Gas Models
and three difficult objectives

Yves Smeers
CESSA meeting
Berlin 31 May, 1 June
Object of the presentation

- There are models of the European gas market
- There are also three objectives
  - Competitiveness
  - Security of supply
  - Sustainability
- Can the models help the objectives?
The models

- Four models of the European market
- Related but certainly not identical
  - GASNAT: CPB
  - GASMOD: DIW
  - GASTALE: ECN, different versions, among them
  - Egging/Gabriel
The basics of competition

- DG COMP has a view of the product and geographic markets
  - Production and sales (including LNG)
  - Transmission not larger than national
  - Storage (not larger than national)
  - Supply
    - To wholesale (not larger than national)
    - Retail (not larger than national)
- And two other markets that we neglect here
  - Exploration and network operations
A Pictorial Description

Production and Sales

Non-EU transport

EU border

Inter EU countries transport

Storage

Intra EU countries transport

Sector
Gas production and sales

- Producers are countries/companies
  - companies appear in GASTALE

- Producer represented by full cost or full cost functions
  - Variable capacities in GASNAT
  - Fixed capacities otherwise
    - Data coming from different sources and difficult to compare

- Sell
  - to countries (GASNAT, GASTALE, GASMOD)
  - to sector in country (Egging/Gabriel)
Transport is EU wide

- In all models
- This is different from DG COMP view
- No detailed description of the grid
  - A point to point representation between countries
    - From countries to countries (GASNAT, GASMOD, Egging/Gabriel)
    - Along corridors from producers to countries (GASTALE, GASMOD)
- Note: Before restructuring
  - gas transport was not cross border driven
  - Today: cross border capacities!!!
Transport capacities

- Variable in GASNAT and last version of GASTALE
  - Investment and operations cost for expanding capacity
- Full cost and exogenous capacities otherwise.
  - With pricing of congestion on capacities
Storage

- No storage in GASMOD and GASTALE
- Storage is national in GASNAT and Egging/Gabriel
  - Exogenous capacities in Egging/Gabriel
  - Variable capacities in GASNAT
Various assumptions on Transport Supply

- Transport is EU wide in all models
- But supply differs from model to model
  - And supply is at the core of DG COMP concerns
Supply: GASTALE (1)

Production and Sales

EU border

Non-EU transport

Inter EU countries transport

Storage

Intra EU countries transport

Supply

Sector

With price discrimination
Supply: GASTALE (2)

Interpretation: Supply is no larger than national with or without destination clause.
Supply: Egging / Gabriel

Producers directly sell to sectors, buy transport and storage services

**Interpretation:** destination clause still applies.
Supply: GASMOD

Interpretation: Supply is EU-wide (eliminates destination clause)
**Supply: GASNAT**

*Interpretation:* Arbitrageurs eliminate destination clause.
The technicalities of supply

- Wholesale and retail
  - GASNAT: a single linear demand function
  - GASMOD: a single constant elasticity demand function
  - GASTALE: three demand sectors (household industry and power) linear demand functions
    - With possibilities of discrimination between sectors
  - Egging/Gabriel: linear demand functions for three demand sectors (household industry and power)
The usual weakness of supply

The critical problem of the demand side

- **GASNAT:**
  - wide range of demand elasticities (from 0.18 to 0.65 with base 0.25)
- **GASMOD:**
  - a “rather low” elasticity (0.6, 0.7)
- **GASTALE:**
  - *Pindyck 1979* with elasticities ranging from 1.5 to 2.2
- **Egging/Gabriel:**
  - “low elasticities”

The same shortcoming as in electricity: lack of a good demand model
Conclusion on the product and geographic markets

- **Product markets in line with DG COMP**
  - Gas production and sales, transport, storage, supply

- **Divergences on the geographic markets**
  - Supply
    - From sector/country supply (GASTALE) to EU wide supply (GASMOD)
  - Transport: EU wide
  - Storage: national

- **The geographic markets are in flux**
The assessment of competitiveness

- Models for assessing losses due to market power
  - And hence the gains of competitiveness

- Two standard competition paradigms
  - Perfect competition
  - Cournot competition
    - Applied to gas production and sales
    - Applied to gas supply
    - Never to transport or storage
      » Recall: EU-transport is regulated but
      » Non EU-Transport is not regulated (Russia did not ratify ECT)
      » Storage is not regulated
Oligopolies in production and sales

- GASNAT and Egging/Gabriel
  - Straight Cournot application on gas production and sales
  - E.g. Egging/Gabriel
    - Price increase by 86% in Cournot
    - Producer surplus drop by 28%
    - The changes differ by country
    - Transport and storage makes profits because of arbitrage possibilities (transport and storage arbitrageurs make profits)
    - But this is due to “low elasticity demand”
      » And possibly to existing capacities that also restrict substitution possibilities
Is this type of analysis useful?

Yes

- The Commission has little legal power (if any) on resources owned by States; it can apply competition law to firms
- But Egging/Gabriel show that investments in transport and storage can decrease market power of the producers
  - Therefore modelling market power on the producer side only is useful
- The model also shows who gains from investments
  - This helps but does not completely solve the problem of finding who will finance this infrastructure (computing a cash flow based on a decrease of price is not standard business practice)
- More on that later
**A standard debate on Cournot**

- GASNAT and Egging/Gabriel resort to conjectural supply functions
  - This generalizes Cournot but also makes the model clumsy
  - The approach has no foundation in economics (it is somewhat equivalent to conjectural variation)
  - It is a nice computational trick; it cannot be validated in practice and will just make all results (e.g. of how gains from a pipeline reinforcement) contestable

- In all cases Cournot results significantly depend on the price elasticities
  - And also possibly here on capacity constraints
  - We should know more about demand but
    - “it is not a good subject for a PhD thesis”
A more sophisticated debate on Cournot

- GASTALE and GASMOD go much beyond the sole market power in production and sales
- Recall: the Commission finds that the supply market is national and concentrated. It wants to act.
- Recall also: Double marginalisation
  - What is worse than a monopoly? a chain of monopolies
  - What is worse than an oligopoly? a chain of oligopolies
- This is what GASTALE implements
  - Subject to drastic assumptions on the supply market
- And what GASMOD does not really implement
  - By relaxing these assumptions
Introduce competition in supply

- The double marginalisation argument « finds » (in principle) that there is a lot to gain by making the supply market competitive.

- This is a recurrent argument of the Commission

- GASMOD and GASTALE (1) confirm
  - But with different assumptions on the market
  - And different modelling approaches

- What do they do?
Three market scenarios

- Recall Egging/Gabriel
  - Cournot vs. Competition in production/sales

- GASTALE and GASMOD
  - Competition in both production/sales
  - Cournot in both production/sales
  - Cournot in production/sales competition in supply ("EU liberalisation" in GASMOD)

- GASTALE
  - GASTALE and price discrimination between demand sectors
GASMOD says that the Commission is right

**GASMOD**

- “in the EU liberalization scenario we find a welfare close to the case of overall perfect competition”
- Two underlying effects
  - Competition in supply increases welfare (almost by construction)
  - The representation of supply in GASMOD eliminate spatial discrimination
    » hence increases welfare (already observed by Golombek et al (1995)
And GASTALE confirms

GASTALE

“total surplus falls as the market moves from the competitive benchmark to oligopolistic producers/competitive traders and then to oligopolistic producers and traders...; the figures also show that if border price discrimination occurs, the producers profit increases at the expense of both trader profits and consumer surplus. However this effect is not large...”
Is this really true?

- Both models give similar results
  - Even though they are not the same
    - In terms of data and market structure
- This may suggest that the finding is firm
  - “this contradicts the widespread thesis that an oligopolistic downstream market is the best response to an oligopolistic upstream market”
- But this is not the case: the debate is on the comparison between: double marginalisation vs. supply with bargaining power
  - But we did not model the latter
Back into some theory

- A technical issue
  - Modelling double marginalisation is more difficult than what appears in GASTALE and GASMOD
  - GASNAT discusses the difference between open and closed loop models of Cournot competition and the difficulty of closed loop models
  - That both GASTALE and GASMOD assume away by convenient assumptions.

- The area is murky (check Karp and Newbery 1993)
  - Open loop, dynamic consistency, Closed loop, Markow perfect equilibrium..
    - we know little as to what is more realistic?
    - And little about the numerical impact of the assumptions
The last version of GASTALE

- Introduces long term contract to mitigate the unrealistic Cournot behaviour
- This brings us back to the old dilemma
  - Long term contracts are good because they mitigate market power
  - Long term contracts are bad because they foreclose entry
- There is a paper (Neuhoff and von Hirchausen)
  - With two demands for gas: long term and short term
  - And no relations between both?
  - Long term should be more elastic and hence decrease market power
  - But there should be a no arbitrage relation between both
    » Now that it is possible to resell the gas
  - And hence less market power in the long run may decrease market power in the short run
- This suggests that
  - Supply can be made more competitive by allowing long term contracts
  - Which is not the position of DG COMP
On gas models and competitiveness

- The treatment of oligopolies and “anti competitive effects” is far from clear cut
  - And even the definition of the product and geographic markets are far for univoque

- We can make quite a lot of assumptions on the representation of market power
  - And should check the variability of the outcome

- But the main issue is that the difference becomes crucial and largely unexplored in static and dynamic models, that is when investments are stake
Moving to investments

- Discussed in GASNAT
  - an investment model in production and transmission
  - That accounts for the character of non renewable resource of gas
  - And contains some interesting notions of option value of the flexibility of Groningen field

- The last version of GASTALE also models investments (in transmission and storage)
Investments are important for Security of supply

- Studies of security draw the attention to
  - The increased dependence on gas
    - And the increased dependence on Russian gas
      » In a climate that some claim is more driven by politics than business

- One then asks to consider measures to decrease this dependence
  - But little is proposed except (e.g. Keppler 2007)
    - Diversification of sources through investments
    - More liquidity in the market (among others through LNG)
Competitiveness and security of supply

- Welfare is increased if we consume more gas: recall
  - GASMOD and GASTALE: a dramatic welfare increase accompanied by an increase of gas consumption (in a reference year) of 65% (GASMOD), 50% (GASTALE)
- they could still be more gas: common wisdom is that power will play a significant role in the increased gas consumption
Sustainability and gas consumption

- Nuclear is uncertain in many countries
- Coal might be out if there is a floor on carbon
  - After the revision of the ETS (and there are good lobbyists pushing for it)
- Renewable and conservation? costing and pricing information remains scarce
- There could thus be more demand for gas
- Except if people feel that gas is insecure
What do the models tell?

- Recall Egging/Gabriel study of strategic investments

- The more recent version of GASTALE looks at investments to get the gas.
  - They are significant,
    - with a large part in countries that some think insecure.
    - And hence also subject to exercise of market power (market power on non-EU transport is never represented so far in our models)

- But even this does not involve any representation of security of supply: it just assumes that the infrastructure will come and that there will be no disruption.

- Are we sure the investments will come?
  - A producer state is not a producer company: investment criterion might be different
  - And uncertainties may deter investments.
Can we go beyond our current investment models

- Could models tell us more? Yes
- Introduce scenarios of disruptions (the old IEA approach)
  - They can be economic (market power margins) or political (physical) disruptions
  - This can be interpreted as “N-1” as in electricity
- Change the models into investment models (this goes beyond the old IEA approach)
  - The European gas market must have the infrastructure to meet the “N-1” disruptions
- Can we model that?
- If we can, do models tell us who will finance the infrastructure?
We might have a financing problem

- GASNAT and the new version of GASTALE can in principle accommodate the N-1 criterion

- But there is a critical incentive question
  - How does one get the payment for the infrastructure in the N-1 states
    - Without a single grid investor?
  - In other words, we need to find a market mechanism for pricing security of supply (in this case the capability to meet the N-1 criteria.
    - All models assume a single perfect TSO in gas transport.
    - But this is quite different from the current geographic market of transportation.
    - That DG COMP sees as national
Models tell us again and again about the same difficulty

- Can we manage without a single grid operator?
  - The reason: the grid and more specifically a grid with redundancies for security of supply is a complex public good
  - The question goes much beyond reduction of trade because of national TSO operating within sufficient capacities
  - It is about disruptions because national TSO may not have the incentive to jointly finance N-1 secure grids.
This raises important questions

- An N-1 secure grid implies
  - An overhaul of the product definition
    - Storage, transmission, supply (interruptible contracts)… are (imperfect) substitutes for security of supply
      » This is the underlying modelling assumption of the last version of GASTALE
    - This should come under the single TSO
  - And an implied change of the geographic market of transmission
  - A search for forms of legally acceptable agreements between operators (suppliers and producers) to (maybe) help set up this single operator
    - That current models do not mention
    - And that should be inserted in the models
The other proposal for security of supply

- A more liquid market
- How do we measure liquidity?
  - Suppose a transaction (in this case a disruption): will the price on the market change?
  - In practice: a market would be liquid if the “N-1” disruptions do not imply more than a 5% price increase.
  - This look like the S(S)NIP criterion in competition law
  - In GASTALE “a system (is) secure if the analyzed disruption scenarios result in temporary wholesale gas price increases of no more than 20%...”
- Develop our perfect competition models in that direction
  - With a better representation of the grid and storage.
Conclusion: models can be used and abused

- The same is true for gas models
  - Competitiveness in supply: results on the sole double marginalization do not tell anything on the comparison of double marginalisation and bargaining power

- Technical ambiguities remain
  - the various possible Cournot assumptions should
    - not prevent us from using the models but
    - should also not be ignored
    - and their impact assessed.
Gas models reveal our ignorance about gas

- We do not know enough about demand
- We do not know what the true geographic market is (think of using a grid model to conduct a SSNIP test)
- We do not know how to invest in a redundant grid without a single operator somewhere
- We do not know what type of agreements between undertakings would lead to the emergence of that investor in the supranational grid.