

Telecommunications Infrastructure and Economic Development

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Bayreuth, 28. September 2006

Jahrestagung 2006 – Verein für Socialpolitik

The importance of infrastructure investment in network industries

Network industries important part of the economy
(6-8% of value added, 5% of employment)

Prices, productivity and employment
(Copenhagen Economics, EU study)

Lisbon objectives
“Member States shouldopen up the network industries
to competition....to guarantee the satisfactory delivery of high
quality services of general economic interest”
EU Commission 2005

Market structure remains concentrated, cross-border infrastructure
limited

Outline

1. Endogenizing infrastructure investment: which instruments?
2. Political economy aspects: more instruments
3. Regulatory aspects of infrastructure investments: competition policy & state aid

Telecom infrastructure vs. other infrastructures

"traditional infrastructures" such as transportation, sewer systems, water, electricity etc. Aschauer, 1989 found that the return to infrastructure could be as high as 70% per year. This would imply that a \$1 million invested over 30 years would result in a return of almost \$5 trillion.

As has been pointed out by a growing number of papers, these results are subject to a severe simultaneity bias and spurious correlation.

=> in need of instruments

Telecom infrastructure and economic performance

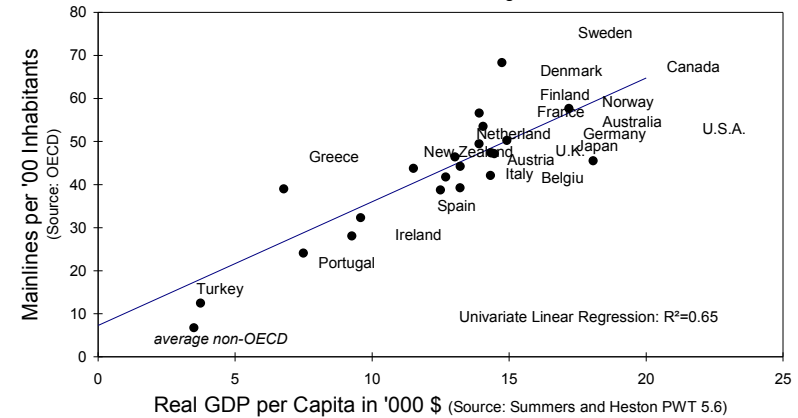
(From Röller and Waverman AER, December 2001)

As expected, telecommunications infrastructure investments (or stocks) are correlated with economic growth

Reverse causality implies that one needs to distinguish two effects:

- (i) the increase in economic growth which is attributable to increases in telecommunications infrastructure and services development and
- (ii) the increase in the demand for telecommunication services which is attributable to increases in economic growth (i.e. the income elasticity of telecommunication demand).

Telecommunication Infrastructure and Economic Activity:
Selected OECD Countries and average non-OECD for 1990



Telecom infrastructure and economic performance: a simultaneous approach

estimate a simultaneous model for telecommunication investments and economic performance

- (i) a structural model, which endogenizes telecommunication investment by specifying a micro-model of supply and demand for telecommunication investments ("classical" instruments taken from supply and demand)
- (ii) the micro-model is then jointly estimated with the macro-production equation.
- (iii) network effects

endogenizes telecommunication investment
spurious correlation: country-specific fixed effects

The econometric set-up

aggregate production function

$$GDP_t = f(K_t, HK_t, TELECOM_t)$$

micro-model of TI demand and supply

$$TELECOM_t = h(GDP_t / POP_t, TELP_t)$$

$$TTI_t = g(TELP_t, Z_t)$$

TI production function:

$$TELECOM_t - TELECOM_{t-1} = z(TTI_t, R_t)$$

Note: non-linearities in telecommunications
income elasticity of demand

TABLE 1

Variable Description and Summary Statistics

Variable	Description
K ¹	Non-residential Capital Stock net of Telecommunications Capital in billion 1985 US\$
TLF ¹	Total labor force in millions
PEN ²	Penetration rate, main lines per capita
GDP ³	GDP in billion 1985 US\$
TELP ²	Price of telephone service, in 1985 US\$, measured as total real service revenue per mainline
GA ²	Geographic area in thousand km ²
GD ³	Government surplus (deficit) in billion 1985 US\$
WL ²	Waiting list for main lines per capita
TTI ²	Investment in telecom infrastructure in billion 1985 US\$
USCAN	Dummy variable for US and Canada
T	Time trend
LOW	Dummy variable set to one when PEN ≤ 20%
MEDIUM	Dummy variable set to one when 20 < PEN ≤ 40%
HIGH	Dummy variable set to one when PEN > 40%

Variable	Mean	Std Dev	Minimum	Maximum
K	413.91	680.40	10.98	3818.58
TLF	16.70	24.48	1.10	126.42
PEN	0.30	0.14	0.01	0.68
GDP	424.73	770.76	14.79	4524.97
TELP	536.66	158.42	244.62	1000.70
GA	1516.39	3088.25	30.513	9970.61
GD	-15.48	31.37	-214.57	8.93
WL	0.01	0.02	0	0.11
TTI	2.78	4.73	.07	25.83
USCAN	0.03	0.18	0	1
T	11	6.06	1	21
LOW	.27	.45	1	0
MEDIUM	.48	.50	1	0
HIGH	.25	.43	1	0

Sources: ¹ Penn World Table 5.6 (Summers and Heston); ² ITU Yearbook 1993; ³ IMF Yearbook 1992, World Bank 1993

Table 2: Compounded Annual Growth Rates (CAGR) of GDP, Mainlines, and Telecommunication Contribution to GDP for OECD Countries

	GDP per Capita (in US\$)		CAGR (percent)	Mainline per 100 Inhabitants		CAGR (percent)	Contribution of Telecommunication CAGR 1971-90 (percent)	
	1971	1990	1971-90	1971	1990	1971-90	$\alpha = 1.54$	$\alpha = .045$
Australia	9513	12575	1.48	22.08	47.09	4.07	2.16	0.73
Austria	10230	16991	2.71	14.19	41.76	5.85	2.81	0.99
Belgium	10739	16013	2.13	14.83	39.26	5.26	2.31	0.78
Canada	10985	16472	2.16	31.38	57.46	3.24	2.73	0.95
Denmark	14708	20496	1.76	26.50	56.63	4.08	3.31	1.19
Finland	10860	20135	3.30	20.49	53.54	5.18	3.67	1.35
France	11359	17399	2.27	9.02	49.78	9.41	6.32	2.70
Germany	12850	19799	2.30	15.76	47.41	5.97	3.42	1.24
Greece	3750	4896	1.41	11.90	38.94	6.44	2.95	1.04
Iceland	11648	19724	2.81	28.99	51.37	3.06	1.86	0.62
Ireland	5764	9921	2.90	8.23	28.06	6.67	2.44	0.84
Italy	7834	14718	3.37	12.90	38.77	5.96	2.67	0.93
Japan	13383	22443	2.76	15.39	43.47	5.62	2.81	0.99
Luxembourg	11251	18783	2.73	25.36	48.17	3.43	1.85	0.61
The Netherlands	11685	16080	1.69	18.24	46.42	5.04	2.71	0.94
New Zealand	9409	10490	0.57	23.37	43.60	2.10	0.91	0.28
Norway	12767	19962	2.38	19.75	50.28	5.04	3.11	1.11
Portugal	2689	4378	2.60	6.68	24.13	6.99	2.42	0.83
Spain	5390	8713	2.56	9.52	32.35	6.65	2.65	0.92
Sweden	13676	20001	2.02	45.90	68.33	2.12	7.38	3.32
Switzerland	20998	27831	1.49	32.59	58.02	3.08	2.70	0.94
Turkey	723	1201	2.71	1.16	12.38	13.26	5.30	2.15
United Kingdom	8490	12625	2.11	16.51	44.25	5.32	2.70	0.94
United States	14719	18656	1.26	34.06	45.34	1.52	0.68	0.21
OECD Average	11297	16321	1.96	20.38	42.58	3.96	1.80	0.59

Notes: GDP per capita is expressed in US\$ at 1987 exchange rates and prices; CAGR stands for Compounded Annual Growth Rate. Source: OECD Communications Outlook 1993, ITU and own calculations

TABLE 3

Telecommunication and Growth: OECD Countries (Nonlinear GMM Estimates of Equations (1') - (4)')

Variable	(1)		(2)		(3)	
	Estimate	T-Ratio	Estimate	T-Ratio	Estimate	T-Ratio
Growth						
Intercept	-8.367	-23.17	-	-	-	-
K	0.411	11.49	0.556	19.88	0.627	19.01
TLF	0.627	16.44	0.614	7.91	0.529	6.52
PEN	0.154	7.84	0.045	4.87	0.034	3.55
MEDIUM	-	-	-	-	0.010	0.96
HIGH	-	-	-	-	0.040	2.40
t	-0.009	-5.10	-0.005	-2.37	-0.007	-2.80
Demand						
Intercept	2.073	3.90	0.711	2.76	0.718	2.76
GDP/POP	2.382	39.63	2.081	60.42	2.076	59.22
TELP	-1.131	-14.55	-1.130	-36.71	-1.127	-36.05
Supply						
Intercept	-4.267	-1.79	2.257	2.74	2.345	2.80
GA	0.396	14.19	0.322	32.49	0.320	31.49
GD	-0.029	-18.97	-0.024	-32.49	-0.024	-31.70
WL	3.624	1.09	-6.727	-6.07	-6.739	-6.06
(1-USCAN)*TELP	-0.752	-2.60	-0.050	-0.51	-0.041	-0.41
USCAN*TELP	-0.535	-1.79	0.150	1.42	0.163	1.53
Production						
Intercept	0.133	7.85	0.141	17.76	0.141	17.60
TTI	0.003	2.29	0.002	1.80	0.002	1.58
GA	-0.005	-3.22	-0.005	-7.31	-0.005	-7.11

¹ Column (1) refers to standard (no fixed effects) model. Column (2) reports the fixed effects estimates, and Column (3) refers to the dummy variable model of the effects on growth. The mean squared error (MSE) of each equation is as follows:

	Growth	Demand	Supply	Production
Model (1):	0.025	0.171	0.906	0.002
Model (2):	0.003	0.154	0.794	0.002
Model (3):	0.003	0.154	0.794	0.002

Number of Observations: 396

Main Findings

investments in communication infrastructure has **significant growth effects**: for OECD countries it is about .59% (on average).

increasing returns to communication investment: *critical mass* in infrastructure investments corresponds to a 40% penetration rate (coined *universal service*, with approx. 2-2.5 people per household). In fact, our analysis implies that the impact is twice as large for those countries that have achieved *universal service*.

marginal improvements in communication infrastructure in non-OECD countries generates small growth effects. Non-OECD countries might only realize significant growth effects, if a relatively large improvement in communications infrastructure is undertaken.

2. political economy aspects: more instruments

“After years of reading and writing about optimal policies, one cannot help but wonder why observed trade policies are so different from the prescription of the normative literature. Of course that literature assumes the existence of a “benevolent dictator” – a species that is all to rare in the real world of economic policy making”. Grossman and Helpman 2001.

Example: simple (non structural) study on state aid (Neven and Röller 2000)

pattern of aggregate state aids by the characteristics of governments and firms.

explanatory variables: three proxies for the structure of the government (fractionalization (-), coalition (+), number of parties (-)), an indication of its ideological orientation (right (+) vs. left wing), budget deficit (-), a proxy for the concentration of firms (lobby) and the timing of elections.

=> Explain 91% of the variance

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Prototype model

Motivation: In order to understand *policy incidence*, we need to integrate political economy considerations into the analysis of empirical industrial organization.

- (i) do political and institutions factors matter in a systematic way in terms of policy decisions (Persson and Tabellini)
- (ii) if so, what does this imply in terms of the *policy incidence* (Besley and Case).

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Prototype model

The basic set-up involves a simultaneous system of two equations.

policy equation

$$s = f(\text{political \& regulatory institutions, ideology, } q) + \varepsilon$$

(reduced form) market equation

$$q = g(\text{demand, costs, market structure, } s) + v$$

recursive system Besley and Case (2000)

$$\begin{aligned} s &= f(\text{political \& regulatory institutions, ideology}) + \eta \\ q &= g(\text{demand, costs, market structure, } s) + \mu \end{aligned}$$

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The Cause *and* Effect of Deregulation (from Duso and Röller EL, 2003)

market information for the mobile telecommunication industry across 24 countries for the period 1993-1997

s=entry (number of licenses)
q=productivity

telecommunications industry: the main conclusion from this literature is that political and regulatory institutions matter significantly for the deregulation process (see for instance Kaserman et al. (1993), Levy and Spiller (1994), and Donald and Sappington (1997)).

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Table 1. Single and Simultaneous Equations Estimates

	Single equation OLS Estimates		Simultaneous equations GMM Estimates	
	Coeff.	St. Err.	Coeff.	St. Err.
Policy Equation				
GDP			0.3031	0.0816***
Population			0.2234	0.0482***
Majoritarian			0.5240	0.1544***
Presidential			-1.0190	0.1885***
Coalition			0.0154	0.1645
RILE			0.0053	0.0027*
Proreg			-0.1303	0.0351***
Accountability			0.6705	0.1797***
Independence			-0.2302	0.1543
Productivity			0.0083	0.0031***
Market Equation				
Constant	3.212	0.851***	1.6894	1.1318
log GDP	-0.136	0.072*	0.2885	0.1003***
log Population	-0.151	0.050**	-0.0575	0.0574
log Investment	0.310	0.131**	-0.3582	0.2076*
Time	0.355	0.047***	0.3995	0.0608***
Entry	0.485	0.101***	0.2475	0.1369*

The dependent variables are ENTRY in the policy equation and log (PRODUCTIVITY) in the market equation.
 Observations = 78. ***, **, and * represent significance at the 1%, 5%, and 10% level respectively. For the single equation,
 OLS estimates R²= 0.5431, for the GMM estimates R² policy= 0.6644, R² market= 0.4401.

Main results

Empirically, we find that both the selection and the competition effects are positive and significant for OECD deregulation, implying that treating deregulation as an exogenous event overestimates the competitive impact of deregulation on productivity by as much as 40%. These findings suggest that the endogeneity of policy decisions matters significantly for the inferred impact of these policies on market outcomes.

General point:
need to endogenize the agency. In order to understand the effect of government intervention in the marketplace, it may be necessary to integrate politics and industrial organization further, i.e. to move towards a political industrial organization.

applies in principle to many policy analysis in other fields.

“The Political Economy of European Merger Control: Evidence using Stock Market Data” (with Tomaso Duso and Damien Neven), Journal of Law and Economics, forthcoming.

"A Political Economy Model of Infrastructure Allocation: An Empirical Assessment", (with Olivier Cadot and Andreas Stephan), Journal of Public Economics, forthcoming.

state aid control

3. Regulatory aspects of infrastructure investments (public and private): competition policy & state aid



competition policy

Regulatory framework for electronic communications

step 1: List of markets => three criteria (Recommendation)

- (i) high and non-transitory entry barriers
- (ii) market does not tend towards effective competition
- (iii) competition policy alone not enough

step 2: NRAs need to show to DG COMP significant market power (SMP)

SMP and single firm dominance
SMP and collective dominance

Current system can lead to under and over-enforcement

Policy outlook: reduce the list of markets, keep the procedure



EU State aid control

public Infrastructure investment

(i) SGEI – new „Altmark package“

- generous block exemptions (no need to notify)
- Altmark criteria (no aid)
- Compatibility : transparency, no overcompensation

Comment 1: need more legal certainty vis-a-vis Altmark criteria („well-run“ company)

Comment 2: efficiency under compatibility => economic growth (Lisbon)



EU State aid control

public Infrastructure investment

(ii) Directly under the Treaty

87(1): is it aid? MEIP
87(3) assessment => balancing test

see "European State Aid Control: an economic framework", (with H.W. Friederiszick and V. Verouden), in Advances in the Economics of Competition Law, Cambridge, Mass.: MIT Press, forthcoming.



the “balancing” test

- a) existence of a market failure or social problem (is there a problem)?
- b) targeting the market failure or social problem (does the aid solve the problem?)
 - i. appropriateness (better placed instrument)
 - ii. incentive effect (windfall profits)
 - iii. aid to the minimum/necessary
- c) distortion of competition, effect on trade + balancing (proportionality)

- remark on integrated approach
- remark on sequencing



3. Regulatory aspects of infrastructure investments: competition policy & state aid

To contribute towards Lisbon objectives

- (i) Private investment incentives – NRF (needs reform, ongoing)
- (ii) Public investments –
 - state aid action plan the right framework
 - services of general economic interests need more
“Lisbon incentives”