Policy measures targeting a more integrated gas market: impact on prices and arbitrage activity

Ekaterina Dukhanina, MINES ParisTech
François Lévêque, MINES ParisTech
Olivier Massol, IFP School & City University of London

ISEFI 2018 - Paris, May, 24th 2018

Introduction

- **Context:**
- An integrated market :
  - opens more opportunities for producers
  - provides cost efficient gas for consumers
  - reinforces the security of supply from a public policy perspective
  - improves possibility to forecast
- Policymakers need to find efficient measures targeting a more integrated gas market aiming at an increase in liquidity on gas trading hubs

- **Motivation:**
- Merger of French gas trading zones offers an example of such policy
- The efficiency of this measure and its impact on gas prices and arbitrage activity have not been evaluated yet
- According to European initiatives to create an integrated, efficient and liquid gas market further mergers of trading zones are proposed (creation of unique gas market zone in France in November 2018

- **The paper**
- Assesses the degree of spatial integration between two natural gas markets through the application of a new methodology based on the theoretical notion of spatial equilibrium
- Accounts for the role played by trade flows, capacity constraints, and unit transaction costs in the evaluation of market integration, which helps to detect causes for market inefficiency
- Analyses the efficiency of the policy, in particular, its impact on market integration and arbitrage activity

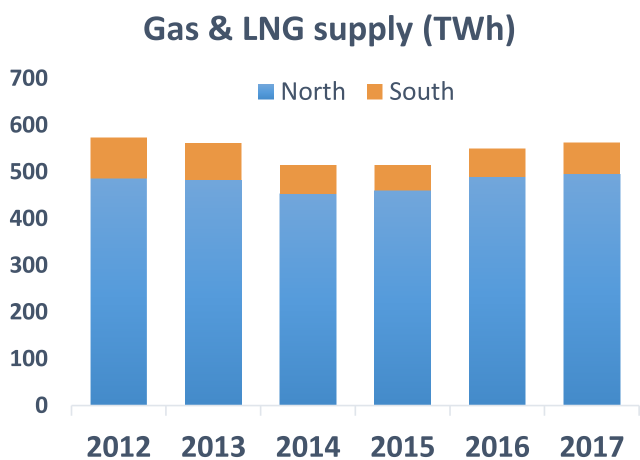
French gas markets after liberalization

- **Gas balancing zones:**

- Entry-exit system for gas transmission tariffs based on division into balancing zones

- The number of zones has been gradually reduced after a series of mergers

- Since April 2015: 2 gas trading regions North & South



Source: GRTGaz

- We study the impact of the merger of Southern zones on North-South arbitrage activity

Integration of gas markets: how to define and measure

- **Definition of integration:**

- Historical definition (Cournot, 1838; Marshall, 1890): two geographical markets for a tradable good are integrated if the price difference between these two markets equals the unit transportation cost

- Spatial price determination (Spiller, Huang, 1985; Enke, 1951; Samuelson, 1952; Takayama, Judge, 1971) emphasizes the role of rational arbitragers and arbitrage costs and points out time varying nature of the LOOP: two spatially distinct areas belong to the same economic market if they are linked by binding arbitrage conditions

- **Classification of methodologies** (Dukhanina, Massol, 2018)**:**

- Early correlation-based studies (Doane, Spulber,1994)
- Cointegration tests (De Vany, Walls,1993; Serletis,1997; Asche et al., 2002, 2013 and Siliverstovs et al., 2005, Brown, Yücel, 2009; Renou-Maissant 2012)
- Granger causality/VAR/VECM (De Vany, Walls, 1996; Serletis, Herbert, 1999; Bachmeier, Griffin, 2006; Park et al., 2008; Brown, Yücel, 2008, 2009; Mohammadi, 2011; Olsen et al., 2015, Growitsch et al. 2015)
- Kalman filter (King, Cuc,1996; Neumann et al., 2006; Neumann, 2009, Neumann, Cullmann, 2012, Li et al. 2014; Growitsch et al. 2015; Mu, Ye, 2018)
- Price convergence estimations (Li et al. 2014; Mu, Ye, 2018)
- AR models of price spreads (Cuddington, Wang, 2006)
- Other models (Spiller, Huang, 1985; Kleit, 1998; Micola, Bunn, 2007; Massol, Banal-Estañol, 2016)

Methodology

- **Spatial equilibrium model :**

- Spatial price spread $P_{it} - P_{jt}$ can be equal to, lower or higher than the transportation (arbitrage) costs C_{ijt}, which determines 3 regimes of a standard parity bounds model. Arbitrage costs are unobservable, but can be explained by a vector of observable variables $C_t = \alpha + \beta X_t + e_t$
- Combining the spatial price spread with the arbitrage costs the PBM estimates by maximizing log likelihood function the probability to be in one of three trade regimes :

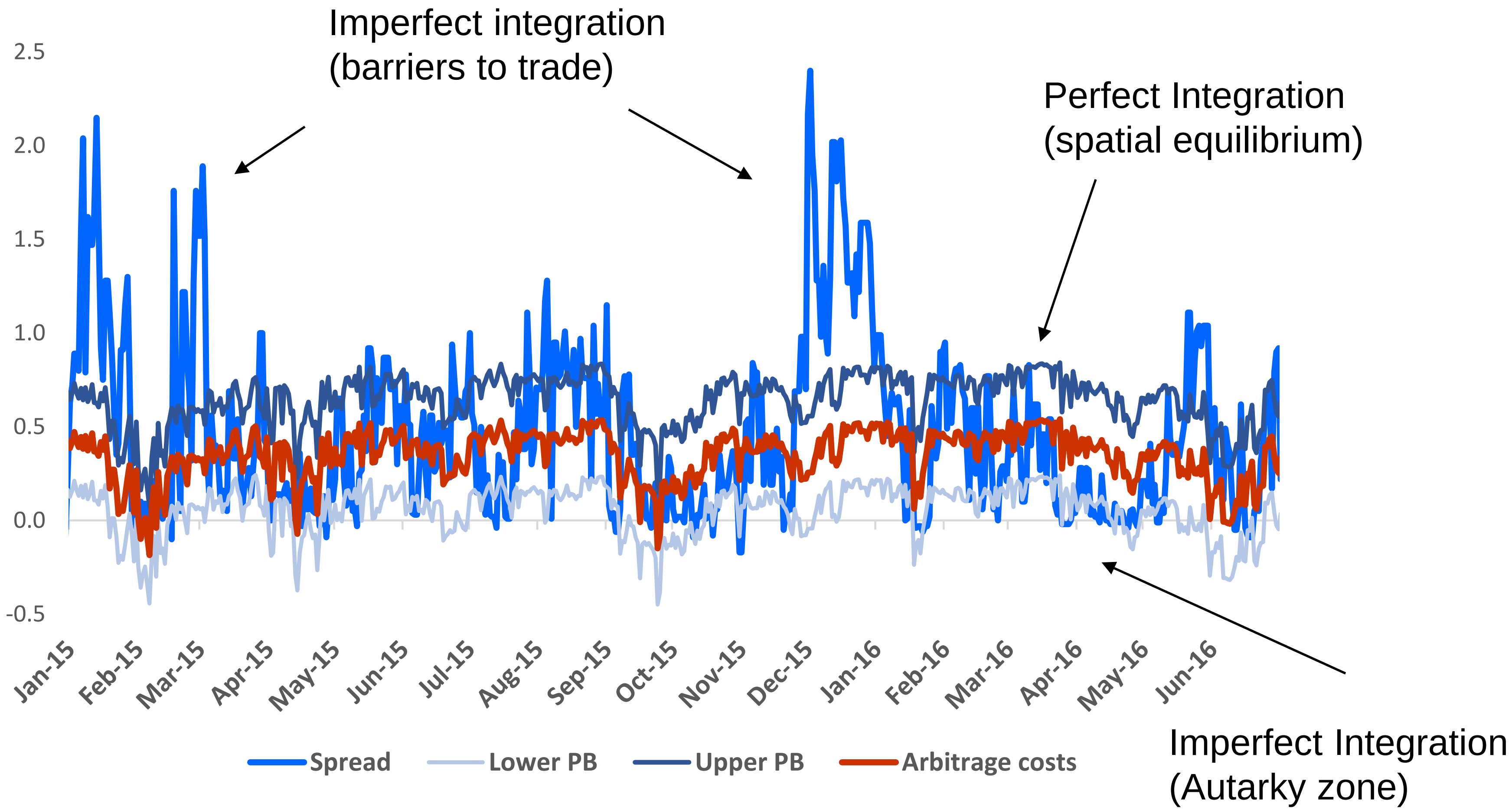
  - Perfect integration (equilibrium) with zero arbitrage rent (R = 0): $\Delta P_{ijt} - C_{ijt} = e_t$
  - Imperfect integration (barriers to trade) with positive arbitrage rent (R > 0): $\Delta P_{ijt} - C_{ijt} = e_t + u_t$
  - Imperfect integration (autarky) with negative arbitrage rent (R < 0) : $\Delta P_{ijt} - C_{ijt} = e_t - u_t$

- Where $R_t = \Delta P_{ijt} - C_{ijt}$ represents marginal rent from arbitrage (price spread net of transportation costs), e_t is a random shock, assumed to be normally distributed with zero mean and standard deviation σ_e and u_t is non-negatively valued random variable measuring deviation of price spread from arbitrage costs and assumed to be half-normal and distributed independently from e_t with standard deviation σ_u

- **Extension of the model :**

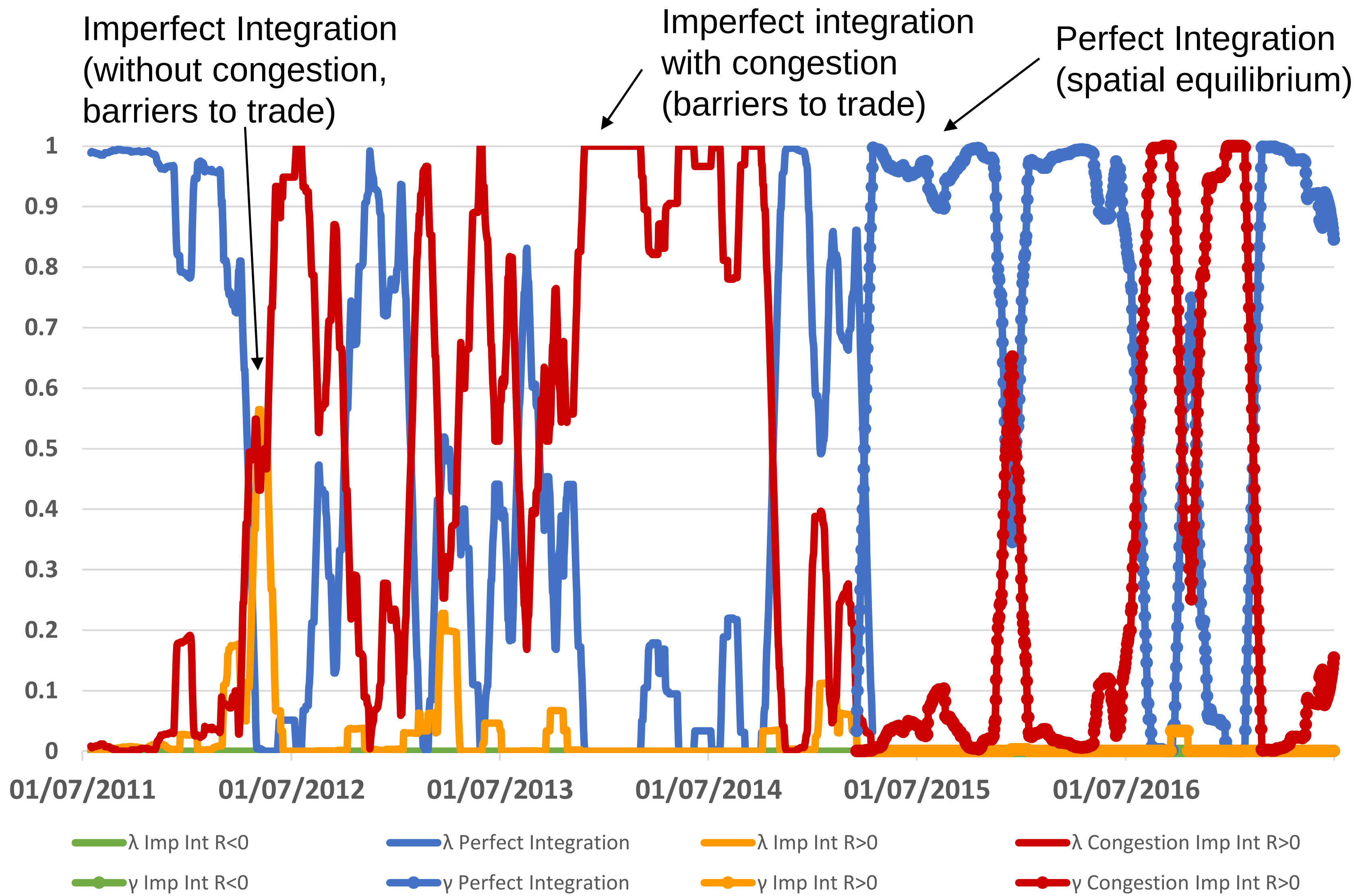
- Additional "congestion" regime (Massol, Banal-Estañol, 2016)
- Policy dummy variables (Negassa, Myers, 2007)
- Estimation of arbitrage costs using price and non-price data
- Tests for the presence of market power (Massol, Banal-Estañol, 2016)

Parity Bounds Model: regime examples



Plot of spatial price difference, estimated arbitrage costs and parity bounds

Parity Bounds Model: ex-post regime probabilities



One month centered moving average estimates of regime probabilities

Results (1/2)

- Transportation costs depend on regulated transmission tariffs and transported volumes

Arbitrage costs estimation	T0	Tariffs	Volumes
Coefficient	-0.450	0.169	2.227
SE	0.068	0.050	0.158

- The presence of market power is revealed by positive and significant coefficient of dependence of transportation costs on transported volumes (Massol, Banal-Estañol, 2016), because the null hypothesis of perfectly competitive spatial arbitrage activity is rejected.

- The estimated arbitrage profit has been reduced after the zone merger

Mean, EUR/MWh	Spread	Arbitrage costs	Arbitrage rent
Full sample	1.88	0.36	1.52
Before the policy	2.22	0.36	1.87
After the policy	1.30	0.36	0.94

- The LR test does not reject the null hypothesis of no change in arbitrage costs coefficients after the zone merger

Results (2/2)

- LR test revealed changes in probabilities and standard deviation parameters after the policy measures.

Period	Before zone merger		After zone merger	
	σ_e	σ_u	σ_e	σ_u
Value	0.289	4.297	0.334	5.569
SE	0.010	0.098	0.014	0.162

- The model shows a higher probability to observe the spatial equilibrium regime after the policy implementation (market became more spatially efficient).

Period	Before zone merger				After zone merger			
Parameters	$\lambda 1$	λc	$\lambda 2$	$\lambda 3$	$\gamma 1$	γc	$\gamma 2$	$\gamma 3$
Regime	R>0	R>0	R<0	R=0	R>0	R>0	R<0	R=0
Probability	0.034	0.503	0.000	0.463	0.001	0.264	0.000	0.735
SE	0.005	0.018	-	0.019	0.001	0.024	-	0.024

- The probability of imperfect integration (barriers to trade) is explained mostly by congested infrastructure, which has been reduced after the zone merger.

- However, unexploited arbitrage opportunities have been observed along with not fully loaded infrastructure before the policy implementation. This can be explained by the presence of imperfectly competitive arbitrage: the null hypothesis of competitive arbitrage activity is rejected by the LR test.

- Zero probability to be in the autarchic regime is justified by the presence of trade flows to the south direction.

Conclusions

- The study allowed us to estimate the efficiency of a policy measure targeting a more integrated gas market using spatial equilibrium framework: a parity bounds model is applied to measure the impact on spatial efficiency of the market of a policy decision to merge two gas trading zones in the South of France.

- The model points out that congested infrastructure and presence of imperfectly competitive arbitrage can be the causes of market inefficiency

- The model shows increased market integration and improved market efficiency after the policy implementation.

THANK YOU!