esmt ESMT Competition Analysis

# Measuring Competition in Regulation & Antitrust – Principles and Examples

Workshop on Effective Competition in Network Industries

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# Measuring Competition – Why?

- Defining competition without **defining a welfare measure** is meaningless:
  - firms bribing officials to win contracts may be considered cut-throat competition – but with disastrous welfare implications
  - 'Protecting rivals' policy standard results in complaint driven antitrust policy (may be ok in the field of state aid)
- **Simple measures** often **go wrong** or result in battles on market definition, distracting attention from the REAL issues
  - Number of firms, market shares, CR or HHI
- Hence, define an objective
  - Consumer welfare or total welfare
  - Productivity
  - Static or dynamic focus
- and then go for the **effects**!

- **Disclaimer**: In regulated industries number of firms, market share measures etc. are more meaningful. Here the (transitory) objective is market opening

# Measuring Competition – Why?

- In antitrust cases measuring competition is carried out to understand the extend of rivalry between two firms, i.e. closest competitor analysis; evidence against coordinated effects
- This helps to understand the consequences of a merger, a collusive agreement or exclusionary conduct on competitors
- Typical analysis include:
- Price/ quality competition:
  - Switching analysis/ diversion ratios,
  - Critical loss analysis or recently UPP
  - Hedonic price regressions
  - Cross price elasticities
  - Bidding analysis
- Dynamic competition
  - Patent analysis, e.g. numbers, validity, scope/ breadth, blocking position
  - Investment levels, e.g. strategic withdrawal of capacity
- Methodology comprises descriptive analysis up to reasonably complex econometrics; reduced form vs. structural modeling/ simulations

# Agenda

- Introduction
- **Measuring competition – endogeneity problem (example railway industry)**
- Measuring competition – dynamic effects (example pharmaceutical industry)
- Some other problems and conclusion

# Measuring Competition – Endogeneity Problem (Example Railway Industry)

- A general problem for measuring competition and its effects on market outcome is the **endogeneity issue**:
  - Market concentration, entry etc. affect prices, but prices also drive market structure
    - e.g. measuring the impact of local HHI on prices turns out to be negative
  - The same is true for regulatory measures
    - e.g. measuring the impact of access regulation on telecommunication investment becomes (negatively) significant only after controlling for reverse causality
- Generally solved by **instrument variable approaches** or **quasi natural experiments** (e.g. unexpected plant closure)

# Example Railway Industry: Background and Motivation

- The EU Commission's "Third Railways Package" foresees market opening of the European long-distance passenger rail sector after 2010
- European rail operators initiated or plan co-operations on long distance passenger transport
- There was concern that this co-operation would be anti-competitive
- DB argued that this concern was unfounded because inter-modal competition from low-cost airlines ("LCAs") servicing long-distance destinations provided sufficient competitive pressure

# Example Railway Industry: Our Assessment

- Examine effect of LCA entry and operation on DB
  - Prices
  - Passenger numbers
- Large, representative panel data set
  - With a rich set of controls
- Grapple with endogeneity
  - Standard panel data methods
  - IV methods accounting for the possibility that LCA entry is a strategic response to DB pricing

# Example Railway Industry: Data Set

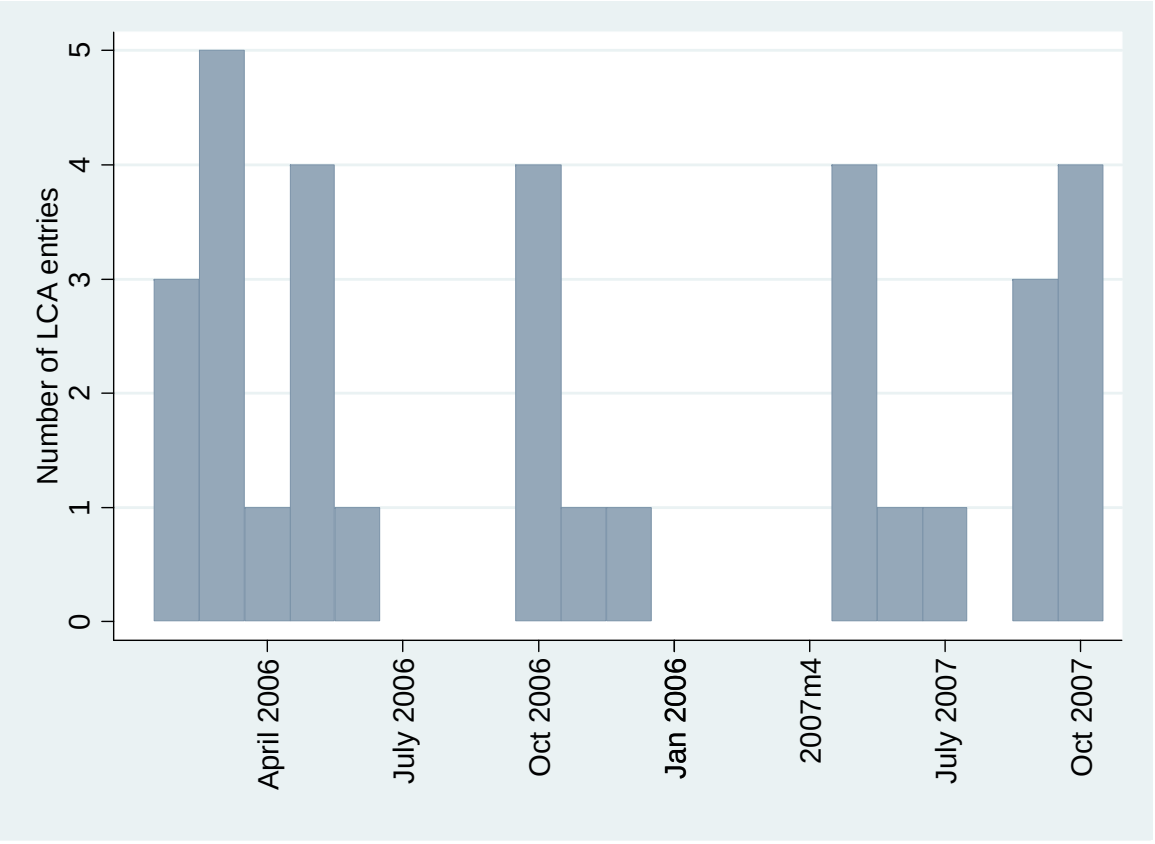
- DB Data
  - Average first and second class ticket prices
  - Passenger numbers
  - For long-distance O&Ds wherein either the origin or destination (or both) lies within Germany

➲ 207 O&Ds observed over a period of 22 months from January 2006 to October 2007: 4554 O&D-month observations

- LCA competition: press releases and airline contacts
  - LCA entry and operation
  - LCA presence in 2006

- Control variables
  - Population & fuel cost data: Eurostat, Statistisches Bundesamt
  - Train type, railroad costs and track data: DB Trassenpreise; EICIS
  - Driving duration: Marco Polo Route planner 06/07
  - Number of airline seats and flights: Arbeitsgemeinschaft deutscher Verkehrsflughäfen (ADV)
  - Flight duration and delay: Association of European Airlines (AEA); ADV; Lufthansa

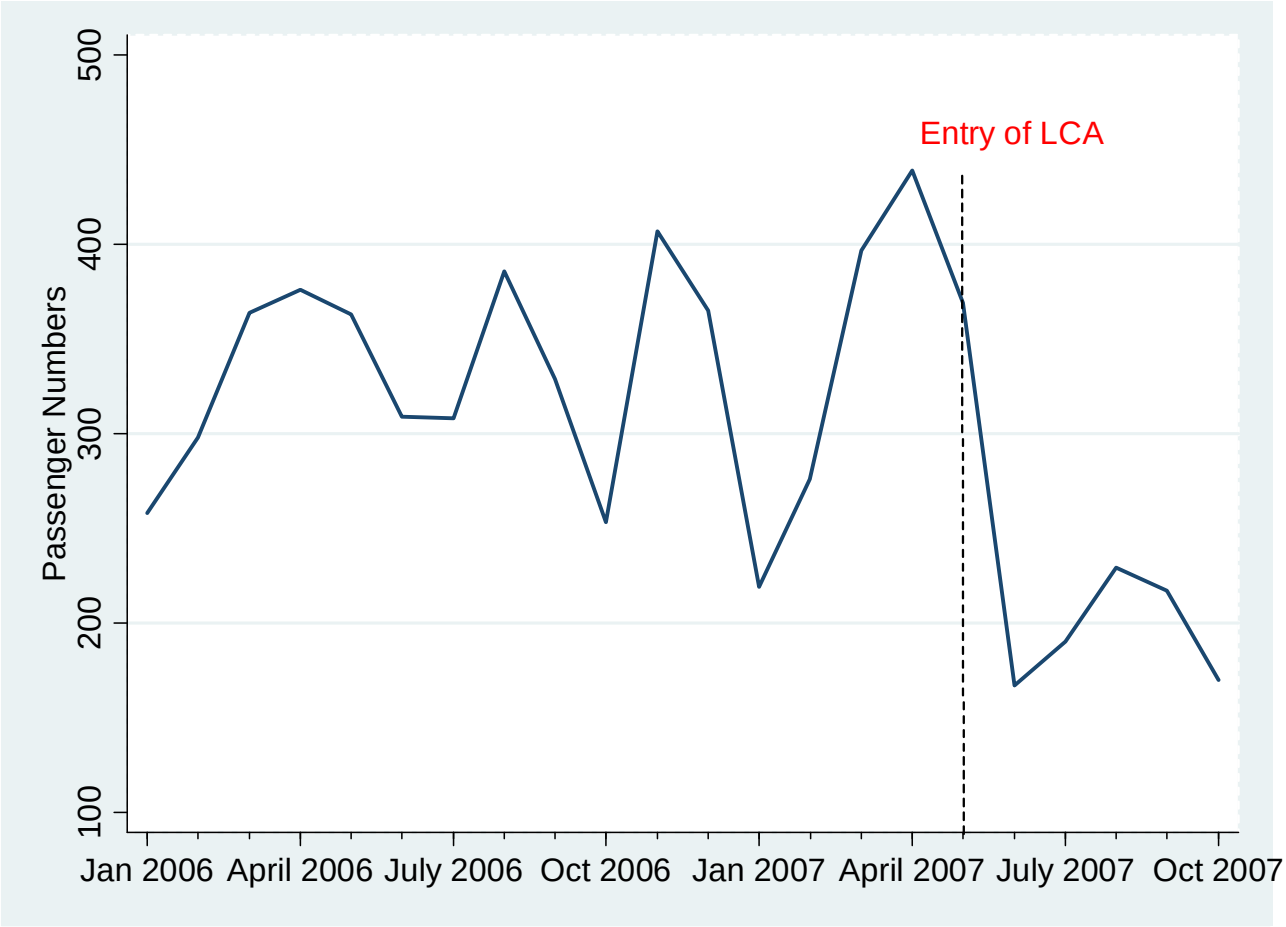
# Example Railway Industry: Descriptive Statistics – LCA Entry during Observation Period




➲16% of full sample (207 O&Ds) experienced LCA entries between January 2006 and October 2007

# Example Railway Industry: Circumstantial Evidence of LCA Entry

Effect on passenger numbers (second class) due to LCA entry in May 2007



# Example Railway Industry: Panel Data Analysis – Model

Econometric model:

$$y_{it} = \delta LCA_{it} + \gamma \mathbf{z}_{it} + \lambda_t + \varepsilon_{it}$$

Where:

- $i$ : a given O&D pair
- $t$ : time
- $y_{it}$ dependent variable, logarithm of
  - (i) passenger numbers (lpax), (ii) average ticket price (lavprice), (iii) revenue (lrev), (iv) passenger-kilometres (lpkm)
  - first class and second class
- $LCA_{it}$ : dummy variable equal to 1 in the period of entry and subsequent operation for those routes which experienced LCA entry over our observation period
- $\delta$ : key indicator of the analysis: long-term percentage change of $y$ because of LCA entry
- $z$ : vector of control variables
- $\lambda_t$ : control variable for seasonal effects
- $\varepsilon_{it}$ : the error term

# Example Railway Industry: Panel Data Analysis – Endogeneity of Entry

- LCA entry is a strategic decision
  1. Entry → lower price (**negative** relation/correlation between entry and prices)
  2. High price → entry of LCA (**positive** relation/correlation between entry and prices)
- We are interested to identify effect 1

- In order to correctly support an antitrust analysis, the empirical methodology must account for this endogeneity and separate the effects!
  - ➲ We use instrumental variables
  - ➲ Instruments is the number of LCAs operating into or out of the destination (origin), to or from a city other than the origin (destination) corresponding to O&D *i* at time *t*.

# Example Railway Industry: Effect of LCA Entry – Summary of Results

- Passengers - second class
  - Statistically and economically significant negative effect on passenger numbers
  - 7%-17% decrease of passenger numbers, depending on dataset
- Passengers - first class
  - Negative effect on passenger numbers less pronounced
  - Up to 18%, depending on dataset
- Prices
  - Strategic entry is important
  - After accounting for strategic entry (endogeneity), LCA entry results in significantly lower prices in both the first and second class. Price effects vary between 16% and 27%

# Example Railway Industry: Conclusions

## Policy conclusion

- LCAs induce substantial competitive pressure
- Competitive pressure can be observed in first and second class and has an effect on both passenger numbers and prices
- Intermodal competition has to be part of a competitive assessment of future rail alliances

## General Issues

- “Simple” treatment effect approach (see Angrist/ Pischke 2010)
- But ex post assessment: what do we learn for the world post liberalization?

# Agenda

- Introduction
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- **Measuring competition – dynamic effects (example pharmaceutical industry)**
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# Measuring Competition – Dynamic Effects (Example Pharmaceutical Industry)

- Many areas of competition policy involve ex post assessment
  - Abuse of dominant position cases (102 TFEU)
  - Horizontal agreements (101 TFEU)
- But what about areas which involve an ex ante assessment:
  - Merger assessments
  - State aid cases
  - Or implications of regulatory measures on infrastructure investment?
- Here a major issue is how to measure the implications of measures taken today on the future
- One approach are simulation techniques

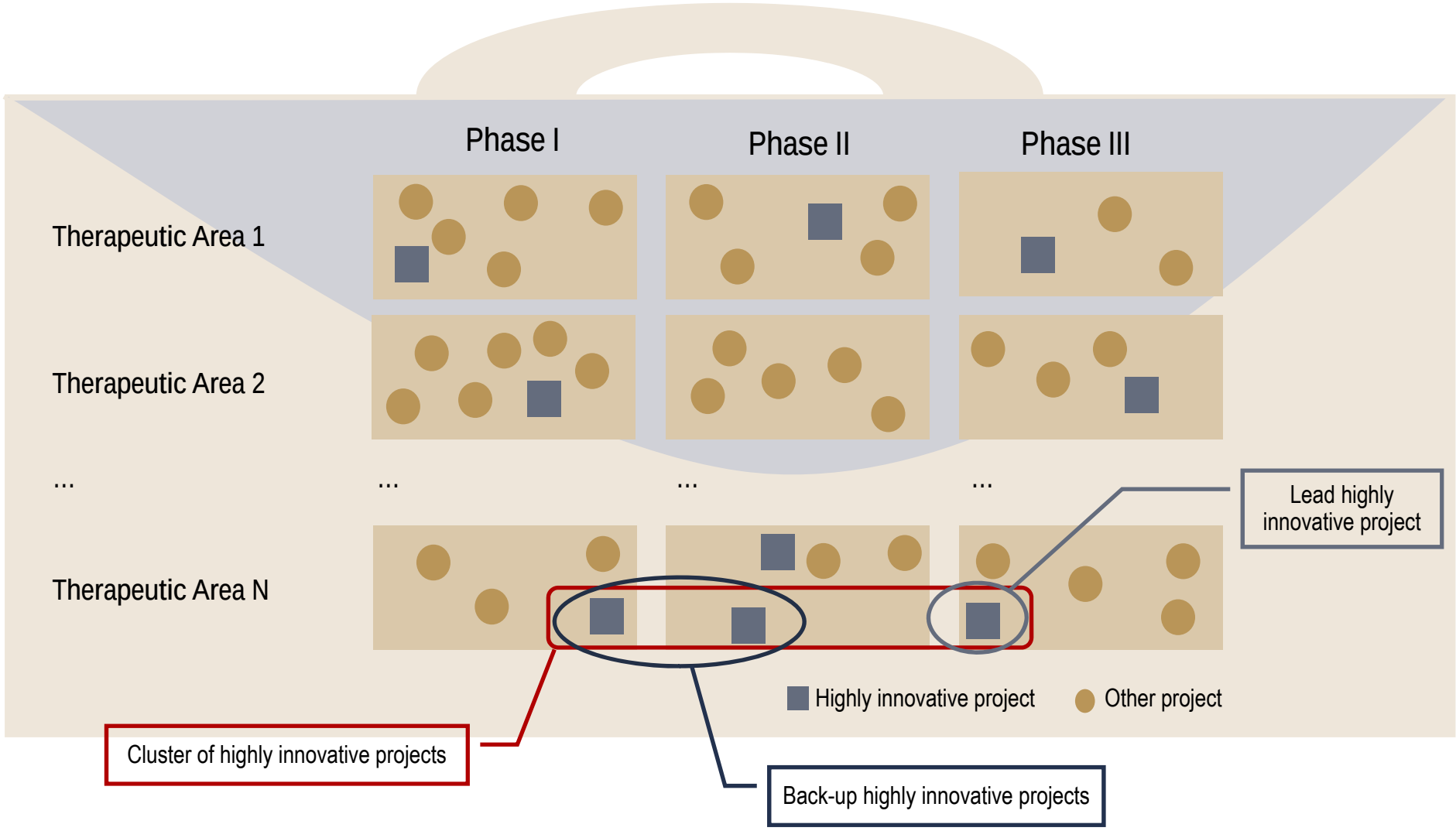
# Example Pharmaceutical Industry: Pharmaceutical Innovation and Pricing Regulation

- In the context of healthcare cost-containment efforts, pharmaceutical products are increasingly subject **to strict pricing and reimbursement conditions** in many European countries and likely the U.S.

- Relatively little attention has been paid to the (potentially adverse) consequences that pricing and reimbursement regulation may have **on pharmaceutical innovation**:
  - affects on the **number** and **characteristics** of drugs that will be launched in the market in the future?
  - Tension between the **global nature** of pharmaceutical innovation and the **national nature** of pricing regulation?

- We set out to evaluate the effect of pricing regulation on innovation in the pharmaceutical industry by performing policy experiments in the context of a **(semi-) dynamic decision tree model**

# Example Pharmaceutical Industry: Development process: Costly, long-lasting, and risky process



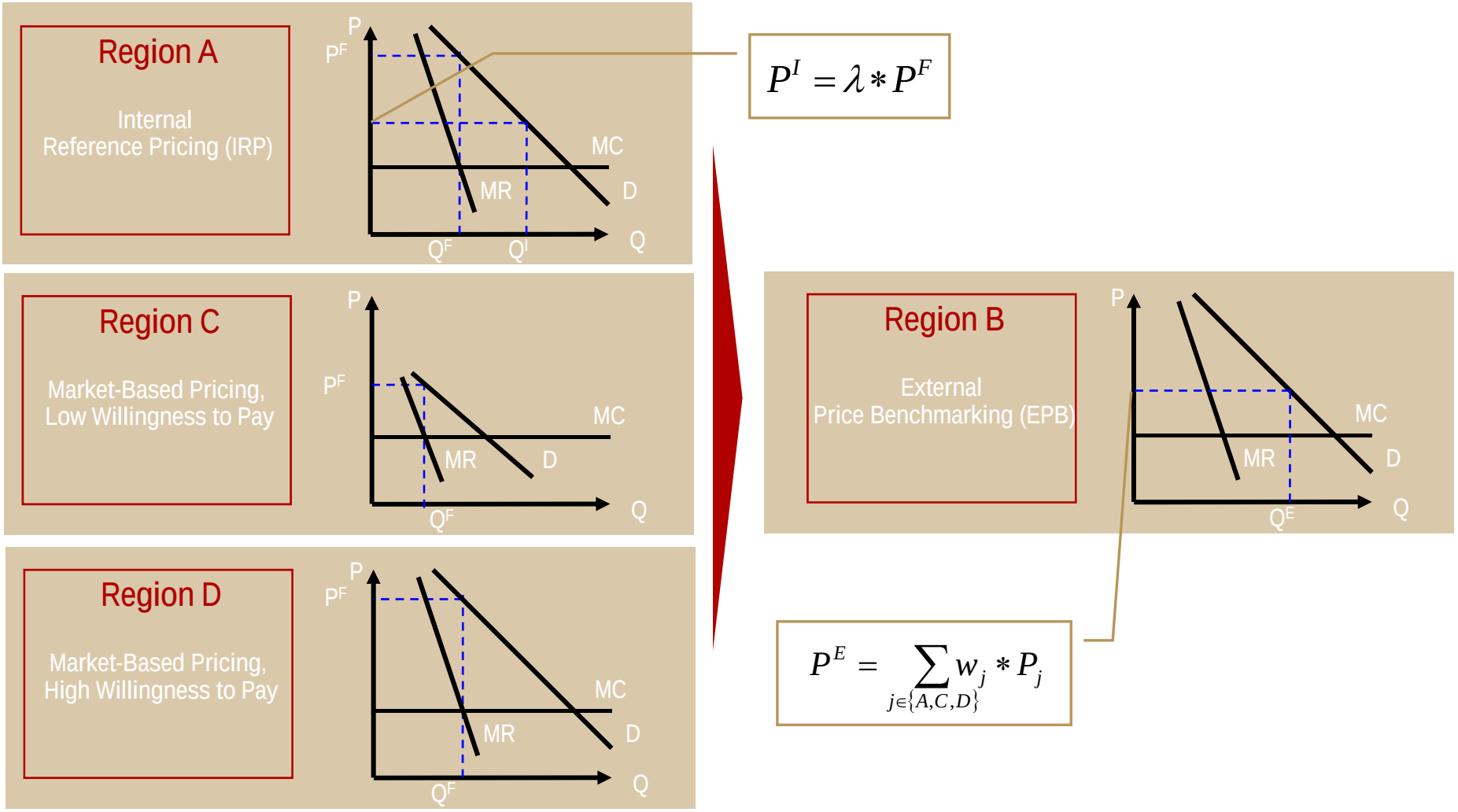
# Example Pharmaceutical Industry: Selected Pricing and Reimbursement Regulatory Schemes in Europe

| Country | External Price Benchmarking | Internal Reference Pricing | Value-Based Pricing | Other Schemes |
|---|---|---|---|---|
| Czech Republic | X | X | | |
| Denmark | | X | X (not mandatory) | |
| France | X | X | | |
| Germany | | X | X | • Market-based pricing of highly innovative, on-patent, drugs |
| Hungary | X | X | X | |
| Italy | | X | | |
| Netherlands | X | X | X | • Risk sharing (conditional pricing) |
| Poland | | X | | • Cost-plus price regulation |
| Spain | X | | | • Cost-plus price regulation |
| UK | | X | X | • Pharmaceutical Price Regulation Scheme (PPRS)<br>• Risk sharing (conditional pricing) |
| ... | ... | ... | ... | ... |

Source: OECD, 2008, *Pharmaceutical pricing policies in a global market*, Paris.

# Example Pharmaceutical Industry: Pricing Regulation Around the World

## Regions and pricing regulation

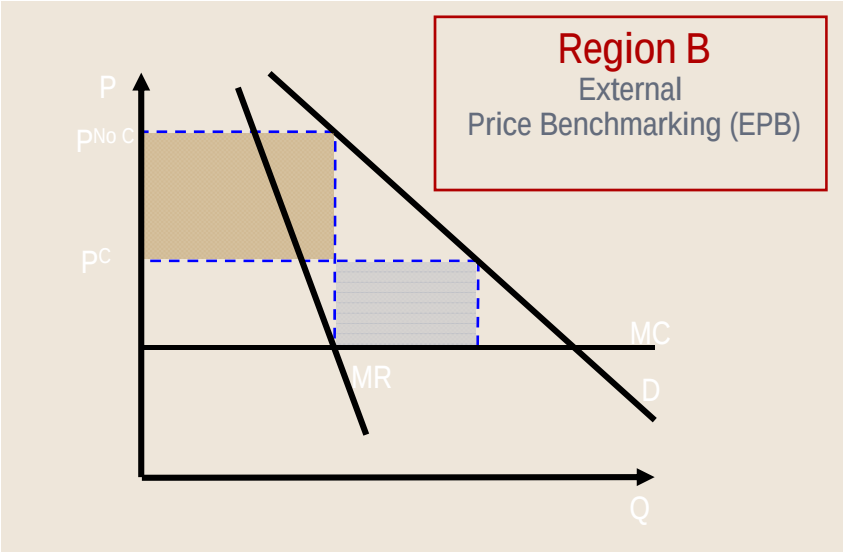


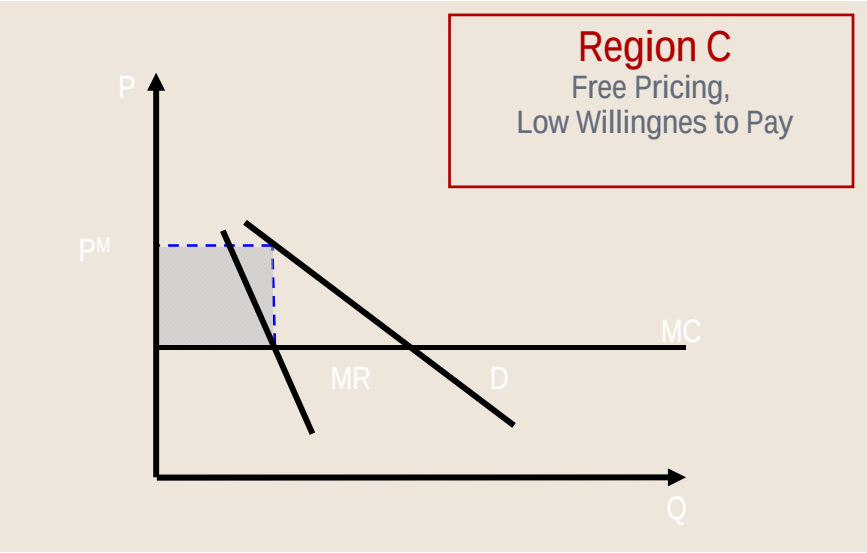
# Example Pharmaceutical Industry: Drug Development
## A Project's Market Launch

- Net sales of a drug:

$$\max\left\{\sum_{j\in\{A,B,C,D\}}\left(P_j - c\right)*Q_j\left(P_j\right), \sum_{j\in\{A,B,D\}}\left(\hat{P}_j - c\right)*Q_j\left(\hat{P}_j\right)\right\}$$

- Launch in Region C?
  - Trade-off between gaining net sales in Region C and losing net sales in Region B (EPB)



# Example Pharmaceutical Industry: Policy experiments
## …after solving the model and calibrating

| | | Policy Scenario | | | |
|---|---|---|---|---|---|
| | | Market-Based Pricing | Internal Reference Pricing | External Price Benchmarking | Pricing Regulation |
| Number of potential projects | Highly innovative | 46 | | | |
| | Total | 74 | | | |
| Number of projects developed | Highly innovative | 32 | 30 | 29 | 26 |
| | Total | 54 | 49 | 51 | 45 |
| Expected number of projects launched | Highly innovative | 13.98 | 12.92 | 12.68 | 11.38 |
| | Total | 21.94 | 20.15 | 20.64 | 18.61 |

# Example Pharmaceutical Industry: Policy Experiments
## Value of the selected portfolio

- As a result of Internal Reference Pricing, the value of the selected portfolio moves from USD 24,808m under Market-Based Pricing to USD 21,912m—a drop of 11.7%
- As a result of External Price Benchmarking, the value of the selected portfolio moves from USD 24,808m under Market-Based Pricing to USD 23,389m—a drop of 5.7%
- As a result of Pricing Regulation, the value of the selected portfolio moves from USD 24,808m under Market-Based Pricing to USD 19,904m—a drop of 19.8%

# Example Pharmaceutical Industry: Conclusions

## Policy conclusion

- Pricing and reimbursement regulation affects pharmaceutical innovation, by
  - Reducing the value of pharmaceutical projects and the resources available to carry them out
- The benefits of more affordable or cost-effective drugs must be traded against the costs of less pharmaceutical innovation
  - Fewer projects are developed in general
  - Different therapeutical areas will be developed

## General Issues

- Specific model assumptions and calibration requirements
- Sensitivity analysis important
- But: forward looking and potentially this is the only way possible for quantification (see Nevo/ Whinston 2010)

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- Introduction
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# Some other issues and conclusion

- There are many complicating effects when measuring competition
  - Endogeneity and dynamics
  - Specific issues in regulated industries – prices are (partially) regulated
  - (Semi-)public firms with different objective function – social objectives, turnover maximization
  - Network effects and 2SM, etc.
- Within an adversarial environment there are is an trade-off between accuracy vs. practicality…
- …and who holds the information
- In general in Europe
  - An accepted canon of robust methods to measure competition exists (e.g. see Davis et al. 2010)
  - Economic assessment has identification power
  - Economic analysis has raised the standard of the competitive assessment to the benefit of competition policy

# Thank you!

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# Example Railway Industry: Descriptive Statistics – Cross Section

| | | Strong airline competition* | | Weak arline competition | |
|---|---|---|---|---|---|
| International route | I | | II | | |
| | Number of observations | 77 | Number of observations | 53 | |
| | Ratio Flight to Train (Simple average) | 11,03 | Ratio Flight to Train (Simple average) | 0,16 | |
| | Number of LCA entries | 11 | Number of LCA entries | 6 | |
| Domestic route | III | | IV | | |
| | Number of observations | 29 | Number of observations | 48 | |
| | Ratio Flight to Train (Simple average) | 0,96 | Ratio Flight to Train (Simple average) | 0,19 | |
| | Number of LCA entries | 1 | Number of LCA entries | 15 | |

** Definition 'strong airline competition': ratio flight passengers to train passengers above 1*

- 130 international routes (63%)
- Routes with and without pre-existing intermodal competition

# Example Railway Industry: Panel Data Analysis – Overview Results

| | Complete sample | | | | | Additional controls | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Random effects | | | | IV (ML) | Random effects | | | | IV (ML) |
| Column number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Depend. variable | **Passengers** | **Avg. Price** | **Revenues** | **Pkm** | **Avg. Price** | **Passengers** | **Avg. Price** | **Revenues** | **Pkm** | **Avg. Price** |
| **Second class** | | | | | | | | | | |
| **Effect of LCC entry (δ)** | **- 6.8%**** | **2.40%** | **-4.50%** | **- 8.9%**** | **-27.0%***** | **-17.0%***** | **0.00%** | **-16.7%***** | **-16.4%***** | **-17.6%***** |
| No. obs | 4421 | 4415 | 4415 | 3527 | 4415 | 1652 | 1652 | 1652 | 1652 | 1652 |
| No. O&Ds | 207 | 207 | 207 | 168 | 207 | 84 | 84 | 84 | 84 | 84 |
| R-squared | 0.394 | 0.45 | 0.43 | 0.279 | | 0.684 | 0.767 | 0.641 | 0.578 | |
| **First class** | | | | | | | | | | |
| **Effect of LCC entry (δ)** | **0.003%** | **2.50%** | **3.80%** | **1.00%** | **-15.6%***** | **-18%***** | **3.6%**** | **-15.7%***** | **-23.1%***** | **-19.7%***** |
| No. obs | 3916 | 3886 | 3886 | 3325 | 3886 | 1634 | 1631 | 1631 | 1634 | 1631 |
| No. O&Ds | 201 | 201 | 201 | 168 | 201 | 84 | 84 | 84 | 84 | 84 |
| R-squared | 0.498 | 0.588 | 0.439 | 0.238 | | 0.758 | 0.757 | 0.744 | 0.715 | |

*p<.10, **p<.05, ***p<.01; “Complete sample” controls for LCA presence, domestic route, prices of coal, kerosene & oil, distance, orig & dest popn., and ICE ; “Additional controls” also controls for number of seats, flights, flight delay, driving duration, train duration, air duration, railpath prices.

# Example Railway Industry: Panel Data Analysis – Endogeneity of Entry (continued)

- Need: an instrument which varies over O&Ds and over time
- Instrument:
  - Whether & to what extent the LCA operates into or out of the origin, to or from a city other than the destination
  - Whether & to what extent the LCA operates into or out of the destination, to or from a city other than the origin corresponding to O&D *i* at time *t*
- Rationale: LCAs have to operate on shoestring budgets. If they are already operating out of the O or D, this minimized their fixed costs of entry, therefore making entry more likely. At the same time, the presence of such networks is unlikely to be influenced by DB prices on the particular O&D in question.
- Data constraint: only have aggregate number of LCA operating on a given O&D
- Actual instrument:
  - Number of LCAs operating into or out of the origin, to or from a city other than the destination.
  - Number of LCAs operating into or out of the destination, to or from a city other than the origin corresponding to O&D *i* at time *t*.

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# Example Pharmaceutical Industry: Classification of National Pricing and Reimbursement Regulatory Schemes

- Market-based pricing and bilateral bargaining
  - Health insurer is a "price taker." Maximum increment that a firm can charge for an innovative new product is the marginal difference in purchaser's willingness to pay for the new product relative to the existing treatment or competitive alternatives. It is further constrained by its bargaining position relative to the health insurer that pays for the product.
- Internal reference pricing
  - The price of or the amount reimbursed for a drug in a country is based on the price of chemically, pharmaceutically or therapeutically similar drugs in the same country, unless the drug is considered highly innovative
- External price benchmarking
  - The price of a drug in a country is based on the price of the same drug in other countries
  - The basket of benchmark countries is selected on the basis of economic and/or geographic proximity. In particular, European countries tend to benchmark each other
- Schemes based on a pharmaco-economic assessment (value-based pricing)
  - The price of a drug in a country is based on a cost-effectiveness or cost-benefit analysis in which the cost of a drug is traded against its health benefits (quantity and quality of life)
  - Pharmaco-economic assessment goes hand in hand with tailored drugs

Source: OECD, 2008, *Pharmaceutical pricing policies in a global market*, Paris.

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# Example Pharmaceutical Industry: Calibration
## Parameters to which a value must be assigned

- Therapeutic areas and number of projects by therapeutic area and development phase
- For every development phase, development costs and probability of technical success: $C_k$ , $\pi_k$
- Development cost premium for highly innovative projects: $\varphi$
- Probability of external competition's success: $\rho$
- Discount rate: $r$
- For every region and every therapeutic area, demand intercept and slope: $a_j^i$ , $b_j^i$
- Average/marginal manufacturing/marketing cost: $c$
- Price discount for not highly innovative drugs in Region A (IRP): $\lambda$
- Development budget constraint: $B$

To calibrate the parameters, we use only information that is available in marketing-research publications or in published academic research

# Example Pharmaceutical Industry: Model Solution
## Some Cases

- Bellman equation for a not highly innovative project:

$$ENPV_k^N = \max\left\{0, -C_k + \frac{1}{1+r}\pi_k ENPV_{k+1}^N\right\}$$

- Bellman equation for a lead highly innovative project:

$$ENPV_k^H = \max\left\{0, -C_k + \frac{1}{1+r}\pi_k\left[(1-\rho)ENPV_{k+1}^H + \rho ENPV_{k+1}^N\right]\right\}$$

- Solving the model, calibrating and sensitivity analysis are the next steps