

Second Workshop on Transport Economics Competition and Regulation in Railways

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The Potential Impact of Open-Access on Prices and Investment The Case of the U.S. Rail Freight Industry

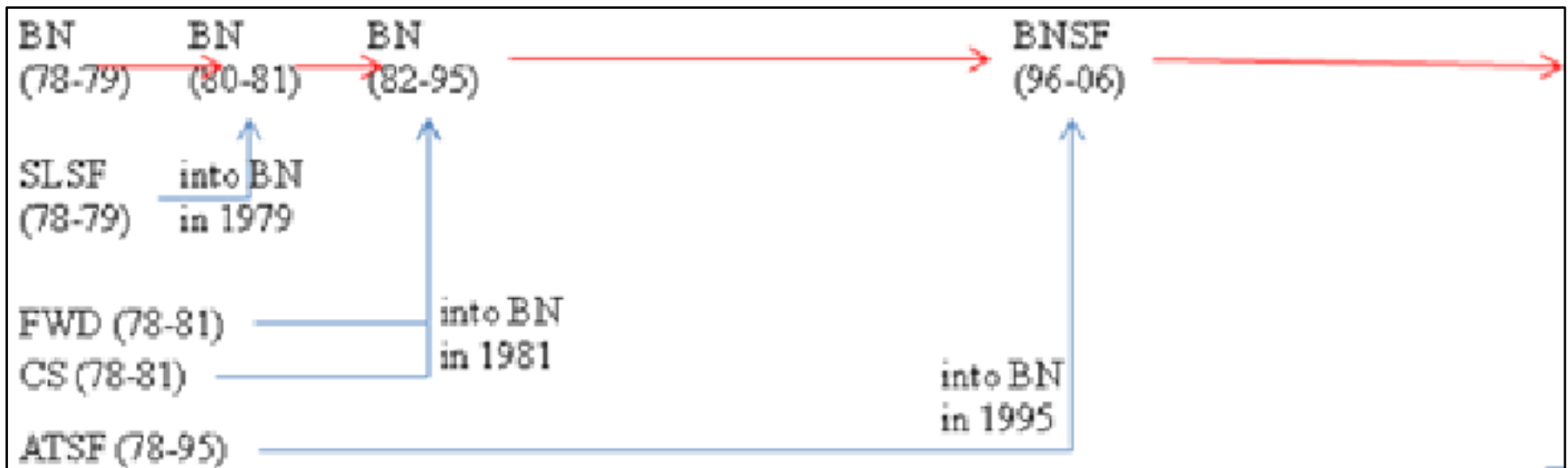
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The US railroad industry

- Deregulation since the Staggers Act in 1980
⇒ Major restructuring: exit of firms and takeovers
- 26 firms (integrated Class 1 railroads) in 1980, 7 in 2006



Concern about competition

- Recent concern about competition: 7 integrated firms
- Law proposal: open-access (GAO, 2006, 2008)
- A (very) hot debate at the Congress
- Definition of open-access: the incumbent must provide access to competitors over (portions of) its network facilities
 - ⇒ Entry of a new firm on the network of an existing firm.
- Price competition will increase

Drawback 1: cost-efficiency argument

- Importance of economies of density
 - ⇒ Ivaldi and McCullough (2001, 2008)
- Open-access ⇒ Sharing of traffic ⇒ increase cost, and thus price

Drawback 2: Investment

- The main argument \Rightarrow focus of this paper
- Idea: track infrastructures is the result of previous costly investment
- Open-access: entrant benefits from good infrastructures by not bearing the cost of investment
 - \Rightarrow prospect to be expropriated (infringement of property rights)
 - \Rightarrow discourage investment in the future
- Motta (2004), OECD (1997, 2006), Christensen (2008)
- Rail infrastructures: key for performance

More on investment

- In the data: investment in ways and structure capital
- Argument 1: some prospects of profits necessary to motivate firms to make costly investment in rail infrastructures
 - ⇒ obtained through above marginal cost pricing
- Argument 2: smaller proportion of rail traffic, weaker incentives to carry out investment
- Open-access ⇒ increase competition (static efficiency)
 - ⇒ decrease rates and market share for the owner
 - ⇒ decrease anticipated revenues
 - ⇒ decrease investment and rail infrastructure quality (dynamic inefficiency)
- Final impact on consumer welfare?

This paper

- To propose an econometric framework to analyse this issue of investment and static/dynamic efficiency
- A structural approach
 - Policy change not in the data
 - Estimate a structural model and counterfactual
 - Policy change = entry of a new firm on an existing network (open-access)
- High potential for competition policy:
 - Merger (CRAI, 2007)
 - Essential facilities (RBB, 2010, Australian Rail industry)

Methodology

- Estimation of a demand model
 - Coublucq (2011): issue of panel attrition
 - Counterfactual: increase in price competition
- Estimation of investment model
 - Parameter of interest: cost of investment
 - Important for counterfactual
- Counterfactual: simulation of entry
 - Price competition and investment behavior
 - Impact on consumer welfare

Simulation of an open-access policy

- Entry on BN's network (market share = 36%)

An open-access policy: presentation

- Simulate the impact on price competition and investment
- BN's (denoted j) network opened to competition
 - New firm denoted n
 - Mean-utility of entrant: $\delta_{n,t_0} = \theta k_{j,t_0} - \alpha p_{n,t_0} + \xi_{n,t_0}$
 - ξ_{n,t_0} : fixed to average efficiency

- Assumptions:

	Network	Services	Total marginal cost
BN	$s \times mc_{j,t_0}$	$(1-s) \times mc_{j,t_0}$	mc_{j,t_0}
Entrant	$a = s \times mc_{j,t_0}$	$(1-s) \times mc_{j,t_0}$	$a + (1-s)mc_{j,t_0} = mc_{j,t_0}$

- Null profit from access for the incumbent BN

An open-access policy: price competition

- Price competition:

- Spot profit for entrant: $\pi_{n,t_0} = (p_{n,t_0} - \underbrace{\text{cost}_{n,t_0}}_{mc_{j,t_0}}) s_{n,t_0}(\mathbf{p}_{t_0}) M_{t_0}$

- FOC: $(p_{n,t_0} - mc_{n,t_0}) \frac{\partial s_{n,t_0}}{\partial p_{n,t_0}} + s_{n,t_0} = 0$

- Using the other 7 FOCs from incumbents, we get a new equilibrium prices vector at date t_0 : \mathbf{p}_{t_0}

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An open-access policy: investment

- Using FOC for BN investment:

$$i_{j,t_0} = \frac{\delta}{\hat{b}} \frac{\partial V_{j,t_0+1}}{\partial K_{j,t_0+1}}$$

$$\Rightarrow i_{j,t_0} = \frac{\delta}{\hat{b}} \left(\frac{\partial \pi_{j,t_0+1}}{\partial K_{j,t_0+1}} + \delta(1-d) \frac{\partial \pi_{j,t_0+2}}{\partial K_{j,t_0+2}} + (\delta(1-d))^2 \frac{\partial \pi_{j,t_0+3}}{\partial K_{j,t_0+3}} + \dots \right)$$

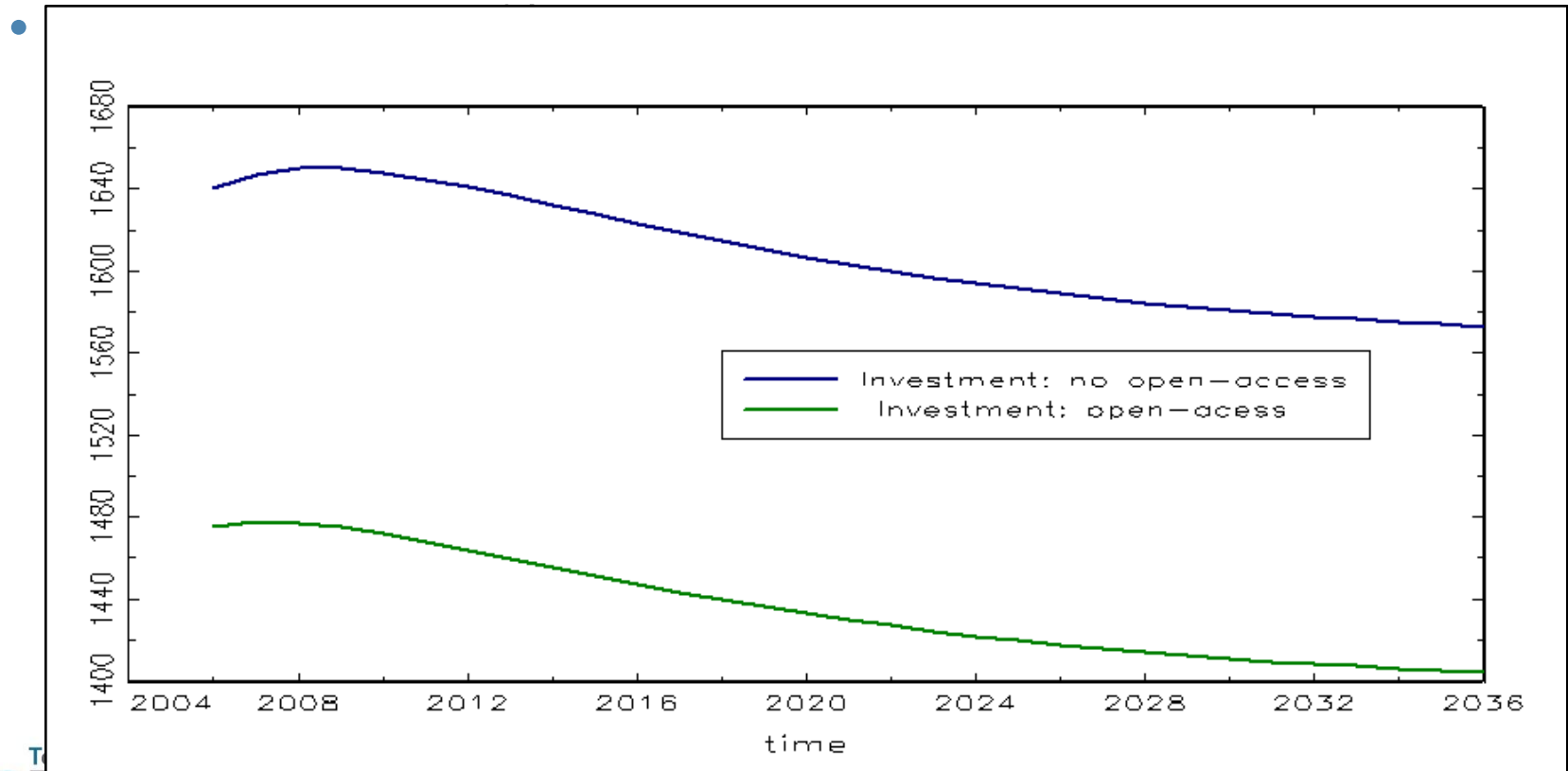
- Where:
$$\frac{\partial \pi_{j,t_0+1}}{\partial K_{j,t_0+1}} = M(p_{j,t_0+1} - mc_j) \frac{\partial s_{j,t_0+1}}{\partial K_{j,t_0+1}}$$

- Open-Access:

- more competition: decrease of anticipated prices and revenues
- Less incentives to invest in network infrastructures

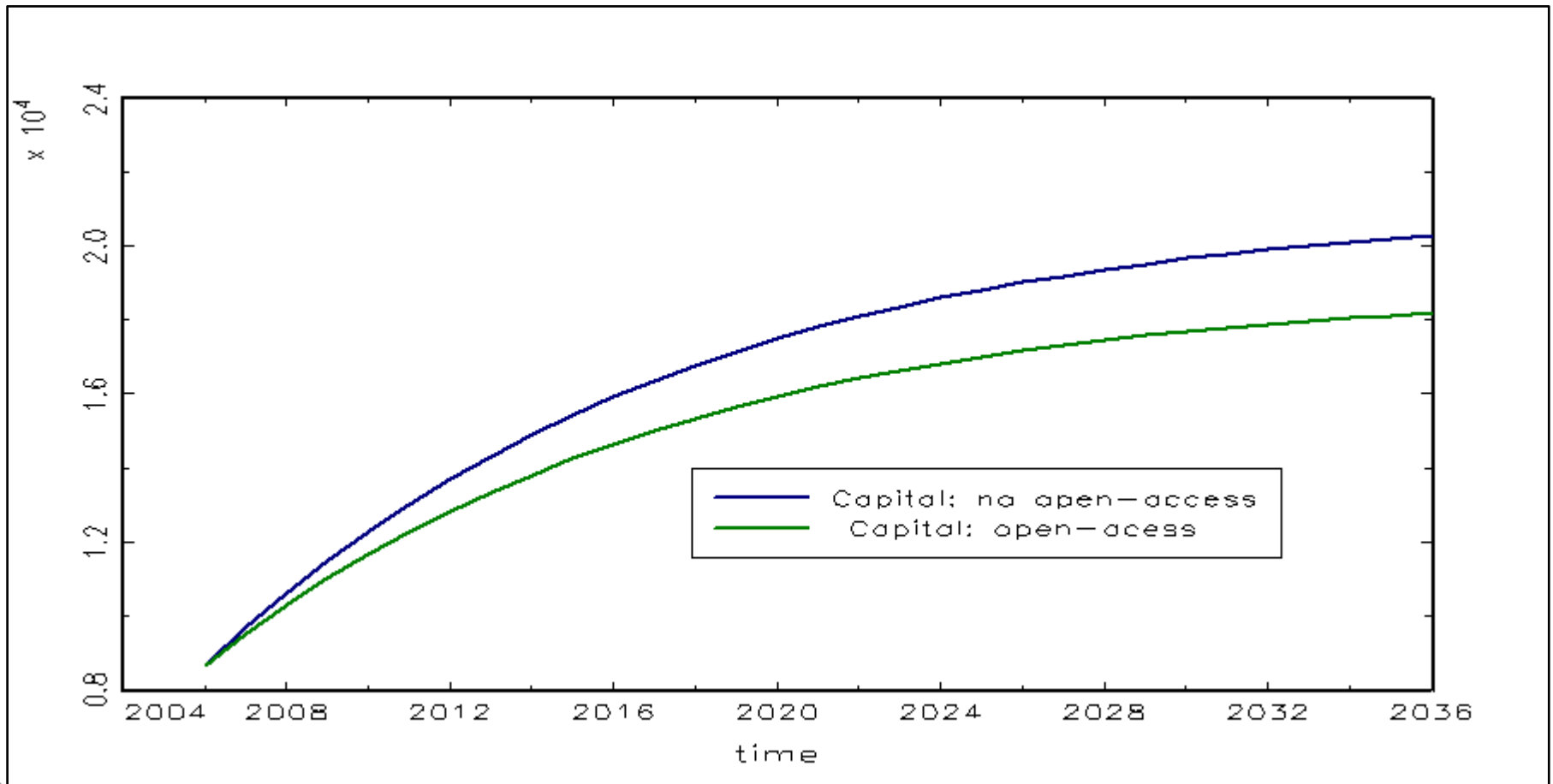
An open-access policy: results (1)

- Overall price decrease: -6% per year (more competition)
- Less traffic for the incumbent (-10%;-13%)



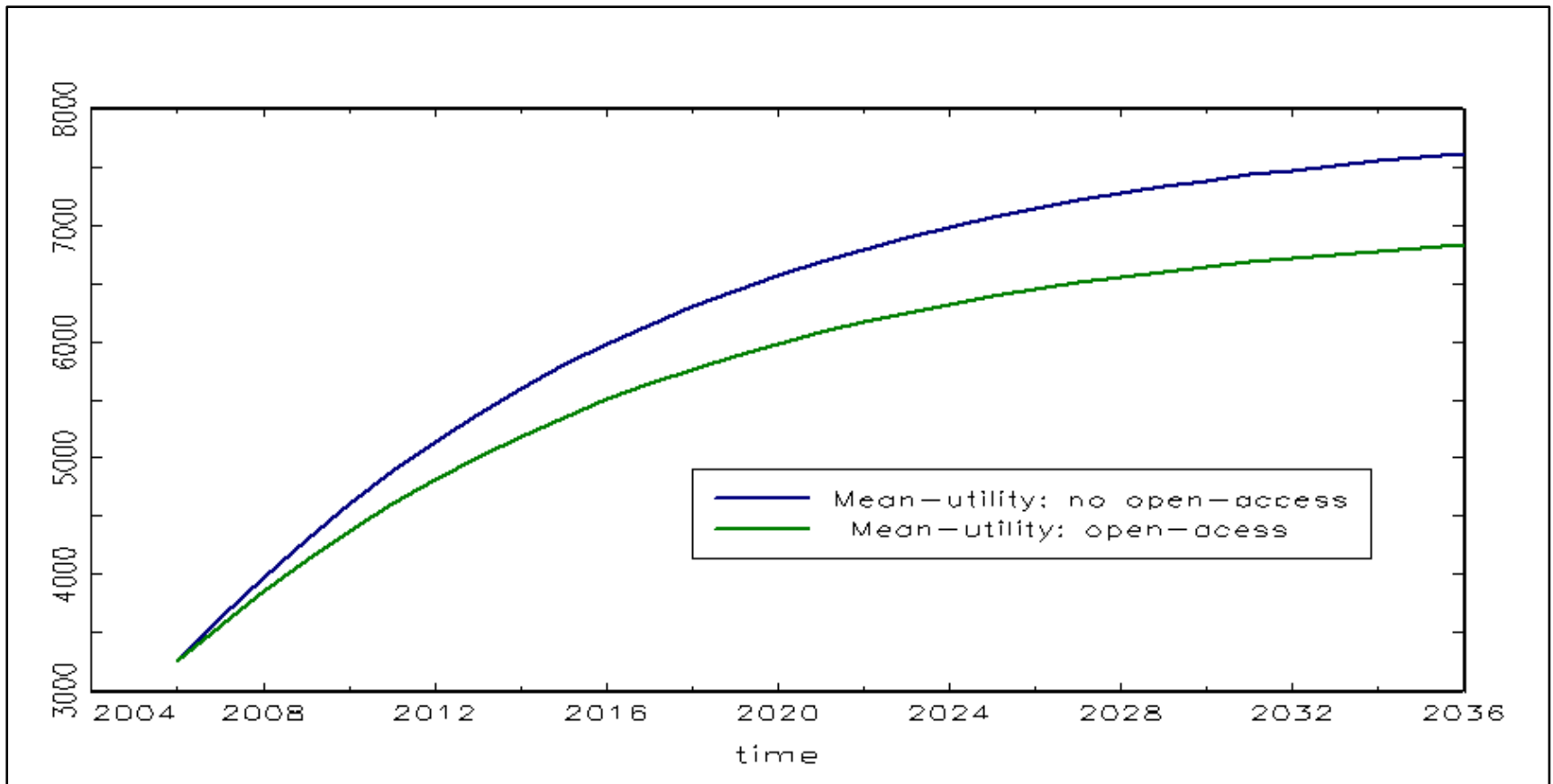
An open-access policy: results (2)

- Exponential loss in network value (10% after 30 years)



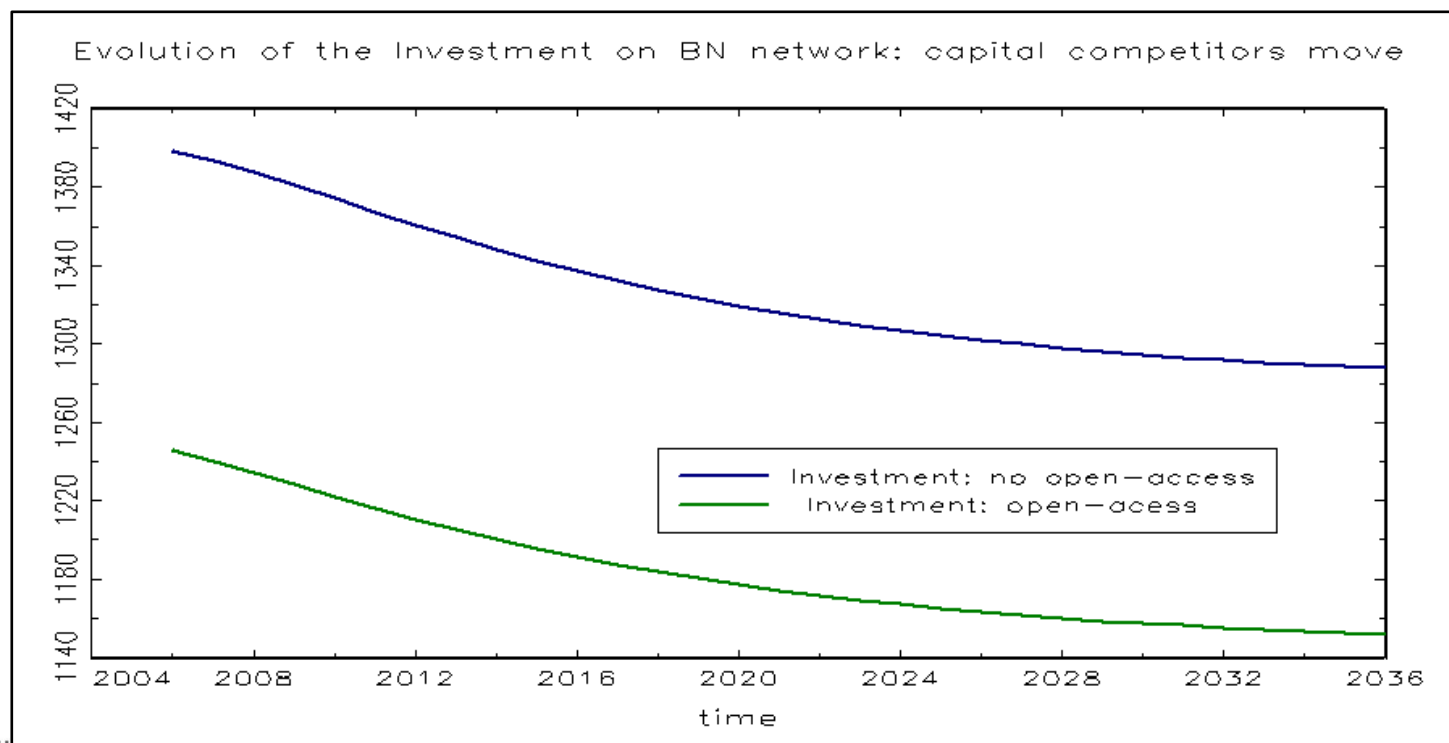
An open-access policy: results (3)

- Welfare of shippers who use BN's network
 - Sensitive to prices and network value



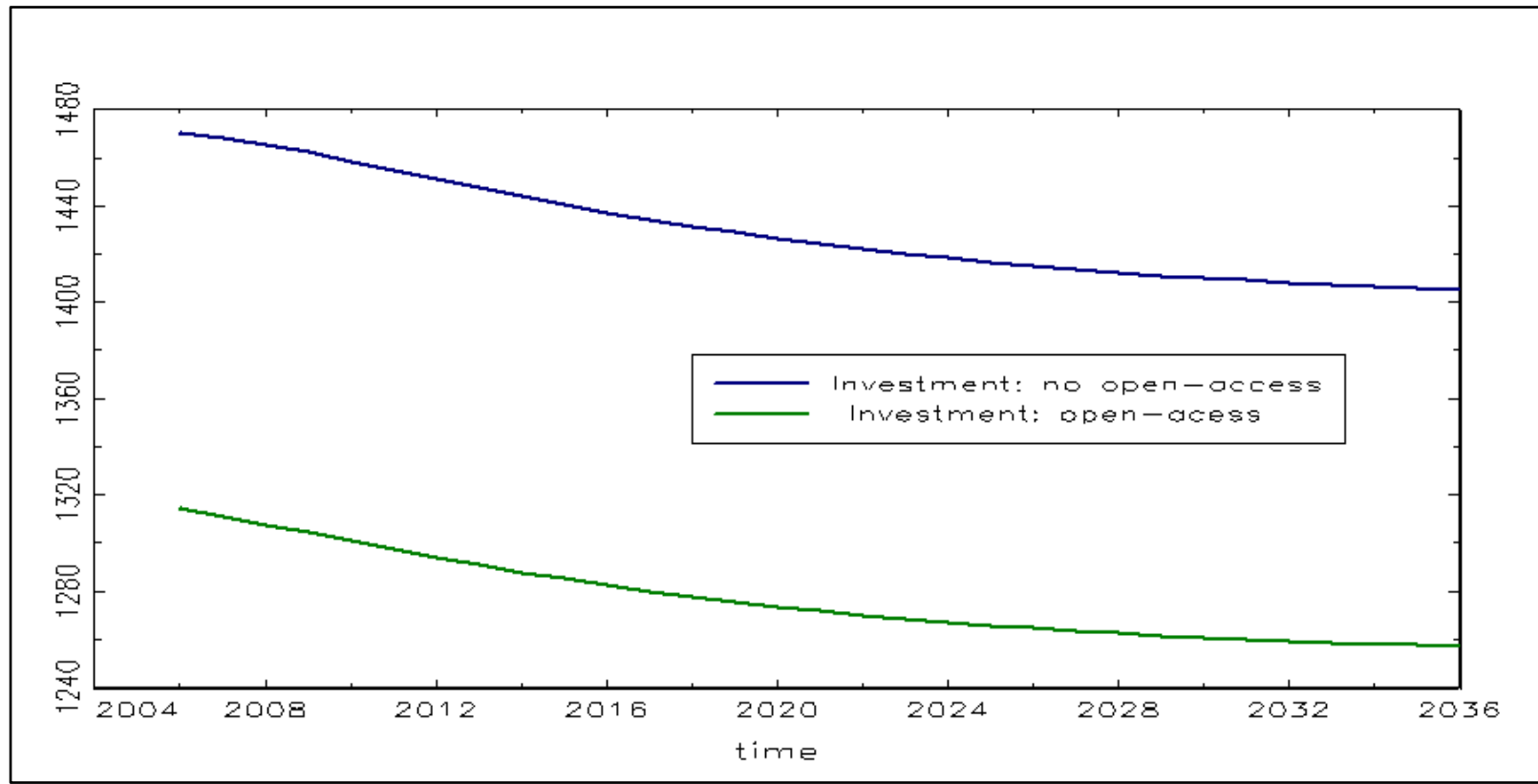
An open-access policy: robustness

- Capital stocks of competitors fixed over time in previous algorithm
 - Similar results if capital stocks of competitors increase



An open-access policy: robustness (2)

- Same simulation with opening of UP's network



Findings

- Entry on BN's network (market share = 36%)
 - Average price: -6%
 - Investment of BN: -10%
 - Consumers on BN's network loses at the end: lower prices, but lower infrastructure quality
- Robust to different specifications of investment policy function
- Similar result for UP
- Message: preserve investment incentives = key for success of open-access
 - ⇒ Simulations show it is not easy (need future research)

Conclusion: contribution

- An empirical framework to analyze the trade-off between static efficiency and dynamic efficiency
- Application to a recent debate in US rail industry
 - Open-Access and the expropriation argument
 - To sustain innovation (dynamic efficiency), investment requires a RoR obtained through above marginal cost pricing (static inefficiency)
 - ⇒ Prospects of profits necessary to motivate costly investment
 - The smaller the proportion of traffic operated, the smaller the incentives to invest as the benefits are shared by other firms

Conclusion: An example

- Entry on BN's network
 - Decrease in prices, but also in investment
 - Bad for consumer's welfare (decrease in the quality of network, tracks, facilities)
- General message: regulator careful with the implementation of open-access policy
 - Key: investment incentives

Conclusion: extensions

- Marginal costs:
 - Constant marginal costs
 - With economies of density: sharing traffic \Rightarrow increase cost
 - \Rightarrow anticipated margins decrease more
 - \Rightarrow higher (negative) impact on investment
- Design of the access charge (needs further research):
 - Framework: linear access charge, with null profit from access
 - \Rightarrow Standard way of thinking for regulator
 - Quid if higher level of access charge
 - Preserve investment incentives, but no impact on competition
 - Quid if 2-part access charge: might work, but complicated in practice

APPENDIX

An open-access policy: simulation

- Forward-simulation procedure (Judd, 1998)
- An investment policy function for BN: $I_{j,t_0} = \gamma K_{j,t_0}$
- Results robust to different policy functions
- Find γ such that investment policy function compatible with the FOC for investment
 - Then compute I_{j,t_0}

An open-access policy: simulation (2)

- Algorithm for a given γ :
 - 1) Compute I_{j,t_0}
 - 2) Update next period capital stock at date t_1
 - 3) Solve for next period equilibrium prices at date t_1
 - 4) Compute next period profit derivative at date t_1
 - 5) Compute I_{j,t_1}
 - 6) Iterate steps 2-5 for T periods
 - 7) Compute RHS of FOC for investment
 - 8) Build function

$$f(\gamma) = i_{j,t_0} - \frac{\delta}{b} \left(\sum_{\tau=1}^T (\delta(1-d))^{\tau-1} \frac{\partial \pi_{j,t+\tau}}{\partial K_{j,t+\tau}} \right)$$

- Solve for $f(\gamma) = 0$, and compute $I_{j,t_0} = \gamma K_{j,t_0}$

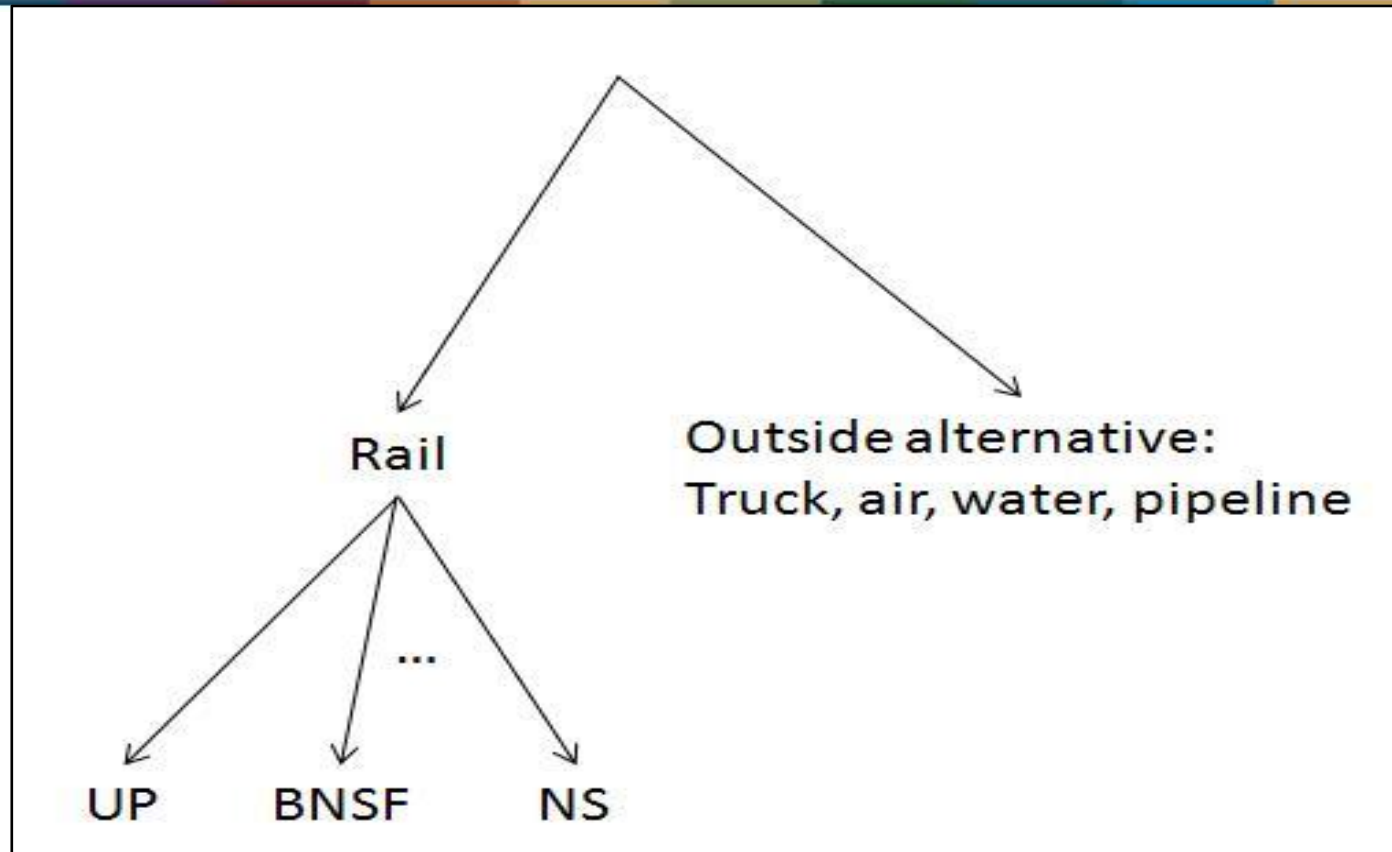
Data

- Demand model: $\delta = \theta k - \alpha p + \xi$
- Main sources: “Analysis of Class1 Railroads: 1980-2006”
- US national freight market: air, truck, railroad, water, pipeline
- In 2007, more than 41% of freight ton-miles (20% in 1980)
 - ⇒ Total size of freight market: from DoT
- Construction of a price index for each firm
 - ⇒ Match of the industry price index with the price index of STB (2009)

Network infrastructures

- Demand model: $\delta = \theta k - \alpha p + \xi$
- Ways and structure capital: tunnels, bridges, ties, tracks and rail materials, ballasts, fences, signaling materials
⇒ Schedule 350 of R1 report
- Construction of the network value: PIM
 - $K_t = K_{t-1}(1 - d) + I_{t-1}$
- Capital adjustment: Berndt et al. (1993)
 - cost savings from increments in ways and structure capital not enough to justify observed levels
 - cost savings might not fully reflect the benefit of investment
 - capital might affect service quality and then the demand

Demand model



- Mean-utility: $\delta_{j,t} = \theta k_{j,t} - \alpha p_{j,t} + \xi_{j,t}$

Demand estimation: selection issue

- Coublucq (2011)
- Standard estimating equation

$$\ln s_{j,t} - \ln s_{0,t} = \theta k_{j,t} - \alpha p_{j,t} + \sigma \ln s_{j,t|g} + \xi_{j,t}, \text{ where } E(\xi_{j,t} | z_{j,t}) = 0$$

- With attrition:
 - firm observed: $r_{j,t} = 1$
 - $E(\xi_{j,t} | z_{j,t}, r_{j,t} = 1) = 0$
- Control function approach:

$$\ln s_{j,t} - \ln s_{0,t} = \theta k_{j,t} - \alpha p_{j,t} + \sigma \ln s_{j,t|g} + E(\xi_{j,t} | z_{j,t}, r_{j,t} = 1) + e_{j,t},$$

where $E(e_{j,t} | z_{j,t}, r_{j,t} = 1) = 0$

Investment model

- Idea: investment is a dynamic decision
⇒ Depends on anticipated future profits

- State of the industry:

$$\mathbf{w}_t = (J_t; K_{1,t}, \dots, K_{j,t}, \dots, K_{J_t,t}; \xi_{1,t}, \dots, \xi_{j,t}, \dots, \xi_{J_t,t})$$

- Adjustment cost function: $c(I_{j,t}) = bI_{j,t}^2$

- Bellman equation:

$$V_{j,t}(\mathbf{w}_t) = \sup_{i_{j,t}(\mathbf{w}_t)} \pi_{j,t}(\mathbf{w}_t) - c(I_{j,t}(\mathbf{w}_t)) + \delta E \{ V_{j,t+1}(\mathbf{w}_{t+1} | \mathbf{w}_t) \}$$

- Estimation: \hat{b} such that observed investment maximizes the firm's value

Investment: estimating equation

- FOC:
$$\frac{\partial c(I_{j,t})}{\partial I_{j,t}} = \delta E \left[\frac{\partial V_{j,t+1}(w_{t+1} | w_t)}{\partial I_{j,t}} \right]$$
- Rewrite as:
$$\frac{\partial c(I_{j,t})}{\partial I_{j,t}} = \delta E \left[\frac{\partial V_{j,t+1}(K_{j,t+1}, K_{-j,t+1}, \xi_{j,t+1}, \xi_{-j,t+1} | w_t)}{\partial K_{j,t+1}} \right]$$
- Using ET, we obtain:
$$E_t \left[\delta \frac{\partial \pi_{j,t+1}}{\partial K_{j,t+1}} + \delta(1-d)bI_{j,t+1} - bI_{j,t} | \mathbf{w}_t \right] = 0$$
- Hansen and Singleton (1982): orthogonality conditions
 - $\mathbf{z}_{j,t}$: vector of variables in agent's information set at date t

Investment: estimating equation (2)

- Denote $h(b) = \delta \frac{\partial \pi_{j,t+1}}{\partial K_{j,t+1}} + b \left[\delta(1-d)I_{j,t+1} - I_{j,t} \right]$
- Build the function $g(b) = \mathbf{z}_{j,t}' h_{j,t}(b)$
- GMM: $Q(b) = g(b)' W g(b)$, where $W = \sum_{j,t} (\mathbf{z}_{j,t}' \mathbf{z}_{j,t})^{-1}$
- Instruments: information available at date t
 - Price, markups, number of active firms, HAUL

Estimation results: demand side

Impact on mean-utility	
Variables	Coeff.
price	-67.467719*** (21.600007)
Capital	.37583955 (.25605218)
Correction	.6281165** (.27461166)
Time	-.09278938** (.04115243)
Time squared	.00225597*** (.00086429)
Nobs	353
Sargan ($\chi^2(7)$)	6.12689 (p = 0.5250)

Estimation results: investment side

- Adjustment cost function $c(I_{j,t}) = bI_{j,t}^2$

	Coeff.
Adjustment cost (b)	1.970873 (1.2239)
Nobs	291
Sargan	2.9446 (p=0.4002)