up to the **aggregate imbalance** of the system, that requires to adjust the net gas injections through **physical flexibility tools** (line pack, storage, production swing, interruptible demand.) to preserve pressure and system integrity



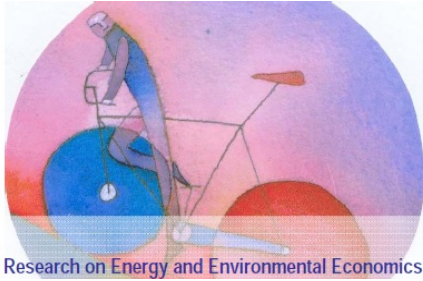
Balancing in a liberalized market

- In the absence of a wholesale market, the aggregate imbalance would further increase; hence, gas hubs are a useful **balancing tool**
- The more **fragmented** the market, the smaller the size of portfolios, the larger the need to trade with other shippers to clear the individual positions
- The creation of a wholesale market requires to set **rules** to ease transactions and give incentives to shippers to clear their individual positions in the market
- The fragmentation of the market raises traded volumes and increases **liquidity**. Short term **arbitrage** opportunities further increase gross trade
- Although only a fraction of total physical deliveries goes through the gas hub, a more liquid wholesale market makes the price a **reliable signal** of the overall state of the market



Balancing in a liberalized market

- Then, the wholesale market offers an opportunity of gas provision in parallel with long term contracts: **second sourcing**
- **Large domestic gas producers** can fuel the supply of gas in the hub (commitment problem in vertical contracting, Hart and Tirole)
- **Upstream gas providers** that buy gas under long term contracts and take or pay obligations would prefer to trade turning to downstream buyers similar commitments
- **Downstream sellers** may exploit the strategic impact of TOP (Polo and Scarpa 2013).
- Hence, it seems that a decisive push to gas trade can come from (domestic) producers
- Balancing and second sourcing are related to the physical delivery of gas, and therefore develop in **each national gas system**
- Price variability requires to develop **financial products** to hedge risk
- Trade of these financial products **concentrate** in a small number of market venues.



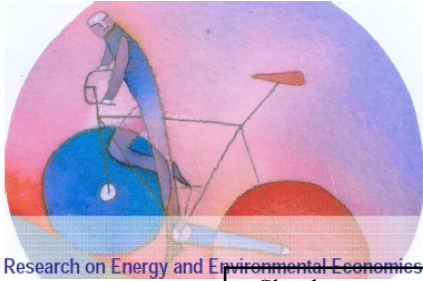
A simple model

- Suppose that in the market there are **n customers** with **inelastic demand**

$$D_i = d + \varepsilon_i$$

for $p \leq v$, where $\varepsilon_i \in \{-\varepsilon/n, \varepsilon/n\}$ are i.i.d. **shocks**.

- Each **supply contact** by a shipper is set to deliver d at a price $p \geq w$, hence ex-post excess demand or supply may occur.
- Each of the shippers $m \leq n$ manages a **portfolio of contracts** involving n/m different customers.
- Some of the shocks (of opposite sign) may be adjusted **within** each portfolio, while others require to clear the portfolio imbalances through **transactions with other operators**.
- If eventually there is an **aggregate imbalance**, this can be adjusted only by dealing with upstream (production, storage) or downstream (interruptible demand) operators.



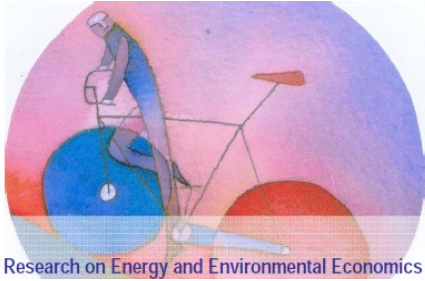
A simple model

Shocks	1 operator		2 operators		4 operators	
States of the world	I.A.	N.I.	I.A.	N.I.	I.A.	N.I.
i) $(-\varepsilon/4, -\varepsilon/4, -\varepsilon/4, -\varepsilon/4)$	0	$-\varepsilon$	0,0	$-\varepsilon/2, -\varepsilon/2$	0,0,0,0	$-\varepsilon/4, -\varepsilon/4, -\varepsilon/4, -\varepsilon/4$
$(-\varepsilon/4, -\varepsilon/4, -\varepsilon/4, \varepsilon/4)$	$\varepsilon/2$	$-\varepsilon/2$	$0, \varepsilon/2$	$-\varepsilon/2, 0$	$0,0,0,0$	$-\varepsilon/4, -\varepsilon/4, -\varepsilon/4, \varepsilon/4$
$(-\varepsilon/4, -\varepsilon/4, \varepsilon/4, -\varepsilon/4)$			$0, \varepsilon/2$	$-\varepsilon/2, 0$	$0,0,0,0$	$-\varepsilon/4, -\varepsilon/4, \varepsilon/4, -\varepsilon/4$
ii) $(-\varepsilon/4, \varepsilon/4, -\varepsilon/4, -\varepsilon/4)$			$\varepsilon/2, 0$	$0, -\varepsilon/2$	$0,0,0,0$	$-\varepsilon/4, \varepsilon/4, -\varepsilon/4, -\varepsilon/4$
$(\varepsilon/4, -\varepsilon/4, -\varepsilon/4, -\varepsilon/4)$			$\varepsilon/2, 0$	$0, -\varepsilon/2$	$0,0,0,0$	$\varepsilon/4, -\varepsilon/4, -\varepsilon/4, -\varepsilon/4$
$(-\varepsilon/4, -\varepsilon/4, \varepsilon/4, \varepsilon/4)$	ε	0	$0, 0$	$-\varepsilon/2, \varepsilon/2$	$0,0,0,0$	$-\varepsilon/4, -\varepsilon/4, \varepsilon/4, \varepsilon/4$
$(-\varepsilon/4, \varepsilon/4, -\varepsilon/4, \varepsilon/4)$			$\varepsilon/2, \varepsilon/2$	$0, 0$	$0,0,0,0$	$-\varepsilon/4, \varepsilon/4, -\varepsilon/4, \varepsilon/4$
iii) $(-\varepsilon/4, \varepsilon/4, \varepsilon/4, -\varepsilon/4)$			$\varepsilon/2, \varepsilon/2$	$0, 0$	$0,0,0,0$	$-\varepsilon/4, \varepsilon/4, \varepsilon/4, -\varepsilon/4$
$(\varepsilon/4, \varepsilon/4, -\varepsilon/4, -\varepsilon/4)$			$0, 0$	$\varepsilon/2, -\varepsilon/2$	$0,0,0,0$	$\varepsilon/4, \varepsilon/4, -\varepsilon/4, -\varepsilon/4$
$(\varepsilon/4, -\varepsilon/4, \varepsilon/4, -\varepsilon/4)$			$\varepsilon/2, \varepsilon/2$	$0, 0$	$0,0,0,0$	$\varepsilon/4, -\varepsilon/4, \varepsilon/4, -\varepsilon/4$
$(\varepsilon/4, -\varepsilon/4, -\varepsilon/4, \varepsilon/4)$			$\varepsilon/2, \varepsilon/2$	$0, 0$	$0,0,0,0$	$\varepsilon/4, -\varepsilon/4, -\varepsilon/4, \varepsilon/4$
$(-\varepsilon/4, \varepsilon/4, \varepsilon/4, \varepsilon/4)$	$\varepsilon/2$	$\varepsilon/2$	$\varepsilon/2, 0$	$0, \varepsilon/2$	$0,0,0,0$	$-\varepsilon/4, \varepsilon/4, \varepsilon/4, \varepsilon/4$
$(\varepsilon/4, -\varepsilon/4, \varepsilon/4, \varepsilon/4)$			$\varepsilon/2, 0$	$0, \varepsilon/2$	$0,0,0,0$	$\varepsilon/4, -\varepsilon/4, \varepsilon/4, \varepsilon/4$
iv) $(\varepsilon/4, \varepsilon/4, -\varepsilon/4, \varepsilon/4)$			$0, \varepsilon/2$	$\varepsilon/2, 0$	$0,0,0,0$	$\varepsilon/4, \varepsilon/4, -\varepsilon/4, \varepsilon/4$
$(\varepsilon/4, \varepsilon/4, \varepsilon/4, -\varepsilon/4)$			$0, \varepsilon/2$	$\varepsilon/2, 0$	$0,0,0,0$	$\varepsilon/4, \varepsilon/4, \varepsilon/4, -\varepsilon/4$
v) $(\varepsilon/4, \varepsilon/4, \varepsilon/4, \varepsilon/4)$	0	ε	0	ε	0,0,0,0	$\varepsilon/4, \varepsilon/4, \varepsilon/4, \varepsilon/4$

I.A. Internal adjustment of shocks within each portfolio

N.I. Net imbalance of each portfolio after internal adjustments

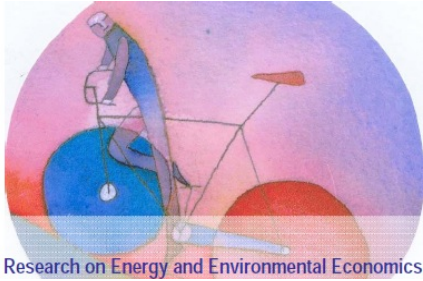
Highlighted areas: trade opportunities between operators to clear the net imbalances



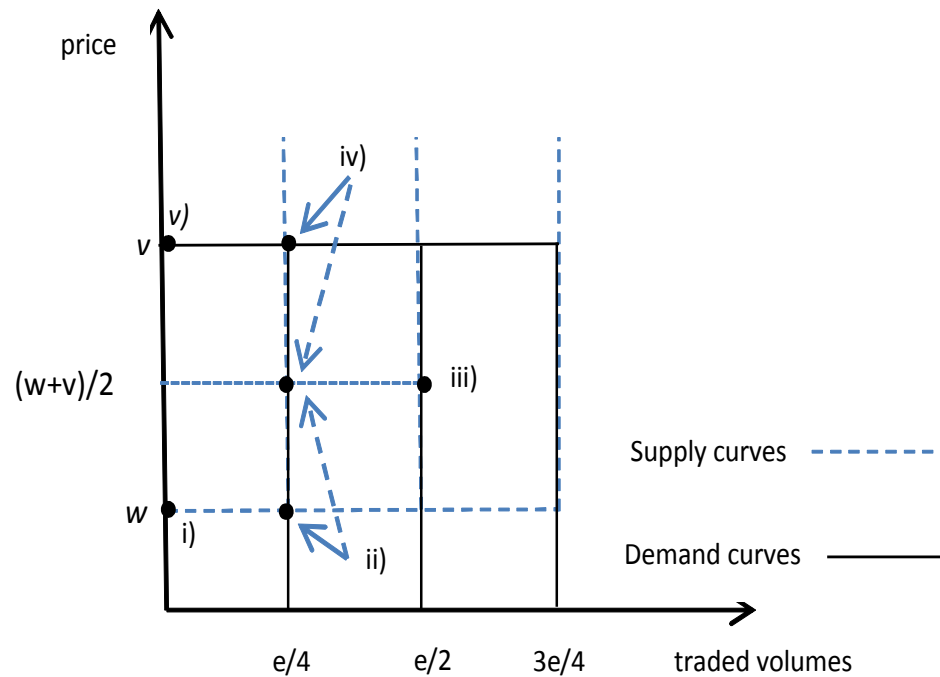
A simple model

Market structure	Wholesale trade	Within portfolio Adjustment	Aggregate Imbalance
a) Monopoly: A(1,2,3,4)	0	5 ϵ /16	6 ϵ /16
b) symmetric duopoly A(1,2), B(3,4)	ϵ /16	4 ϵ /16	6 ϵ /16
c) asymmetric duopoly A(1,2,3), B(4)	2 ϵ /16	3 ϵ /16	6 ϵ /16
d) asymmetric oligopoly A(1,2), B(3), C(4)	3 ϵ /16	2 ϵ /16	6 ϵ /16
f) symmetric oligopoly A(1), B(2), C(3), D(4)	5 ϵ /16	0	6 ϵ /16

Proposition 1: *When gas customers' demand is hit by random shocks while supply contracts are set according to the expected demand, individual shippers may face ex-post individual imbalances, while the system as a whole may be unbalanced as well. These latter imbalances can be cleared only dealing with agents, and using tools, outside the network of pipelines (e.g. imports, storage). Shocks hitting individual customers' demand can be cleared through compensations within each operator's portfolio of contracts and through wholesale trade between shippers with opposite net positions. This latter tool involves larger volumes of trade the larger the number of shippers and the larger the number of shippers with small portfolios.*



A simple model



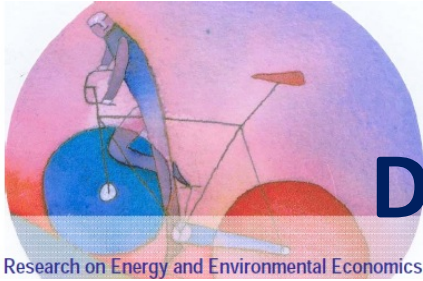
Proposition 2: *When the market structure of the shippers is not excessively asymmetric, the price that is set on the wholesale market is an unbiased signal of the state of the aggregate market for gas. When one shipper dominates the market, managing a large portfolio of contracts, it can manipulate the market price pushing it up when in a long position and down when being in a short position. In these cases, the wholesale price does not reflect the market fundamentals.*



The evolution of wholesale gas markets

From the previous arguments we can expect the following pattern in the evolution of wholesale gas markets:

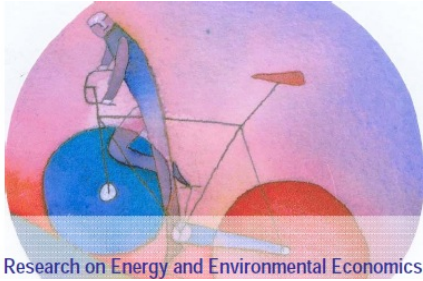
- 1. Balancing:** wholesale trade is driven by deals to clear individual imbalances, according to the rules and incentives defined by regulation; traded volumes increase with the fragmentation of the market and with the proper design of market rules
- 2. Second sourcing:** increased liquidity makes the market price more reflective of the underline conditions, and a better signal for trade aimed at providing gas as an alternative to long term contracts
- 3. Risk management:** price variability driven by market fundamentals requires financial products to hedge risks



Designing a wholesale gas market

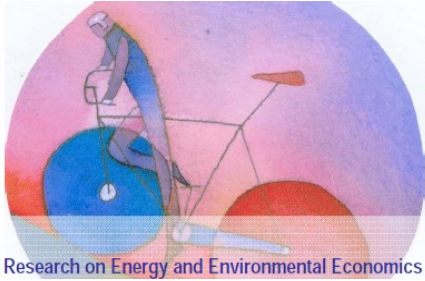
The creation of a wholesale gas market requires to carefully design several elements:

- The choice of a **transmission system model** to allow re-trading gas provisions with entry-exit patterns different from the original ones , establishing a virtual trading zone >> EC recommends an entry-exit transmission system model
- The design of **balancing rules** to incentivize the operators to directly clear their imbalances >> EC recommends market-based mechanisms
- The provision of **information** to market participants to ease the direct clearance of imbalances >> EC recommends fundamental transparency rules.



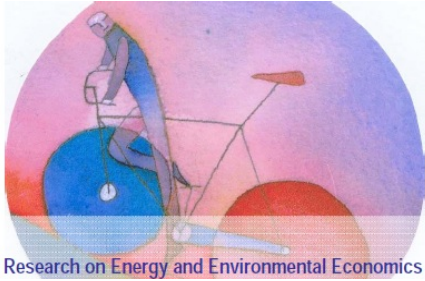
Predictions/Educated guesses

1. *The first phase in the development of a wholesale gas market entails **balancing** as the primary objective of traders, while a more mature phase entails gas provision as a **second sourcing** in the wholesale market. Being linked to the physical delivery of gas, these phases tend to develop in **each national gas system**.*
2. *An entry-exit model, a market based balancing regimes and rules for fundamental transparency are the more favorable **market design** for the development of a wholesale market for balancing needs.*
3. *The **wider** the virtual trading area within a national gas system, the more rapid and effective the development of wholesale gas markets*
4. *Market liquidity increases more rapidly in countries endowed with significant **local gas production**.*
5. *Transactions of **financial instruments** to hedge gas price risk, the third phase of the development, concentrate in a **small number of market venues**.*

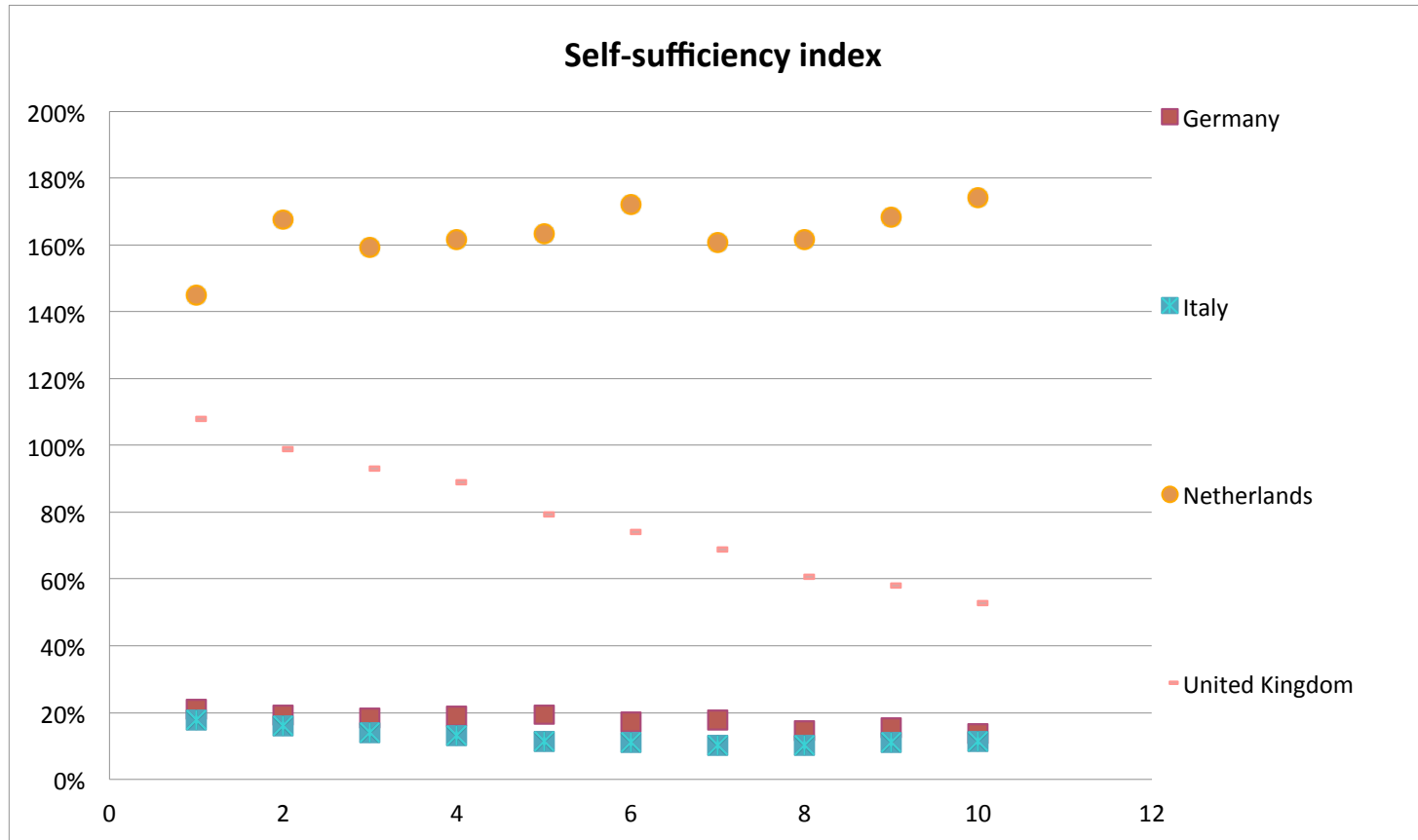


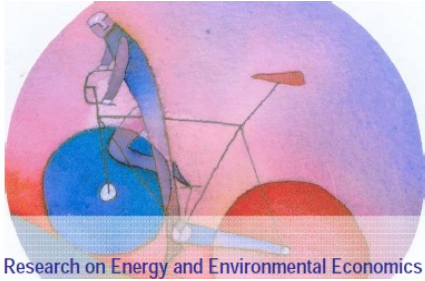
Data

- Data collected from a number of sources.
- Data on volumes:
 - Where available, data published by TSOs or hubs operators.
- Data on prices:
 - Bloomberg database;
 - ICE Endex;
 - EEX.
- Data on consumption, production, import, export:
 - IEA, Eurostat.



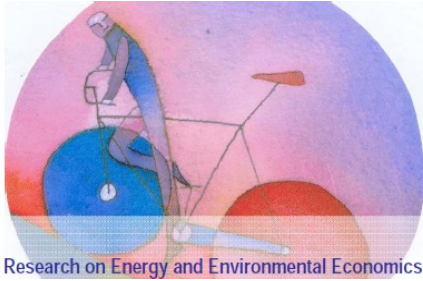
Domestic production





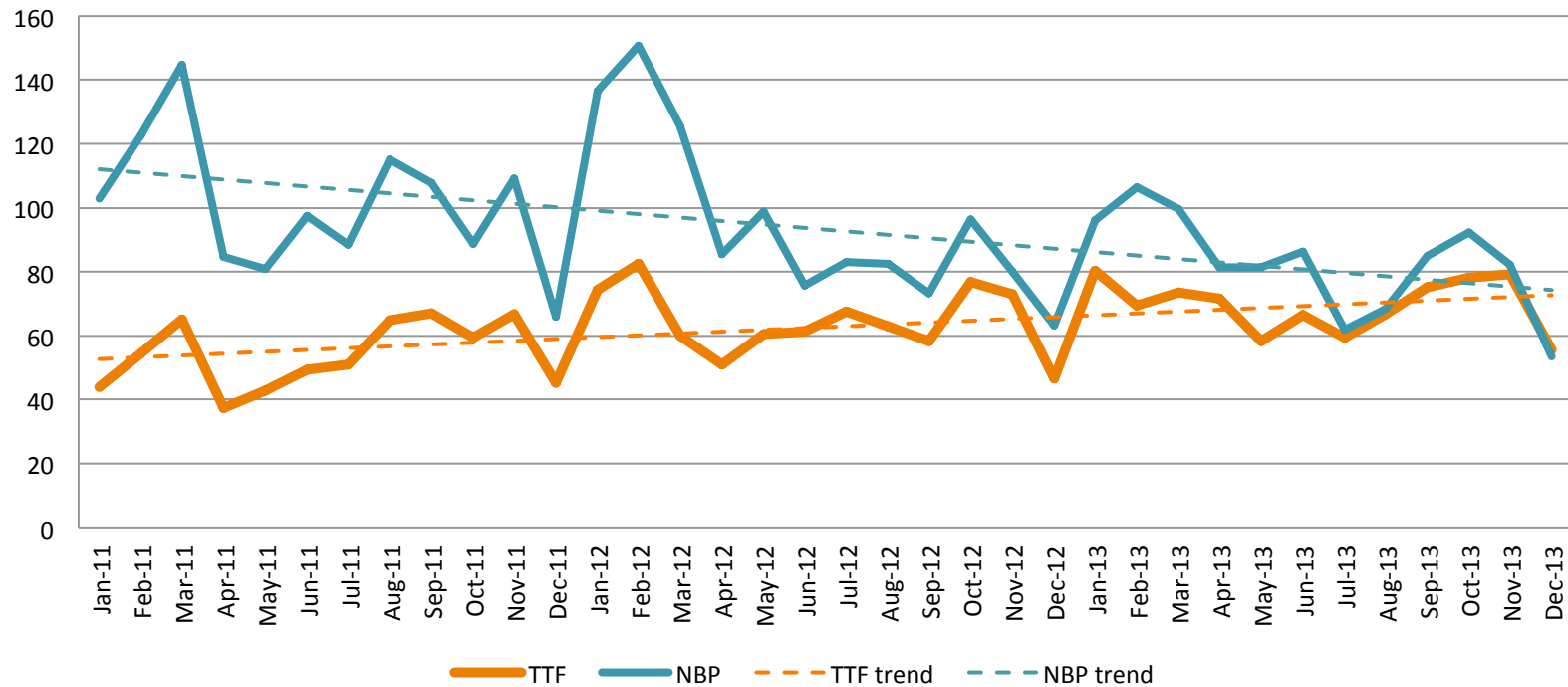
Regulation

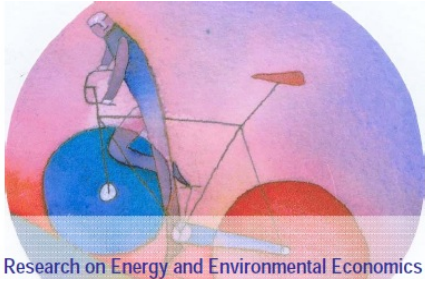
- All countries have adopted an entry-exit model and the rules for fundamental transparency (still, very different accounting criteria, non-comparable data, changes in accounting rules)
- Balancing rules display some difference from country to country
 - UK and TTF: market-based
 - Germany: two balancing zones (previously 19!)
 - Italy: first attempt to promote a wholesale market for trading (unsuccessful), then a balancing platform introduced,



Traded volumes

Traded volumes at NBP and TTF

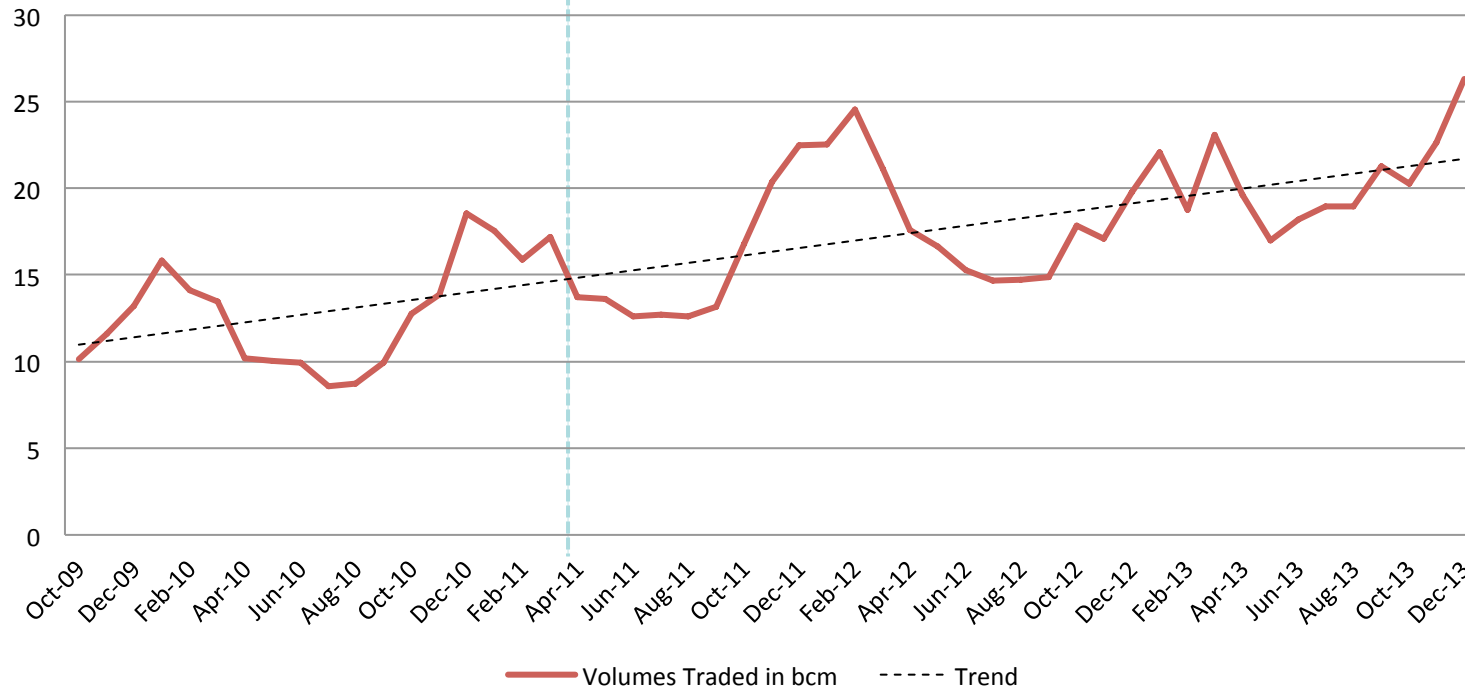


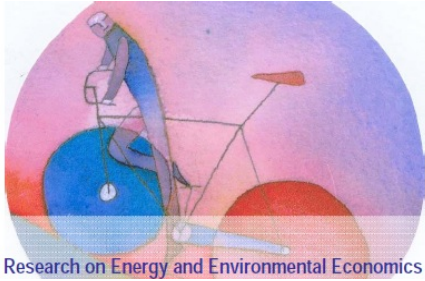


Traded volumes

Reduction of market areas from 12 to 3

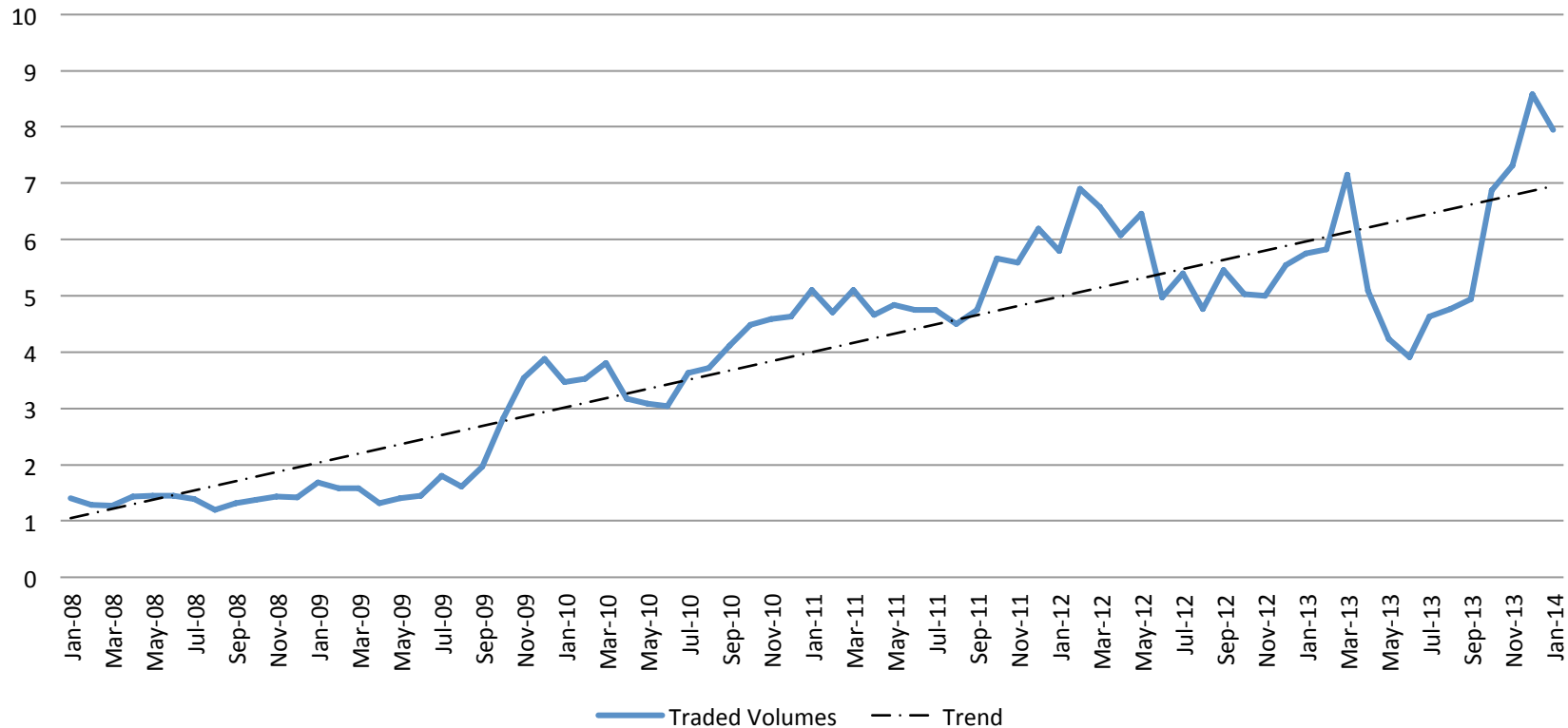
Volumes Traded in Germany

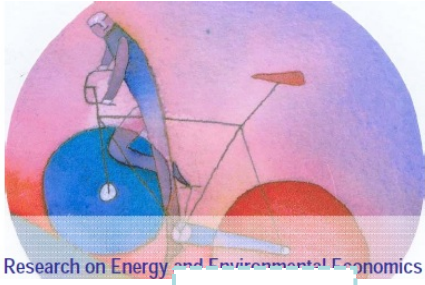




Traded volumes

Traded volumes at PSV

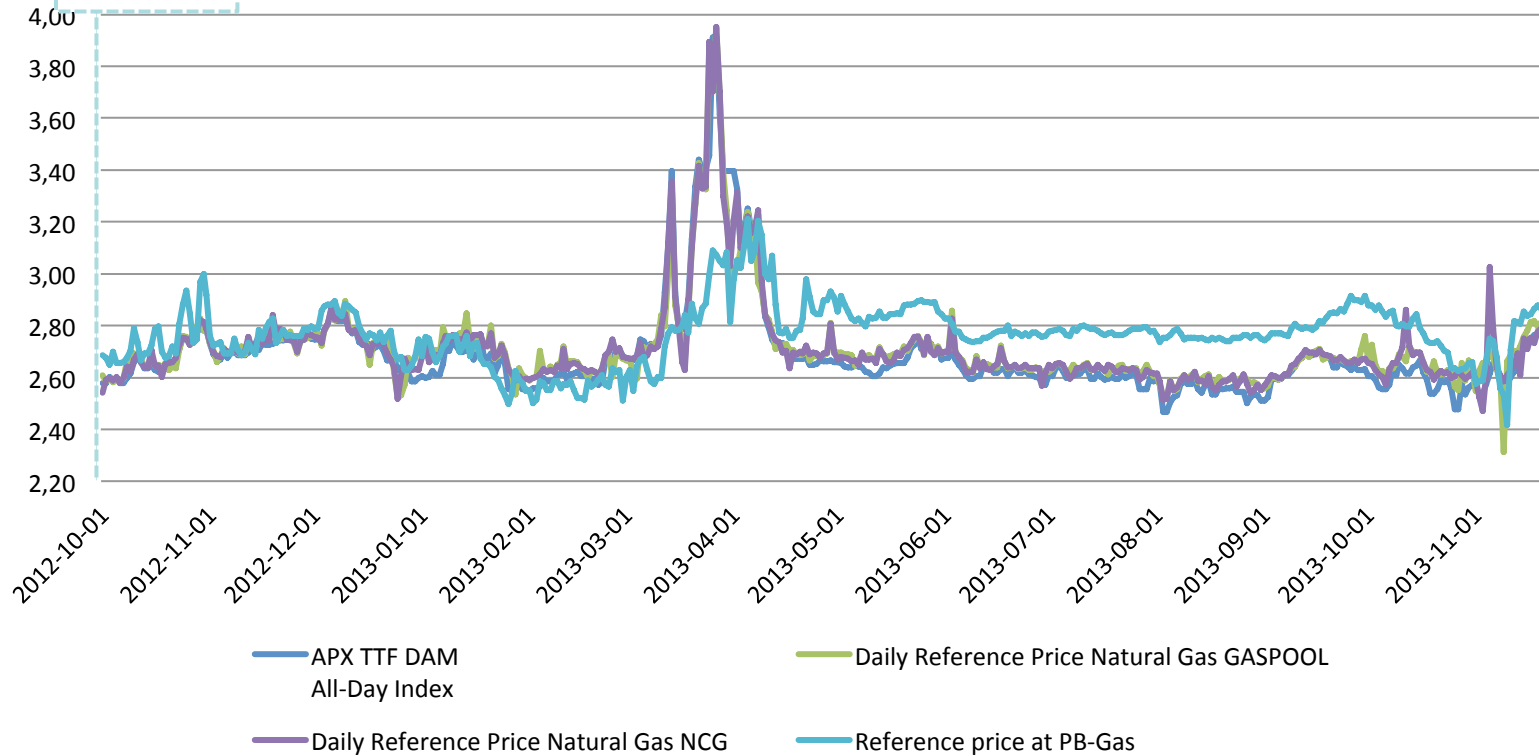


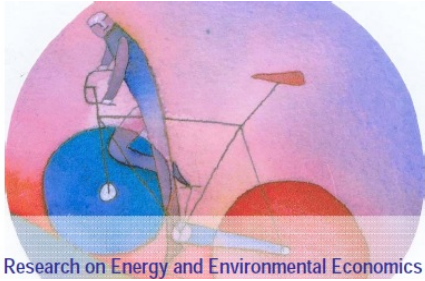


Price convergence

Auctions
on
European
pipelines
(e.g. TAG)

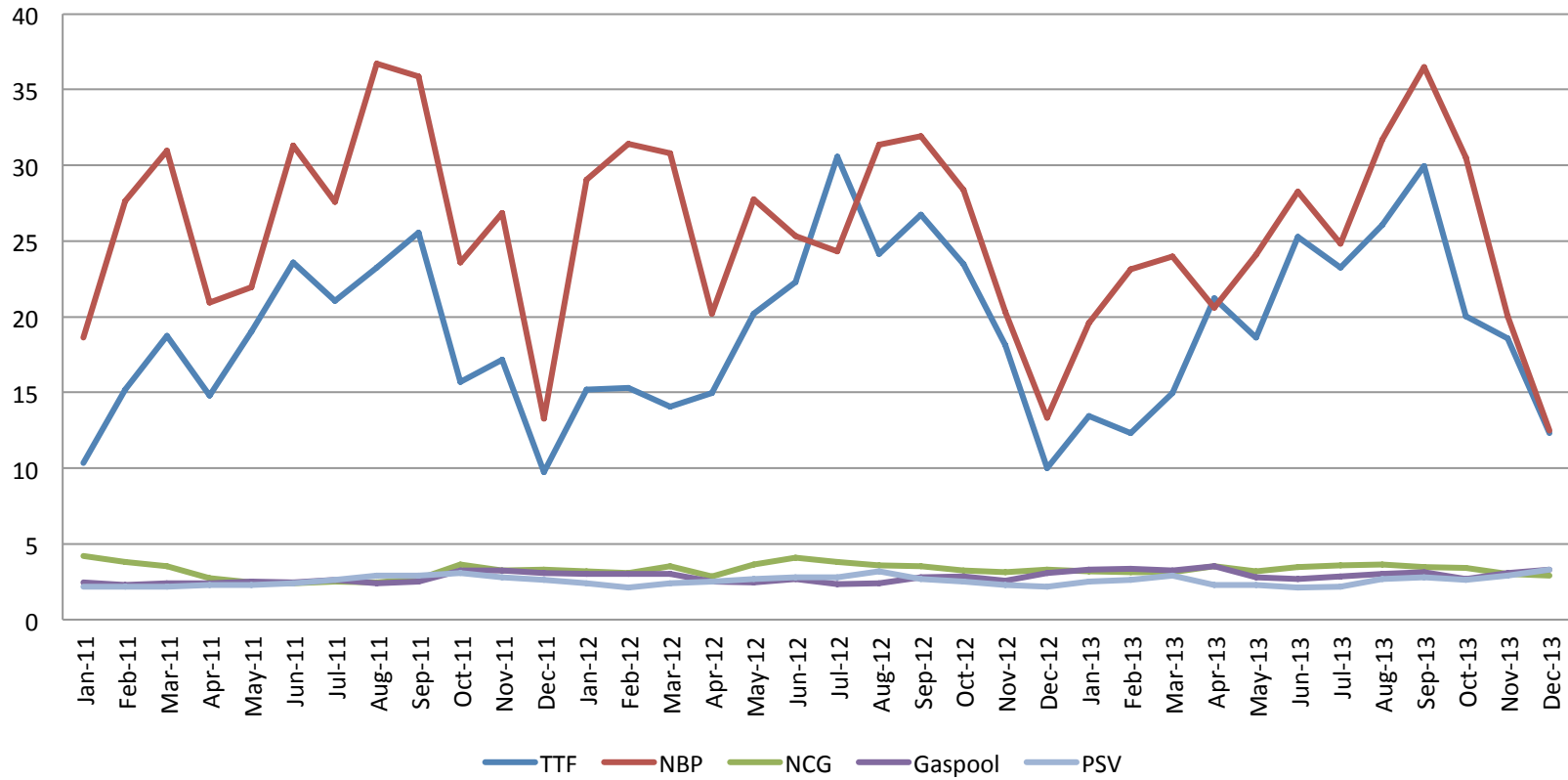
Reference prices (€/kWh)

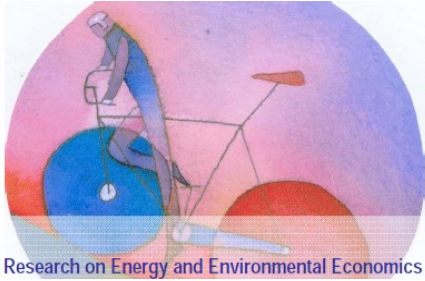




Churn ratio

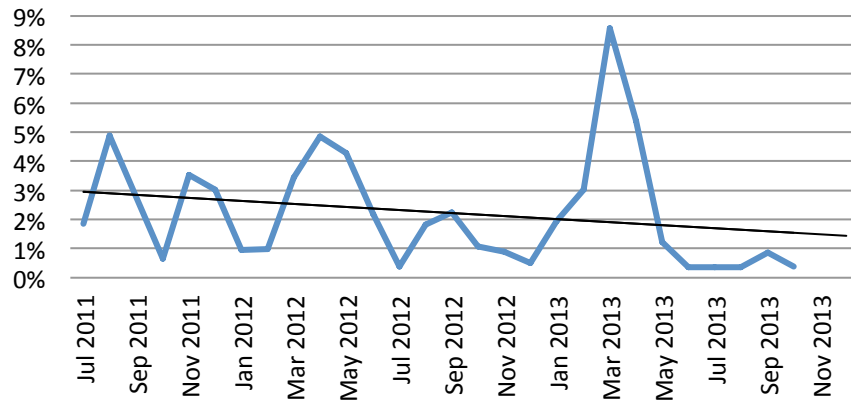
Churn ratio comparison



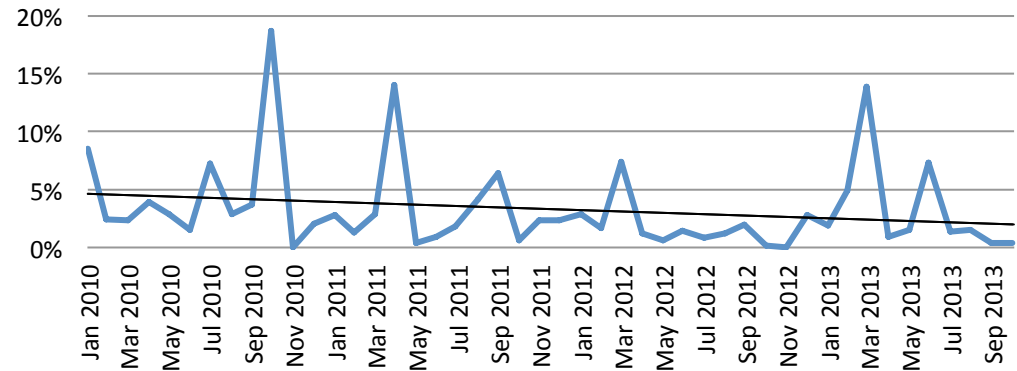


Bid-ask spread

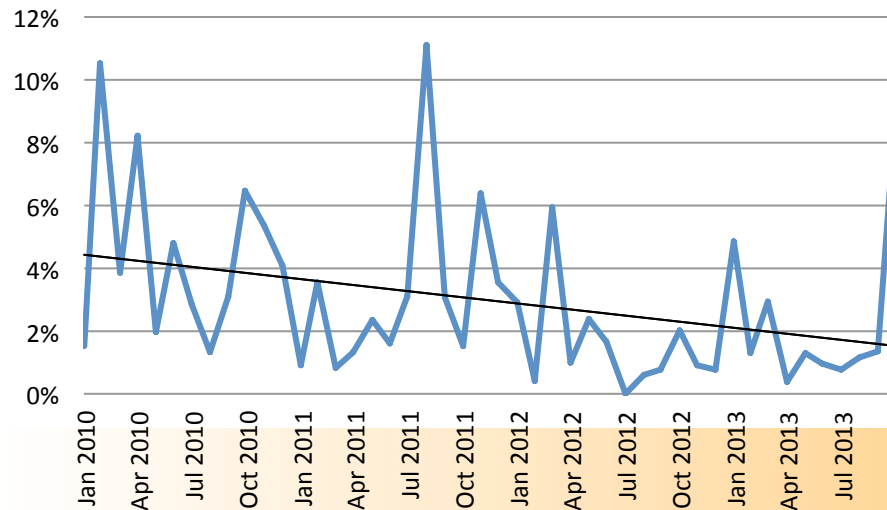
Relative Bid-Ask Quote - PSV



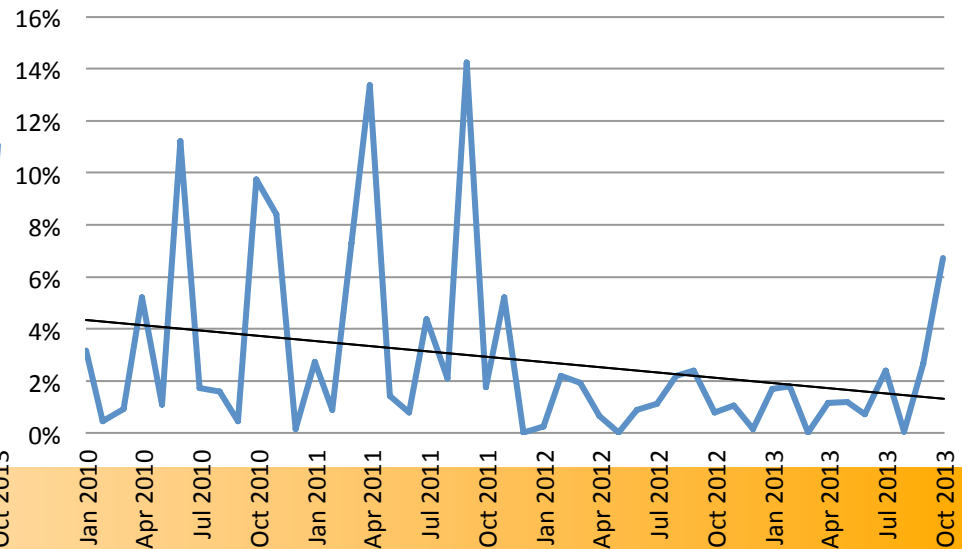
Relative Bid-Ask Quote - NCG

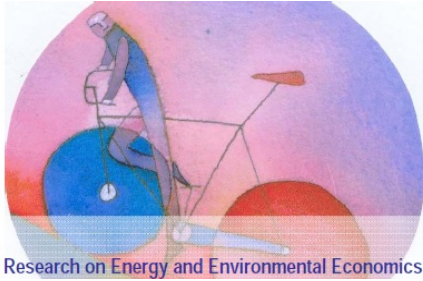


Relative Bid-Ask Quote - TTF



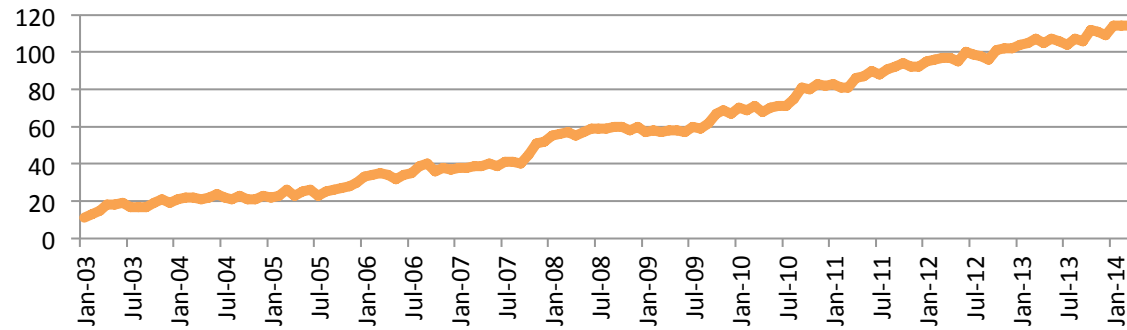
Relative Bid-Ask Quote - NBP



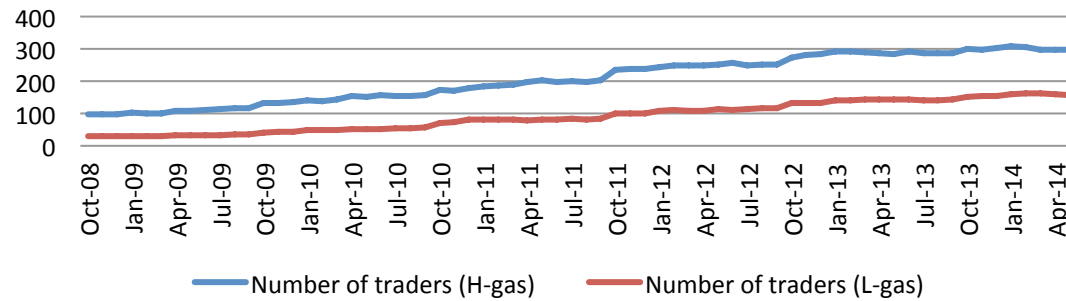


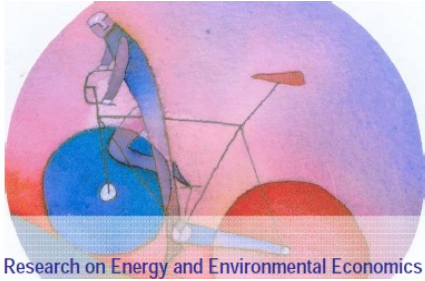
Number of traders

Number of active parties at TTF

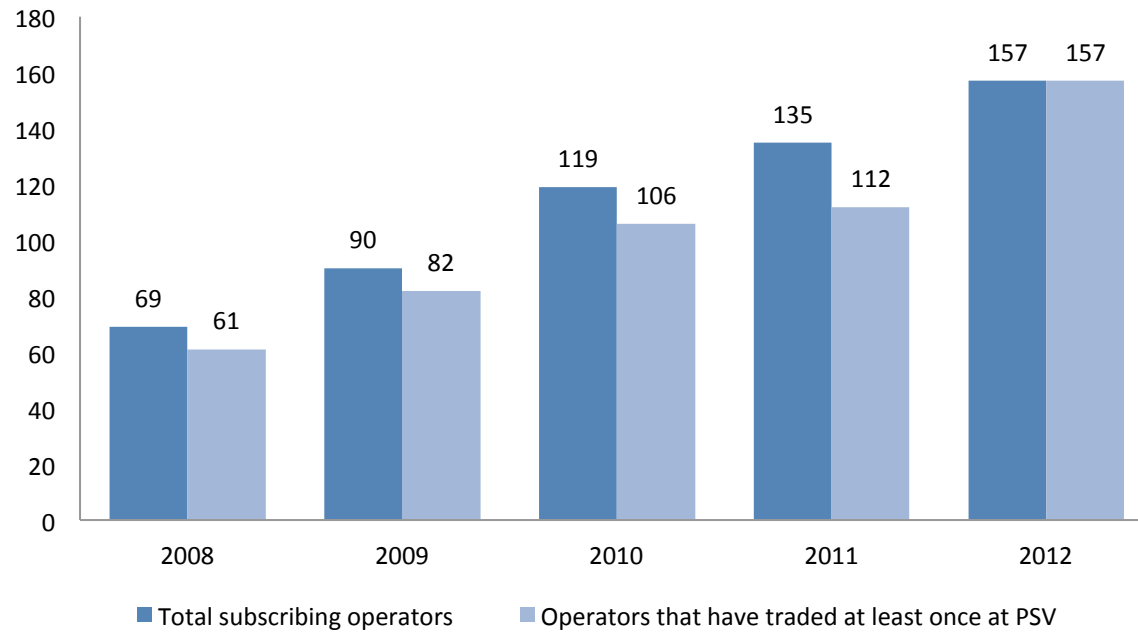


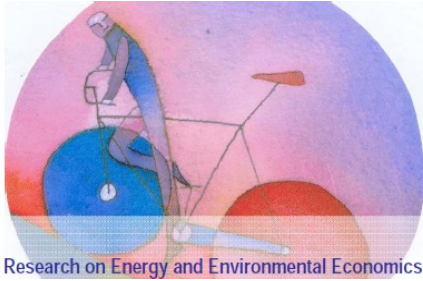
Number of traders at NetConnect





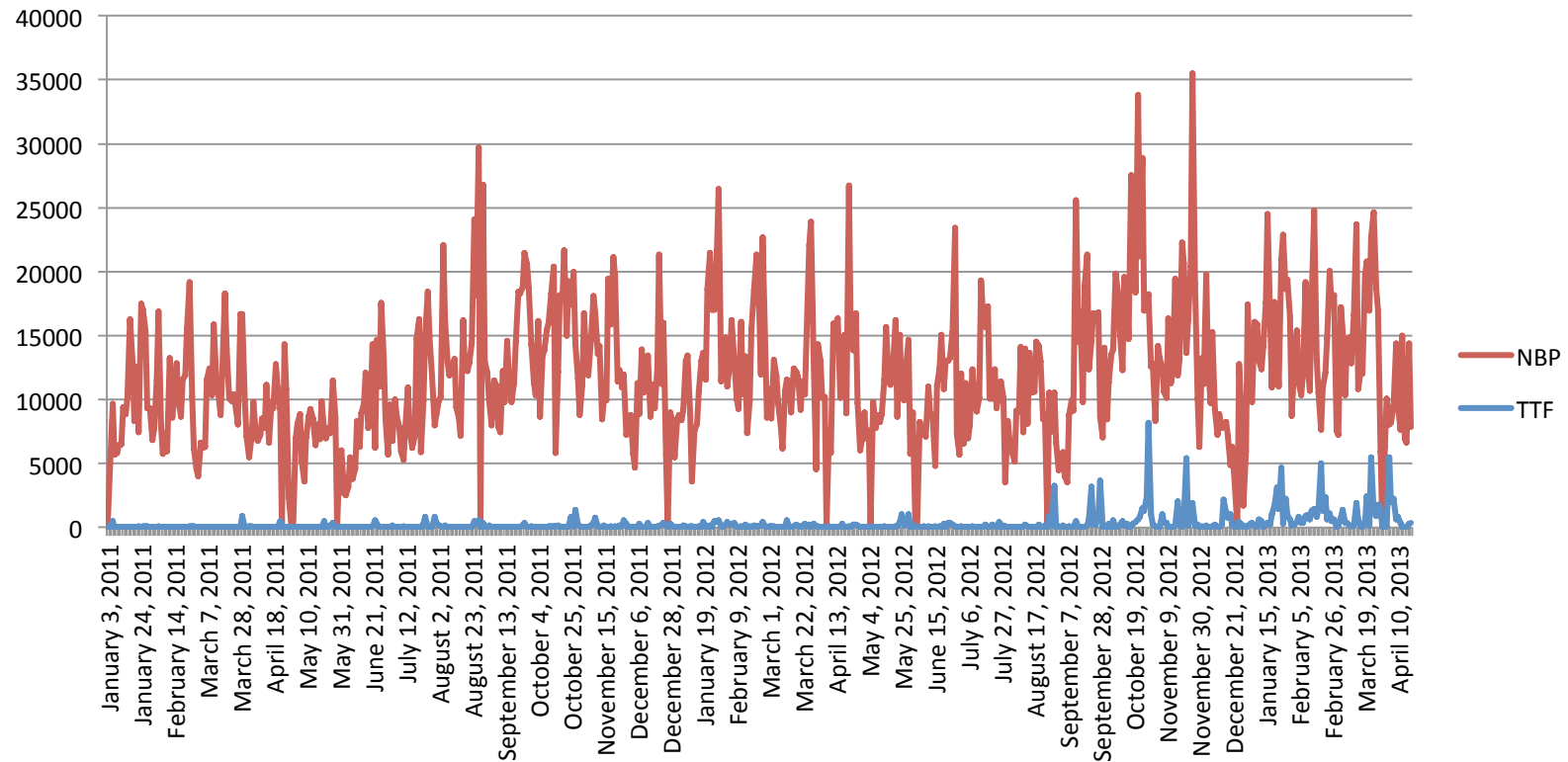
Number of traders

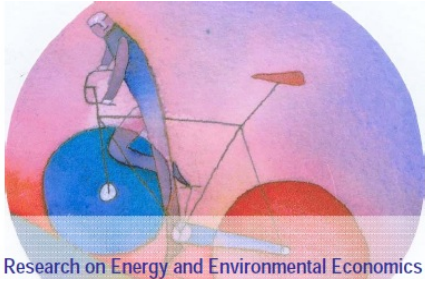




Indicators: financial market

Contracts exchanged (ICE Monthly Futures, num of contracts)





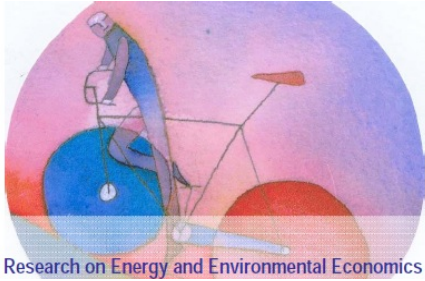
Conclusions

- Wholesale gas trading consequence of market liberalization.
- Natural endowment/importance of upstream long term contracts matter.
- Appropriate rules may help enhancing market liquidity:
 - Adoption of an entry/exit system;
 - Transparency;
 - Adoption of a market-based balancing system → e.g. UK, Netherlands;
 - Reduction of market areas → e.g. Germany;
 - Start with balancing platform → counterfactual: Italy;
- Wholesale gas trade in each national gas system, financial transaction in a single market venue: U.K.

Bocconi

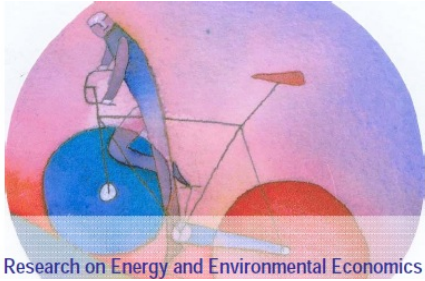
IEFE

Centre for Research on Energy and Environmental Economics and Policy

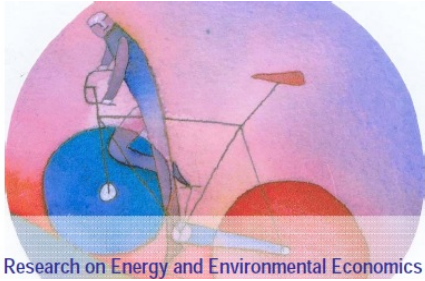


Thank you.



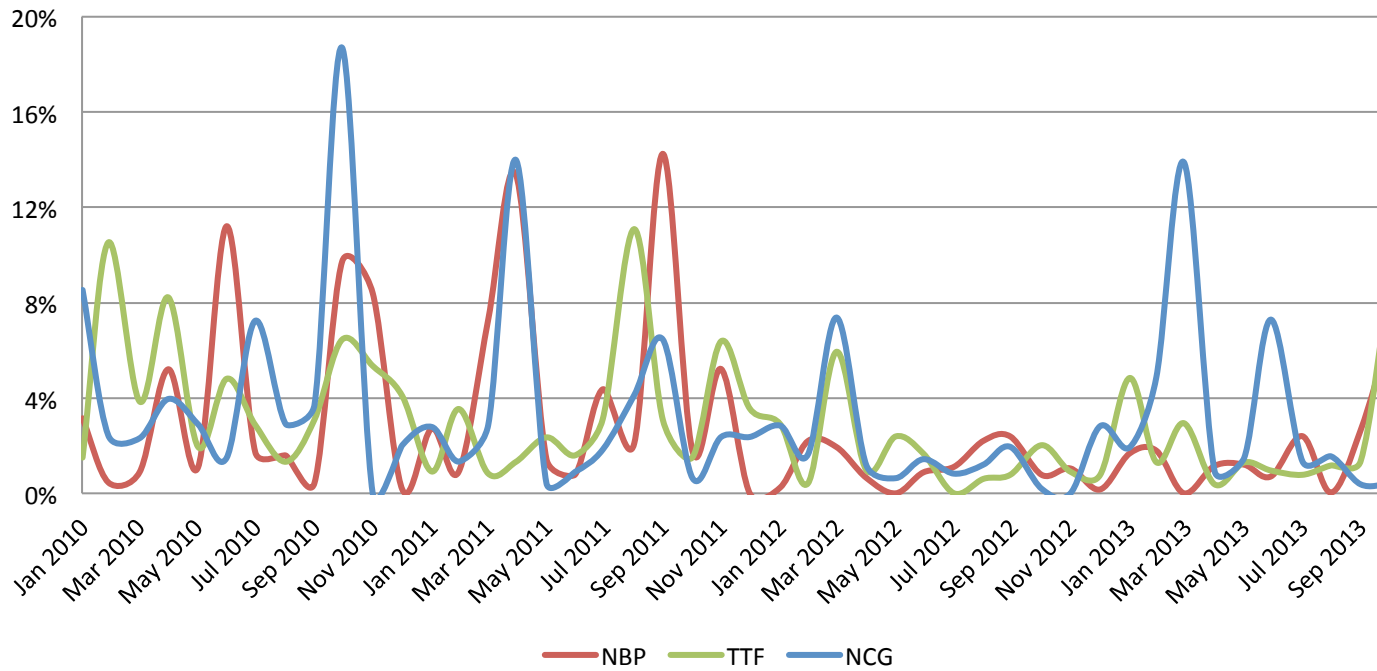


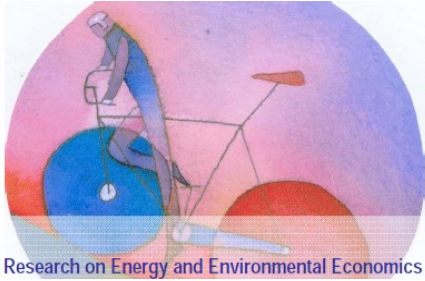
Back-up slides



Indicators: liquidity

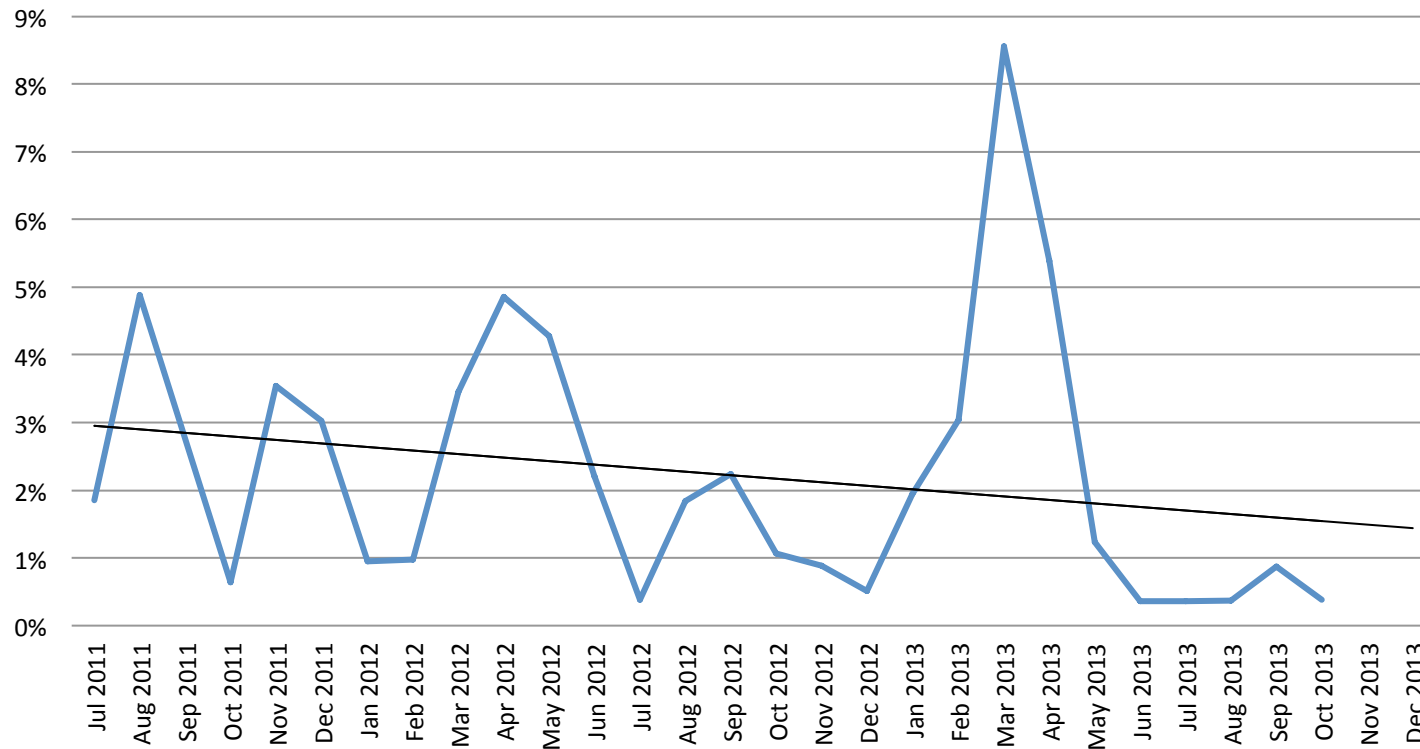
Relative Bid-Ask Quote

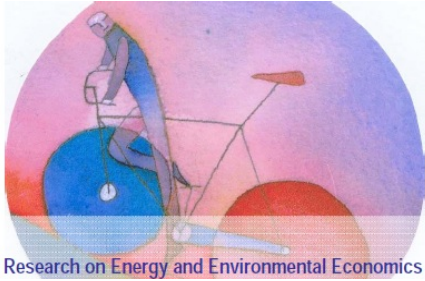




Indicators: liquidity

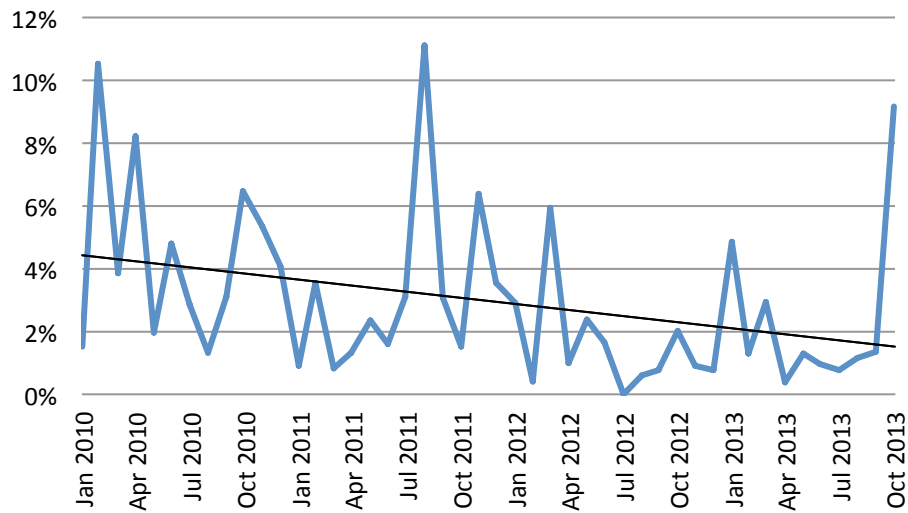
Relative Bid-Ask Quote - PSV



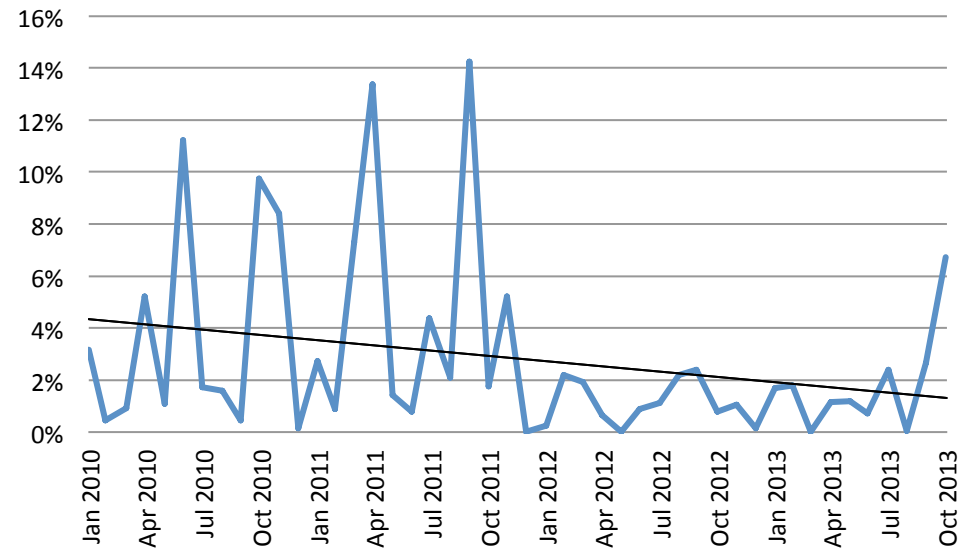


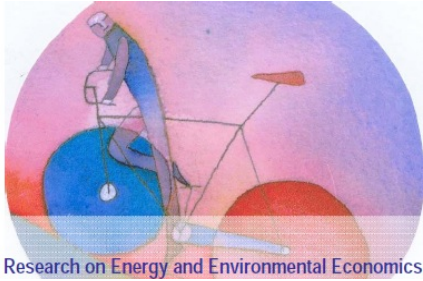
Indicators: liquidity

Relative Bid-Ask Quote - TTF



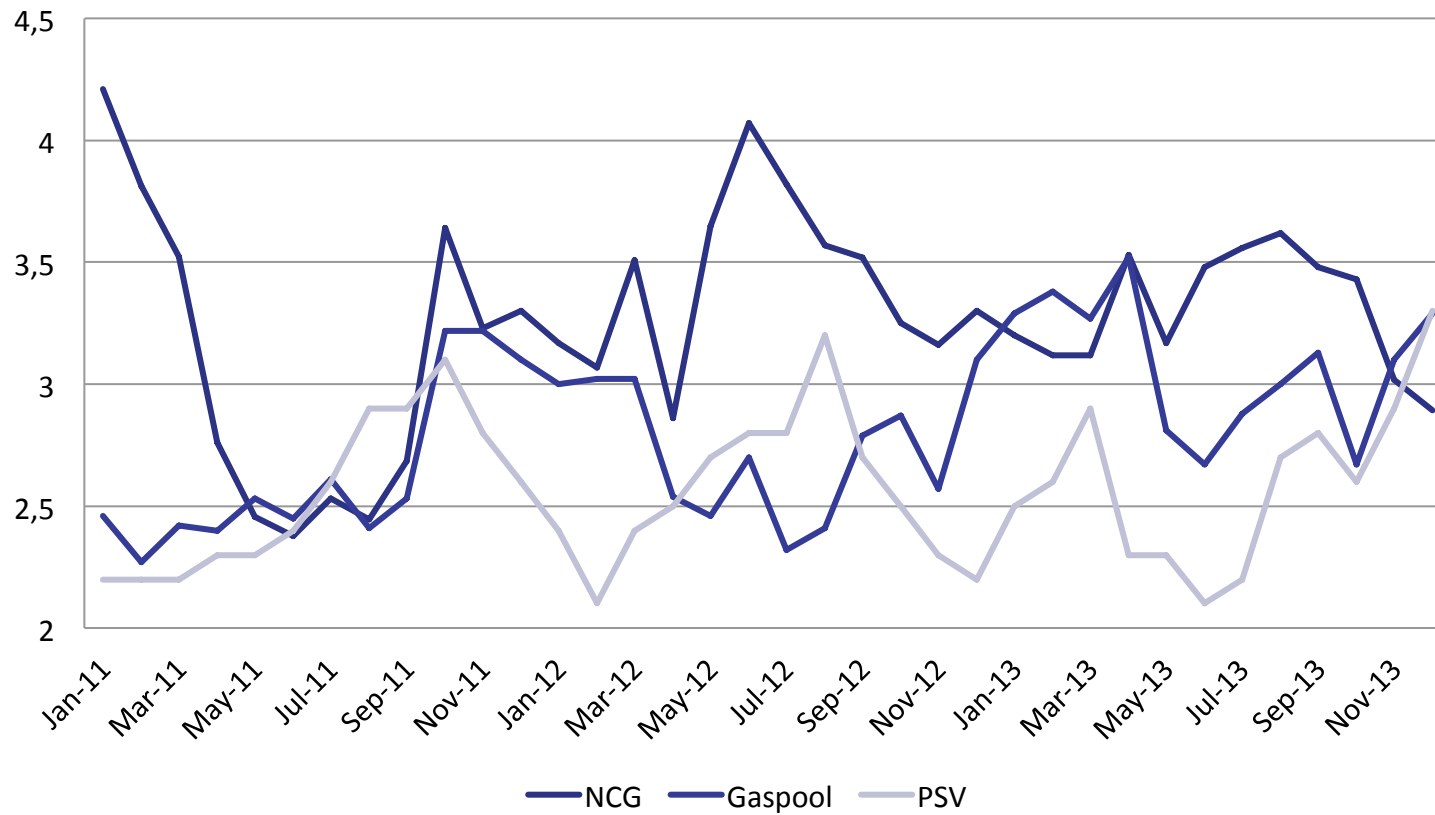
Relative Bid-Ask Quote - NBP

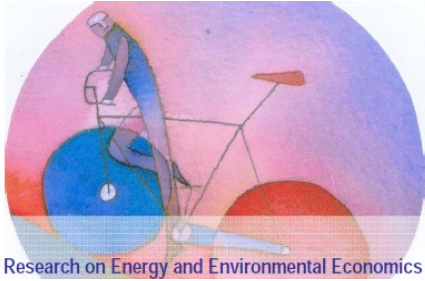




Indicators: liquidity

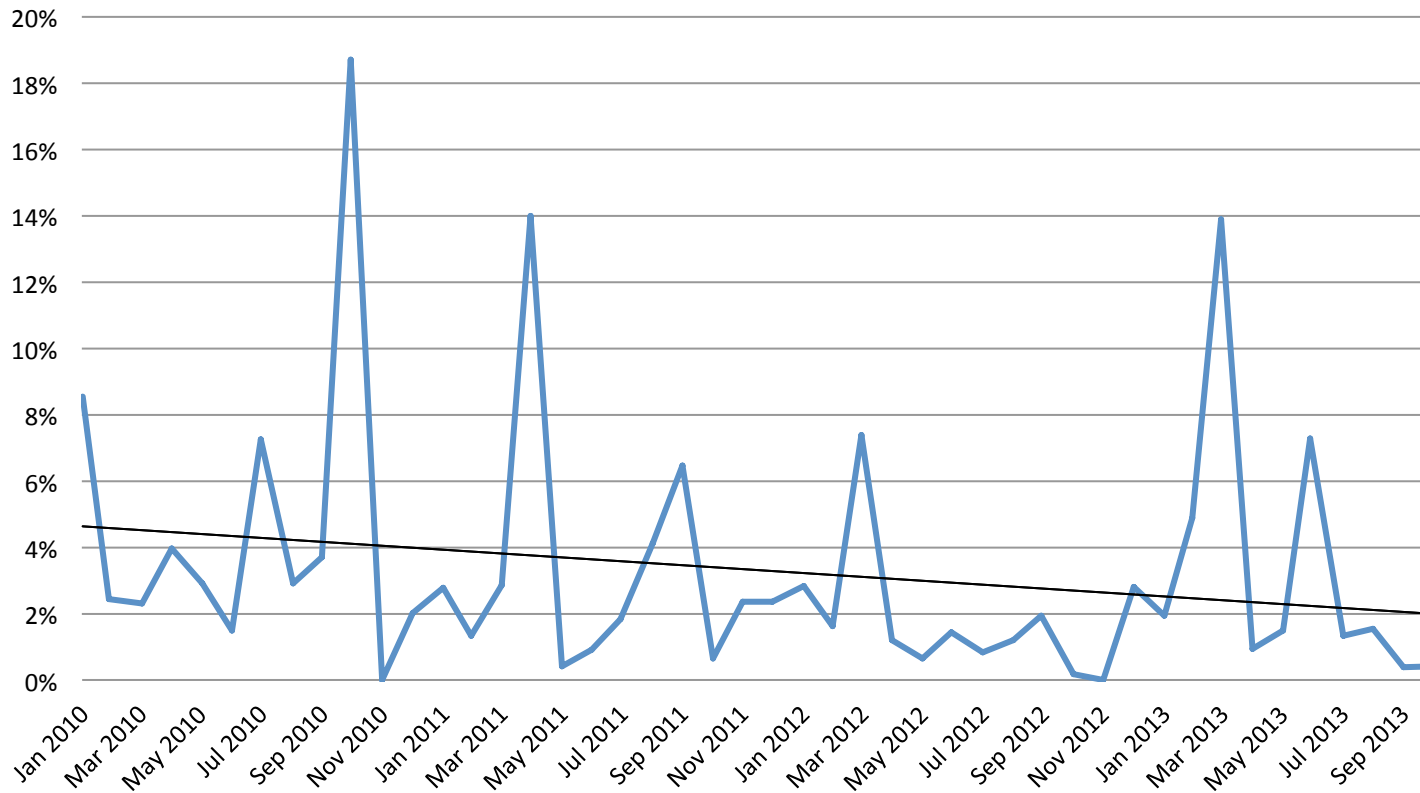
Churn ratio comparison (w/o NBP and TTF)

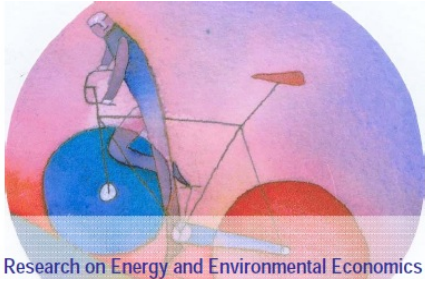




Indicators: liquidity

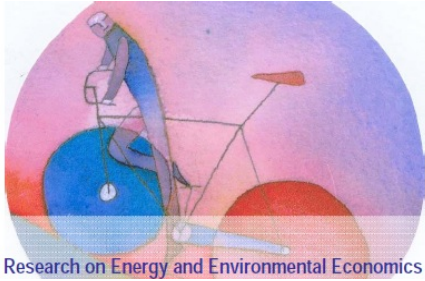
Relative Bid-Ask Quote - NCG





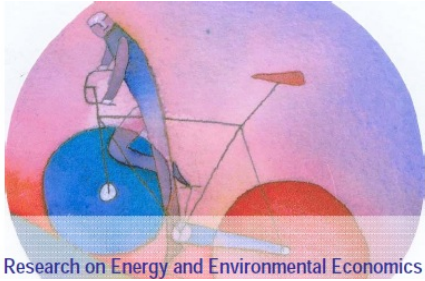
Regulation: UK

- First EU country to liberalize gas market.
- '90s: creation of *Flexibility mechanism* for balancing, heavily relying on the physical flexibility tools available.
- 1999: *New Gas Trading Arrangements* (NGTA): more reliance on market-based tools for balancing, in order to improve price signals and to reduce the cost of balancing.
- Operators have incentives to clear their positions, with the TSO (National Grid) balancing only residually the system at a price related to the System Average Price (SAP).
- The price set on the OCM is used as a reference for the SAP; subsequently, the System Marginal Buy Price (SMBP) and the System Marginal Sell Price (SMSP) are computed.
- The main market instrument to acquire the resources for balancing is the On-the-day Commodity Market (OCM).



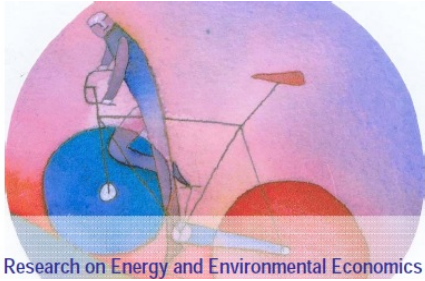
Regulation: the Netherlands

- 2004: GTS (Gas Transport Services) introduced an entry-exit capacity system and the virtual trading point TTF.
- 2005: ownership unbundling of Gasunie into GasTerra, as trading company, and Gasunie as transportation company.
- 2007-2009: rules to improve transparency, quality conversion and balancing regime.
- 2011: *Nieuw marktmodel* introduced. TTF becomes the central trading point for all natural gas in the Dutch transmission system.



Regulation: Germany

- 2002: creation of the Bunde-Oude hub on the Dutch/German border.
- 2005: Energiewirtschaftsgesetz (EWG), entry-exit system; 19 entry-exit zones, called “Marktgebiete”.
- 2008: reduction of the zones to 12.
- 2010: Gas Network Access Ordinance (GasNZV) required TSOs to reduce the market areas for L-gas to one and for H-gas to two by 2011.
- 2013: Further steps into balancing market reform.



Regulation: Italy

- 2006: creation of the PSV hub.
- 2010: creation of the P-GAS, in order to exchange quotas of imported gas.
- 2011: creation of the PB-GAS for balancing purposes (similar to old UK flexibility mechanism).
- 2014: enlargement of the flexibility tools allowed for balancing.