Regulation of Natural Gas Pipeline Investments - An Experimental Evaluation

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WORK IN PROGRESS!

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Overview

- Introduction
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Introduction

Introduction

- EU Natural gas market requires additional investments in gas pipelines to obtain a common market
- How to induce an optimal level of investments is a question for policy makers and academia
- Obstacle for the network operator (TSO) to invest
  - Risk of stranded assets, fear insufficient return on investments

Introduction

- Has liberalization possibly made that situation worse?
  - Vertical unbundling of TSO and shippers, restrictions of LT contracts

    → Riskier, more uncertainty, less incentives to invest (Cremer et al.)
  - Strict regulation of TSO

    → possibly underinvestment, upside potential of investment is capped (Vogelsang)
- Potential means to address these issues:
  - Regulatory Holiday
  - Long Term Financial Transmission Rights (LTFTR)

Regulatory Holiday

- TSO is temporarily exempted from regulation for the **new** pipeline capacity

- Why?
  - Additional revenue (potential) is intended to compensate the TSO for an ex-ante risk of stranded assets (Gans & King)
  - EU-regulation (Directive 2003/55/EC) has provisions for such exemptions, potential investors have applied for exemption under this provision.

Long Term Financial Transportation Rights

- LTFTR are financial hedges
- The TSO sells LTFTRs to shippers, and agree on a forward price *f*
- For the duration of contract, the TSO pays the shippers the difference between the spot market price *p* and the forward price of capacity *f*
- Benefits for TSO
  - Forward price gives information about future demand
  - Volatility of income stream is reduced. The TSO receives the forward price *f*
- Benefits for Shippers
  - Shippers receive insurance against changes in the spot market price
- Financial transmission rights do not lead to foreclosure (Joskow & Tirole)

Research Question

- What is the performance of the **regulatory holiday** in achieving an optimal level of investments compared with RoR regulation?

- Does the inclusion of **LTFTR auctions** enhance / interact with the performance of the regulation?

What we do

- Set-up an **economic laboratory experiment**
  - (Lumpy) Investments in capacity (TSO) over several periods
  - Shippers can buy capacity in capacity market
- **Baseline Treatment**
  - Rate of Return Regulation with Used and Useful rule
- **Three alternative Treatments**
  - LTFTR for all existing capacity
  - Regulatory holiday for limited period for new capacity
  - Combination of LTFTR for existing capacity + Regulatory holiday for new capacity

What we find

- **Baseline treatment (RoR with used and useful rule)**
  - Notwithstanding the risk, the investment levels were relatively efficient
  - Cf. theory: As long as the regulation is not too strict, a price control increases investment levels (Vogelsang)
  - Shippers (as well as the TSO) make sufficient profit, even though they only trade on the spot market
- **Long term contracts**
  - Depressed forward prices because shippers are reluctant to buy forward
  - Investments are reduced
  - Bidding behavior in the spot market is significantly affected by individual LTFTR holdings
- **Regulatory holiday**
  - TSO delays investments, creates scarcity
  - Repeated operation of regulatory holidays might be inefficient
  - Efficiency loss compared to baseline is modest though

Economic Experiments

Core-features of Economic Experiment

- Real human beings (the “subjects”) are put into a **controlled laboratory environment**
- The subjects (inter-)act according to a **set of rules** (“institutions”) specified by the experimenter
- Subjects are paid in real currency, their **payment is performance-dependent**

Benefits of Experiments / Business Games

- Experiments allow ex-ante evaluation of market organization
  - Analytical models are not always available or predict multiple outcomes
- Using empirical data of existing markets is not always possible
  - With an experiment, we impose the valuation of players, so we can compare the outcomes with the theoretical benchmark
- Experiments allow us to learn which strategies might work in different market environments
- Useful in the discussion with engineers and practitioners. Helped us to think about implementation issues

General Features

- 1 TSO, 4 shippers
- 30 spot market periods
- **Every 6 periods:** (1,7,13,19,25)
  - Shippers learn their *individual* transport capacity for 6 periods
  - Shippers can commit to higher demand for 6 periods at a cost
  - Aggregate demand grows (1-12), stagnates (13-15), decreases (16-18) and increases (19-30), unknown to players
- **Every 3 periods:** (1,4,7,…)
  - TSO can invest in pipeline capacity

Treatments without LTFTR

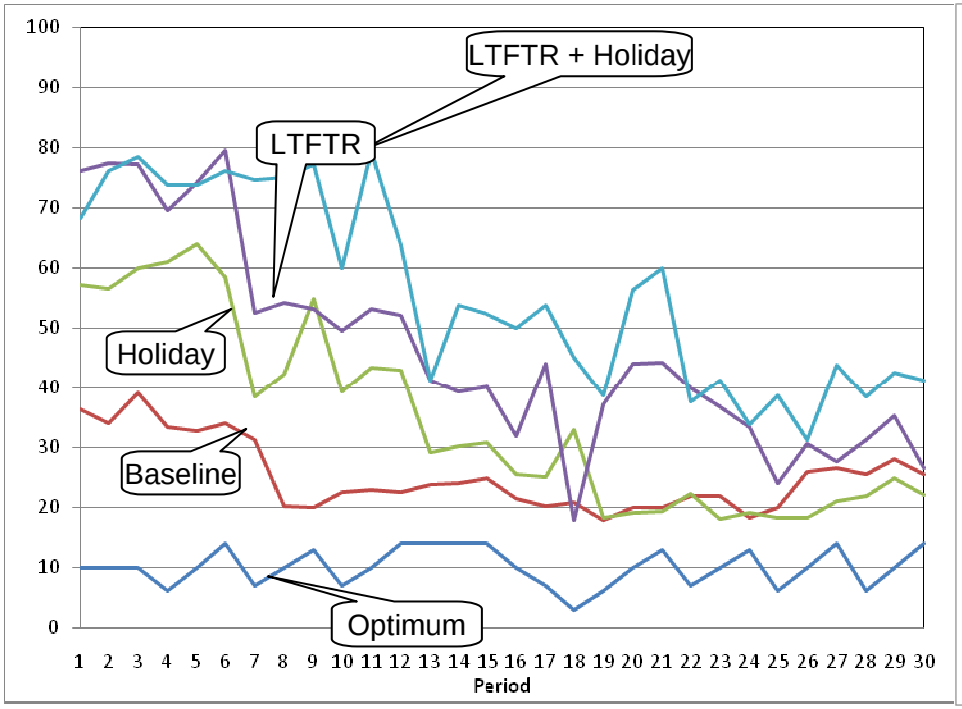
- **No contract (LTFTR) market**
- Common features:
  - TSO decides how much it sells in the spot market,
  - Shippers pay the market price
- Specific to Baseline Treatment:
  - Price cap for TSO (hence a pre-specified return for each unit of capacity) on entire pipeline capacity
- Specific to Holiday Treatment:
  - Price cap on existing pipeline capacity, for new capacity TSO can obtain the unregulated market price.

Treatments with LTFTR

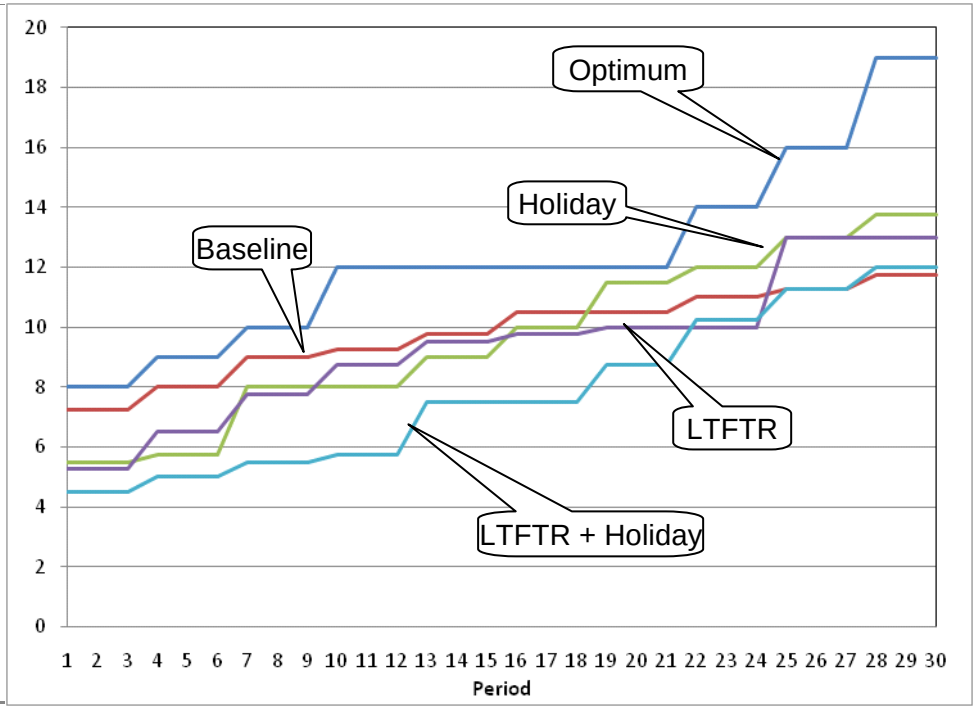
- LTFTR Treatment
  - TSO must immediately offer LTFTR for all pipeline capacity, existing and new
  - LTFTR are valid until next LTFTR auction
  - TSO receives capped price for each unit sold (same cap as in the spot markets “No LTFTR” treatments
- LTFTR & Holiday Treatment
  - TSO is only required to offer LTFTR for existing pipeline capacity
  - For new capacity for which the TSO does not offer LTFTR, it obtains the unregulated clearing price in the spot market

Results

Spot Price



Installed Capacity



Price, Capacity & Efficiency

	Coef.	Std. Error	z	$P > \|z\|$	95% Conf. Interval	
$K_t - K_t^*$						
LTFTR	-0.475	0.833	-0.57	0.568	-2.107	1.157
Holiday	-0.175	0.833	-0.21	0.834	-1.807	1.457
LTFTR*Holiday	-1.375	1.178	-1.17	0.243	-3.683	0.933
Constant	-2.575	0.589	-4.37	0.000	-3.729	-1.421
$P_t(K_t) - P_t^*(K_t^*)$						
LTFTR	21.633	6.293	3.44	0.001	9.299	33.968
Holiday	9.625	6.293	1.53	0.126	-2.710	21.960
LTFTR*Holiday	-0.542	8.900	-0.06	0.951	-17.986	16.902
Constant	14.758	4.450	3.32	0.001	6.036	23.480
General Eff.						
LTFTR	-0.068	0.030	-2.23	0.026	-0.128	-0.008
Holiday	-0.058	0.030	-1.91	0.057	-0.118	0.002
LTFTR*Holiday	-0.050	0.043	-1.15	0.251	0.134	0.035
Constant	0.945	0.022	43.81	0.000	0.902	0.987

Observations

- Baseline is most efficient
- LTFTR , and Regulatory Holiday reduce efficiency
- Combination of LTFTR and Regulatory Holiday: Reduce efficiency even more
- Why do LTFTR and regulatory holiday not work?

Static Efficiency?

- Conditional on actually installed / available pipeline capacity, is the allocation of capacity on the spot markets efficient?
  - Allocation is highly efficient in all treatments, hence no significant differences in static efficiency
- Does the spot price reflect scarcity?
  - In LTFTR treatments, the (compared to non-LTFTR treatments higher spot price) spot price is closer to the static optimum, but significantly further away from dynamic optimum
- Conclusion: Differences in general efficiency are rooted in differences in dynamic efficiency!

Dynamic Efficiency & LTFTR

- Reluctance of shippers to buy LTFTR

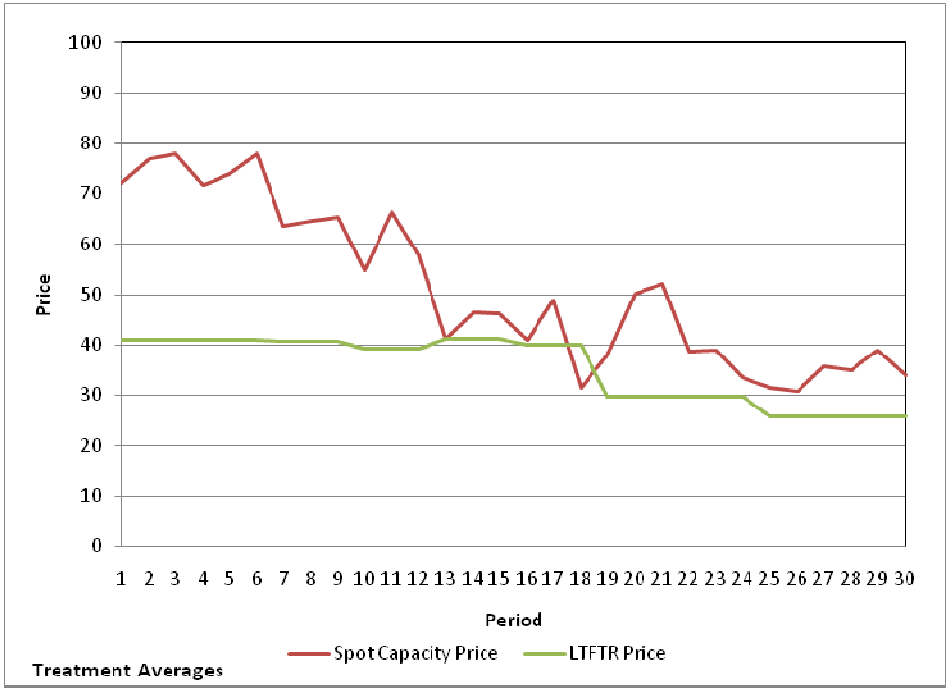
→Lower prices for LTFTR

→Rational for shippers?

- TSO is obliged to sell all capacity forward

→ Will sell at lower prices

→ But still reasonable profit



Dynamic Efficiency & LTFTR

- Regulatory holiday
  - TSO makes a profit by creating scarcity
  - Gives TSO upside benefit of innovation with uncertain return
- Repeated periods of regulatory holiday
  - TSO has incentive to create permanent scarcity
- Use regulatory holiday only once
  - Unique opportunity for TSO to have unregulated profits
  - But note: The loss in efficiency is significant but relatively modest

Conclusions

Conclusion

- **Experiments can be used** as a tool for evaluating market outcomes
  - Complimentary to simulations and empirical studies
- **Baseline performs** better than expected
  - Notwithstanding the risk for the TSO, investment levels are relatively efficient
  - Shippers make sufficient profit, even though they only trade on the spot market. They commit to high demand levels without abilities to hedge
  - For environments with a higher demand volatility and larger commitment effects this might not hold
- **Alternative scenarios** underperform,
  - Investments are delayed by TSO
    - Price of capacity too high, lower efficiency
  - Long term rights seem not to have additional benefits
    - Forward prices are depressed, TSO does not obtain better information in forward market
    - Insurance benefits: TSO remains reluctant to invest, even if it receives a profit for sure
    - Bidding behavior in spot market significantly affected by LTFTR holdings
  - Regulatory holiday
    - Incentives to withhold capacity

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