Regulation and Innovation in Telecommunications

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Main points

- ICT is an innovative sector in its own right and has considerable indirect effects on innovation in other sectors

- Sector-specific regulation affects these innovation processes in positive and negative ways and often affects players differently

- The aggregate empirical evidence examined in our study provides evidence that the overall effect on innovation is negative but non-linear

Overview

- Background
- Conceptual framework
- Empirical approach
- Concluding thoughts

Background

Innovation

- Implementation of a new or improved
  - production process
  - product, good, or service
  - marketing method
  - organizational method (OECD, 2006)
  - "soft innovation" (Stoneman, 2010, referring to aesthetic and intellectual appeal)
- Innovation is an evolutionary process
  - Recombination of elements ("adjacent possible", Kauffman, 1993; Arthur, 2009; Antonelli, 2011)
  - Experimentation-selection-replication

ICT and innovation

- ICT innovation is important in its own right, but it also has additional repercussions
- It enables many forms of process innovations that result in productivity increases
- It enables product and service innovation in other sectors (generativity, GPT)
- Digital technology changes the way innovation is done (Brynjolfsson, 2011)
  - Allows continuous experimentation
  - Real time measurement and feedback
  - Sharing of observations and ideas

ICT innovation system
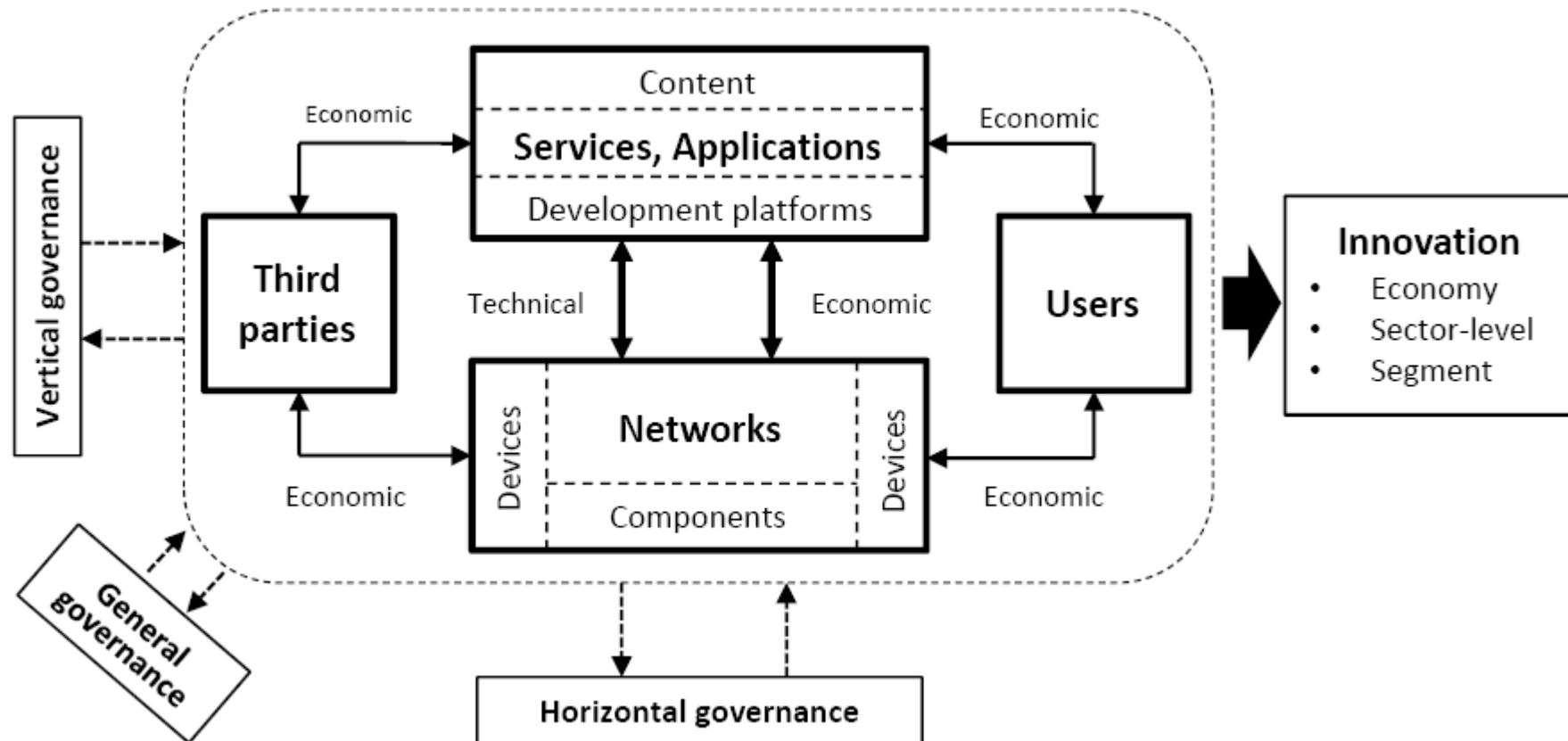
Effects of regulation on innovation

- Regulation interacts with the ICT system
  - Network infrastructure (e.g., unbundling, interconnection, interoperability requirements)
  - Rules governing vertical relations among players (e.g., network neutrality, interoperability requirements)
- Asymmetric, positive and negative effects on different classes of players
  - Example unbundling (incumbent, new entrant)
  - Example zero price mandate (network operators, content providers)
- Net effect on innovation system overall is analytically difficult to establish but open to empirical investigation

Conceptual framework

Related research

- Regulation and innovation
  - Bailey (1974), Greenstein et al. (1995), Hausman (1997), Jorde, Sidak and Teece (2000), Bourreau and Doğan (2001), Ai and Sappington (2002), Prieger (2002, 2007), Bauer (2007, 2010), Gabel and Huang (2008), Van Schewick (2010), Reggiani and Valletti (2011)

- Regulation and investment
  - Friederiszick, Grajek and Röller (2008), Cambini and Jiang (2009), Grajek and Röller (forthcoming), Krämer, Wiewiorra and Weinhardt (forthcoming)

- Regulation and broadband diffusion
  - Distaso et al. (2006), Bouckaert, Van Dijk and Verboven (2010), Gruber (2007), Lee (2008), Gruber and Koutroumpis (2011)
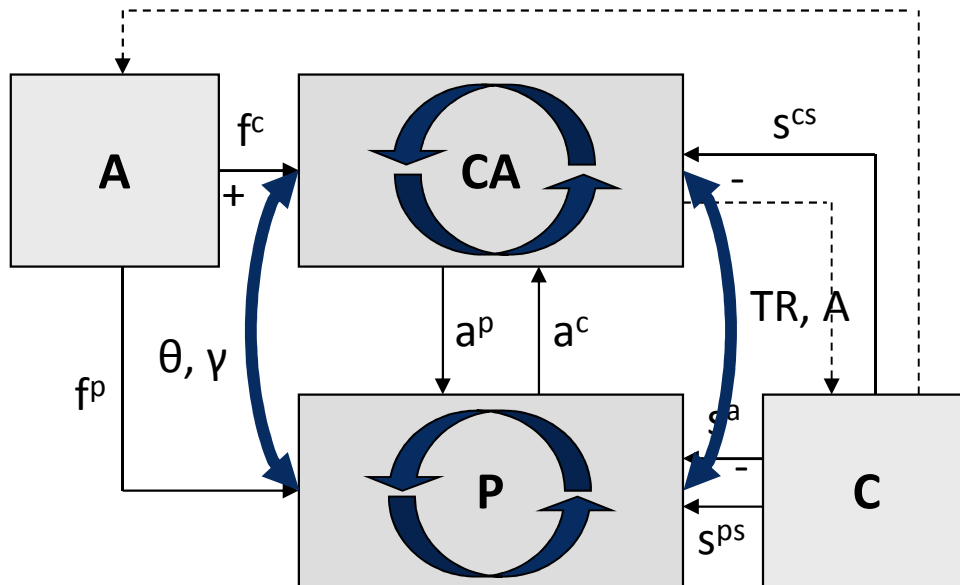
Firm-level innovation decision
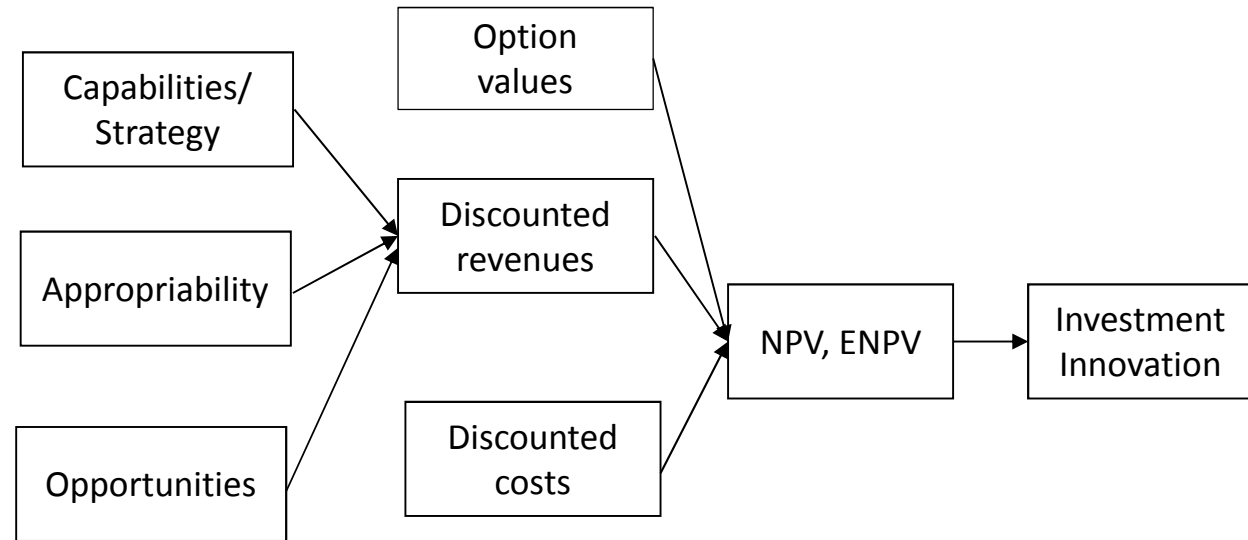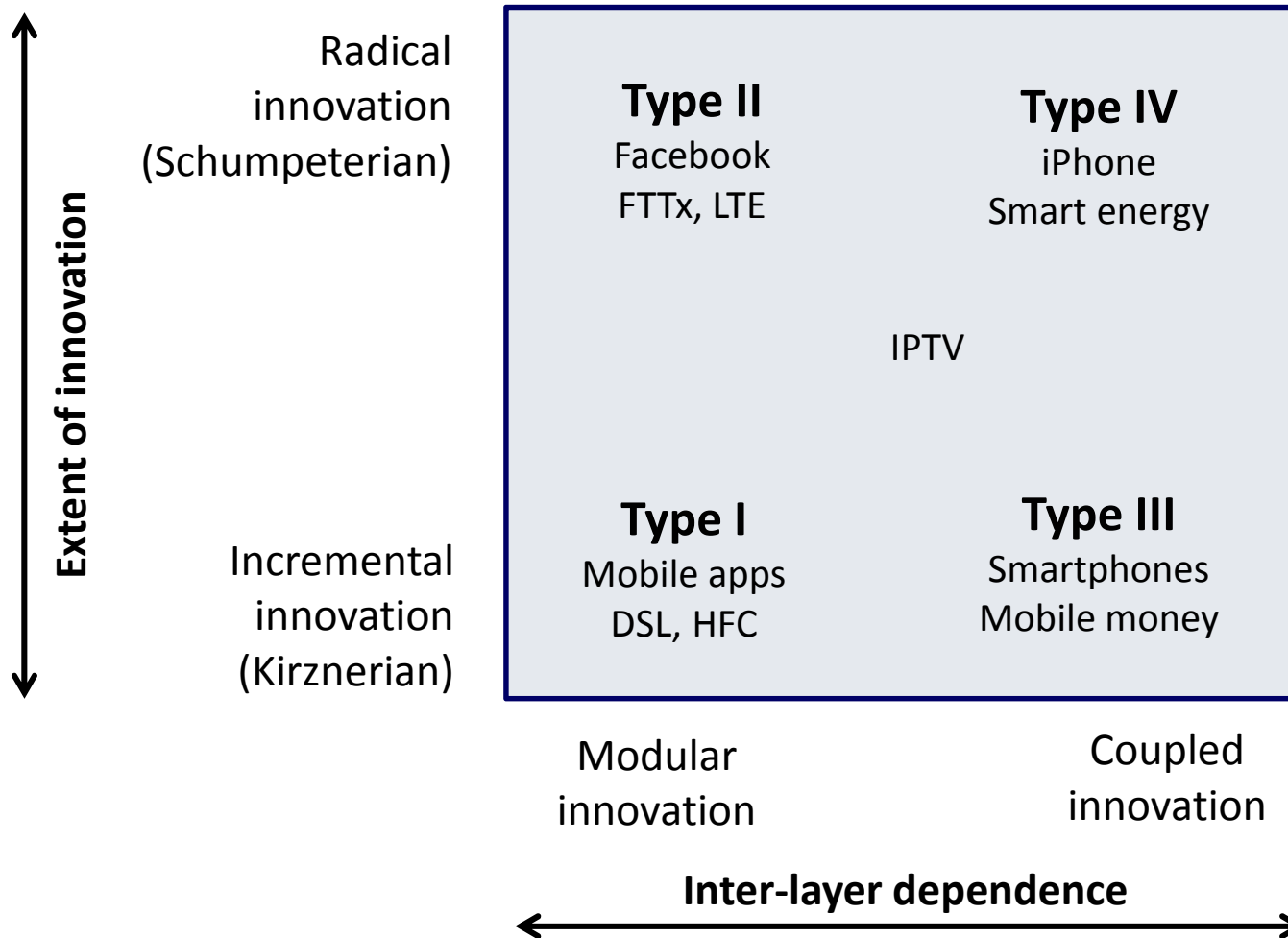
Firm-level innovation decision
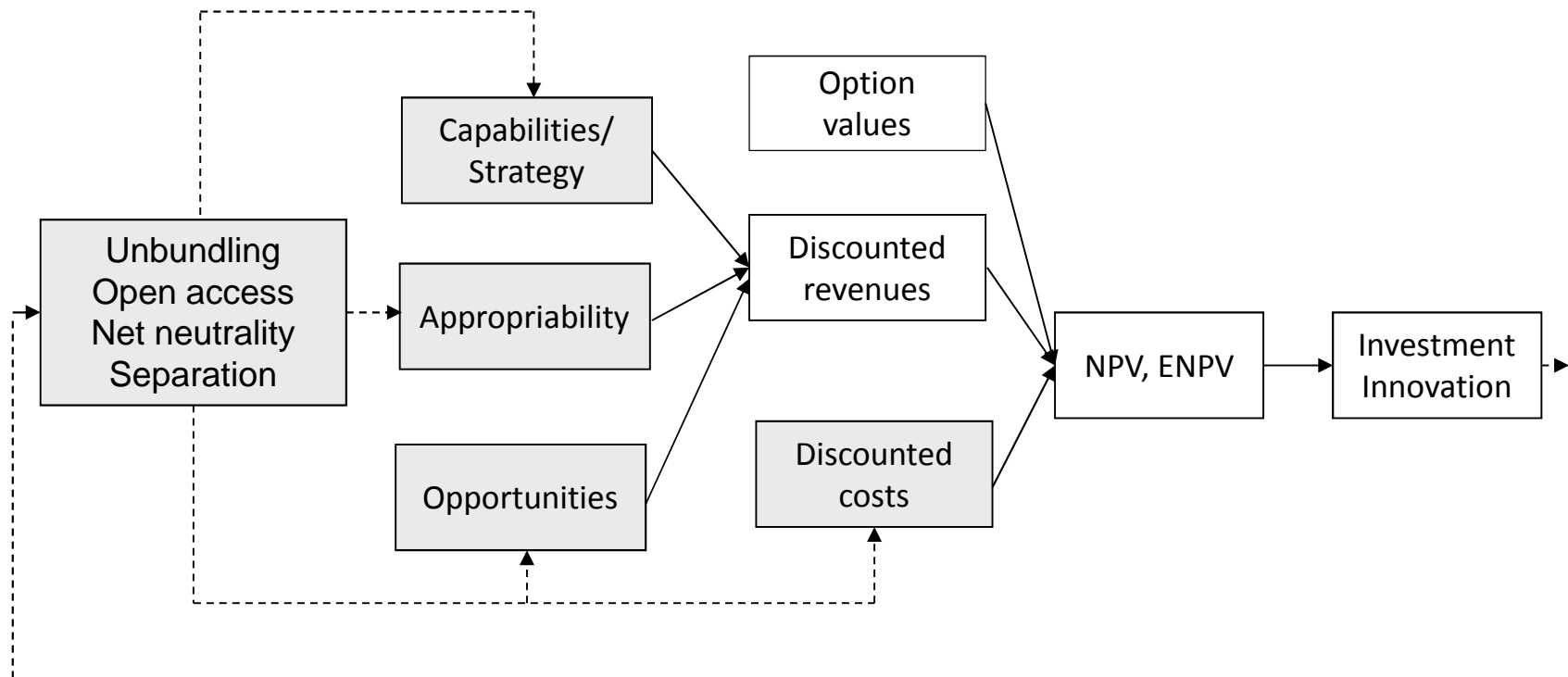
Innovation in layered systems

P .. platform operators; CA .. content, application providers; C .. consumers; A .. advertisers; s, f, a .. charges between players; TR .. transaction costs; A .. adaptation costs; θ, γ .. complementarity coefficients

- Innovation (P, CA)
  - Opportunities (+)
  - Appropriability
    - Concentration (+)
    - Contestability (-)
  - Firm capabilities (+)

- Interdependencies :   P → CA, CA → P
  - Complementarities (+)
  - Transaction costs (-)
  - Adaptation costs (-)

13

Innovation scenarios

Extent of innovation (vertical axis)

Radical innovation (Schumpeterian)

Incremental innovation (Kirznerian)

Type II
Facebook
FTTx, LTE

Type IV
iPhone
Smart energy

IPTV

Type I
Mobile apps
DSL, HFC

Type III
Smartphones
Mobile money

Modular innovation

Coupled innovation

Inter-layer dependence

14

Heterogeneity of incentives

	Network layer			Content/Application layer	
	Incumbent	Service-based entrant	Facilities-based entrant	Complement	Substitute
Unbundling	<0	>0	<0	>0	>0
Zero price constraint	<0	>0	<0	>0 (modular) <0 (coupled)	>0
Vertical separation	<0	>0	<0	>0 (modular) <0 (coupled)	>0

Empirical research questions

- RQ1: Does a correspondence between sector-specific regulation and innovation exist?
  - At the network layer?
  - For network-based services?
- RQ2: Are there characteristic patterns for different types of innovation?
- Alternative measures of innovation (e.g. input, output, actual market data)
- No strong a priori expectation as to shape and direction of relationship

ICT innovation system
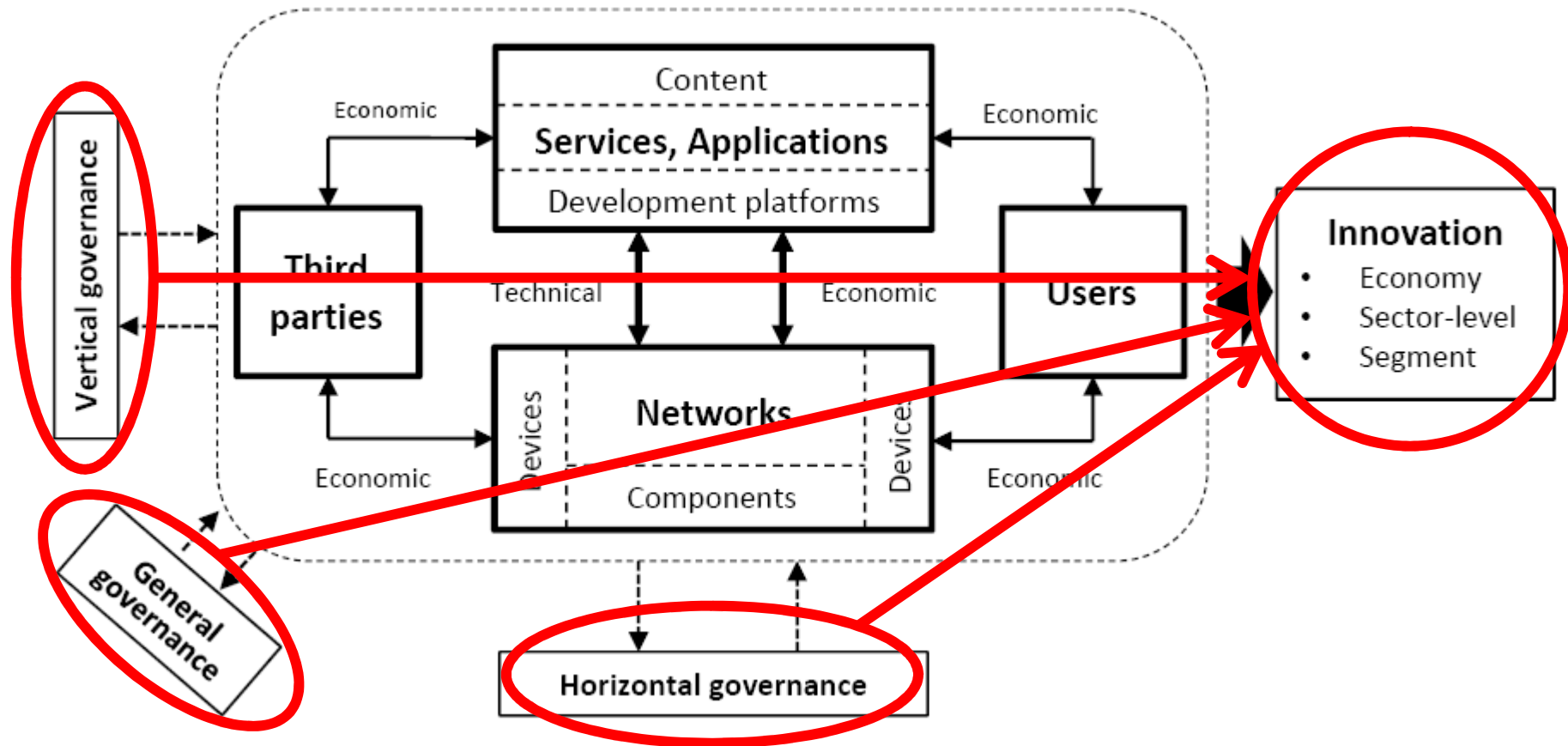
Empirical approach and preliminary findings

Modeling approach

- General estimation model

$$I_{it} = \alpha_{it} I_{it-1} + \beta_1 R_{it} + \delta X_{it} + e_{it}$$

I_{it}, I_{it-1}	Innovation activity in country i at time t, t-1
$\alpha, \beta_1, \beta_2, \delta$	Parameters
R_{it}	Regulatory density in country i at time t
X_{it}	Independent and control variables

- GMM panel estimation, instruments to overcome problems of endogeneity

- Examination of data for non-linear effects

Data

- Data for 32 countries (EU-27, AU, CH, JP, SG, US), 1997-2010 (448 observations)
- Dependent variables
  - Measures for network innovation (broadband adoption, FTTx)
  - Measures and proxies for services and applications innovation (e-commerce, IPTV)
- Independent variables
  - Regulatory Density Index 2012 (total index, market entry/competition, price regulation components) (Zenhäusern et al., 2012)
  - Economic and socio-demographic variables

Findings: secure servers

Variable	log(Servers)	log(Servers)	log(Servers)	Servers/100	Servers/100	Servers/100
log(Servers)(t-1)	0.7236*** (0.0462)	0.6647*** (0.0369)	0.7608*** (0.0442)			
Servers/100(t-1)				1.1038*** (0.0361)	1.1014*** (0.0392)	1.0793*** (0.0416)
Total regulation	-0.3667** (0.1539)			-0.0019* (0.001)		
(Total regulation)^2	0.0184** (0.0087)			0.0001* (0.0001)		
Price regulation		-0.243 (0.3574)			-0.0082*** (0.0031)	
(Price regulation)^2		0.0842 (0.0686)			0.0017*** (0.0006)	
Entry regulation			-0.217 (0.1948)			-0.0079*** (0.003)
(Entry regulation)^2			0.0104 (0.0176)			0.0007*** (0.0003)
log(GDP)	1.8694 (0.3582)	1.0122 (0.2855)	2.0954 (0.3772)	0.0161*** (0.0036)	0.0117*** (0.0038)	0.0202*** (0.0047)
log(population)	2.07 (1.3525)	2.6117*** (0.8767)	1.9689 (1.2309)			
χ^2	2681.40 p>0.001	5361.48 p>0.001	2421.41 p>0.001	2269.56 p>0.001	2201.35 p>0.001	1742.97 p>0.001
N	300	300	300	300	300	300

Standard errors in parentheses. *, ** and *** denote significance at 10%, 5% and 1%, respectively.

Effect sizes
(at sample mean)

Dependent variable: secure servers						
	log(Servers)	log(Servers)	log(Servers)	Servers/100	Servers/100	Servers/100
Total Regulation	-0.3956			-0.0517		
Price Regulation		0.3772			-0.0090	
Entry Regulation			-0.5659			-0.1315
Dependent variable: fixed broadband connections						
	log(Fixed)	log(Fixed)	log(Fixed)	Fixed/100	Fixed/100	Fixed/100
Total Regulation	-0.0634			-0.0503		
Price Regulation		-0.2151			-0.3030	
Entry Regulation			0.1562			-0.0132

White table cells indicate cases where the coefficients of the regulatory density variable (R and R^2) are statistically significant (p>0.1).

Discussion

- Evidence of negative relation between stringency of regulation and innovation activity

- Non-linear, asymmetrically U-shaped relation (negative at sample mean, strongly negative at -1σ, positive at $+1\sigma$)

  - Increasing regulatory density in countries that start with low regulatory density has strongly negative effects on innovation

  - Increasing regulatory density in countries that start with mean regulatory density has negative effects on innovation

  - Increasing regulatory density in countries that start with high regulatory density has a (weak) positive on innovation

Concluding thoughts

Take away

- ICT is an innovative sector in its own right and has considerable indirect effects on innovation in other sectors

- Sector-specific regulation affects these innovation processes in positive and negative ways and often affects players differently

- The empirical evidence examined in our study suggests that in most cases the overall effect on innovation is negative but non-linear

Selected references

- Antonelli, C. (2008). *Localized Technological Change: Towards the Economics of Complexity*. London: Routledge.

- Arthur, W. B. (2009). *The Nature of Technology: What It Is and How It Evolves*. New York: Free Press.

- Bauer, J. M., & Shim, W. (2012). Regulation and Innovation Behavior in Telecommunications. Quello Center for Telecommunications Management and Law Working paper 12-01. East Lansing, MI: Michigan State University.

- Brynjolfsson, E. (2011). Innovation and the E-economy. Unpublished paper. MIT, Sloan School of Management. October 1, 2011.

- OECD (2006), *The Measurement of Scientific and Technological Activities*. Paris.

- Stoneman, P. (2010), *Soft Innovation: Economics, Product Aesthetics, and the Creative Industries*. Oxford: Oxford University Press.

- Zenhäusern, P., Schneider, Y., & Vaterlaus, S. (2012). Regulierungsdichte-Index 2012. Olten, Switzerland.

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