

The impact of regulation and public policy on telecom sector performance

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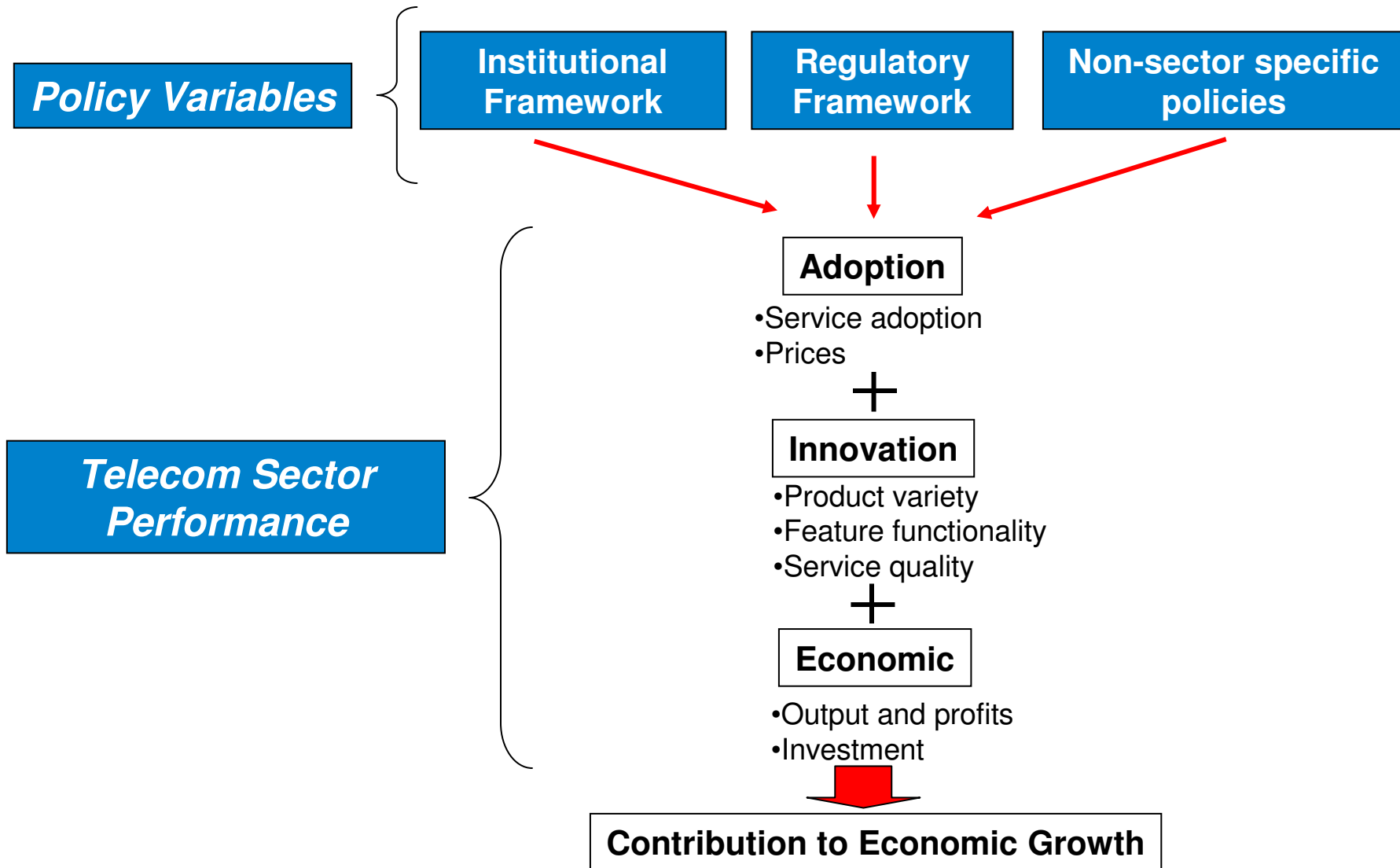
This study is focused on assessing the relationship between regulation and telecom sector performance

- What is the impact of the policy framework on ICT diffusion/adoption? How do models of regulation and public policy in the ICT sector condition specific sector performance?
- Which of those policies and frameworks are consistently associated with above par sector performance? Why are some countries more effective than others in implementing policy tools?
- What are the regulatory and policy issues influencing ICT outcomes in mature and emerging markets? What explains the trends in the evolution of policy?
- Can we draw a consistent set of policy factors yielding positive performance outcome?
- Do markets with more open, stable and predictable regulatory environments yield more robust ICT sectors?
- What non-regulatory policy initiatives successfully promote dissemination of ICT, and how does their success depend on the policy and regulatory framework?
- Are there any specific variables acting as influencers, enablers and obstacles of potential policy and regulatory frameworks? What institutional arrangements and policy frameworks are better suited to maximize ICT sector performance?

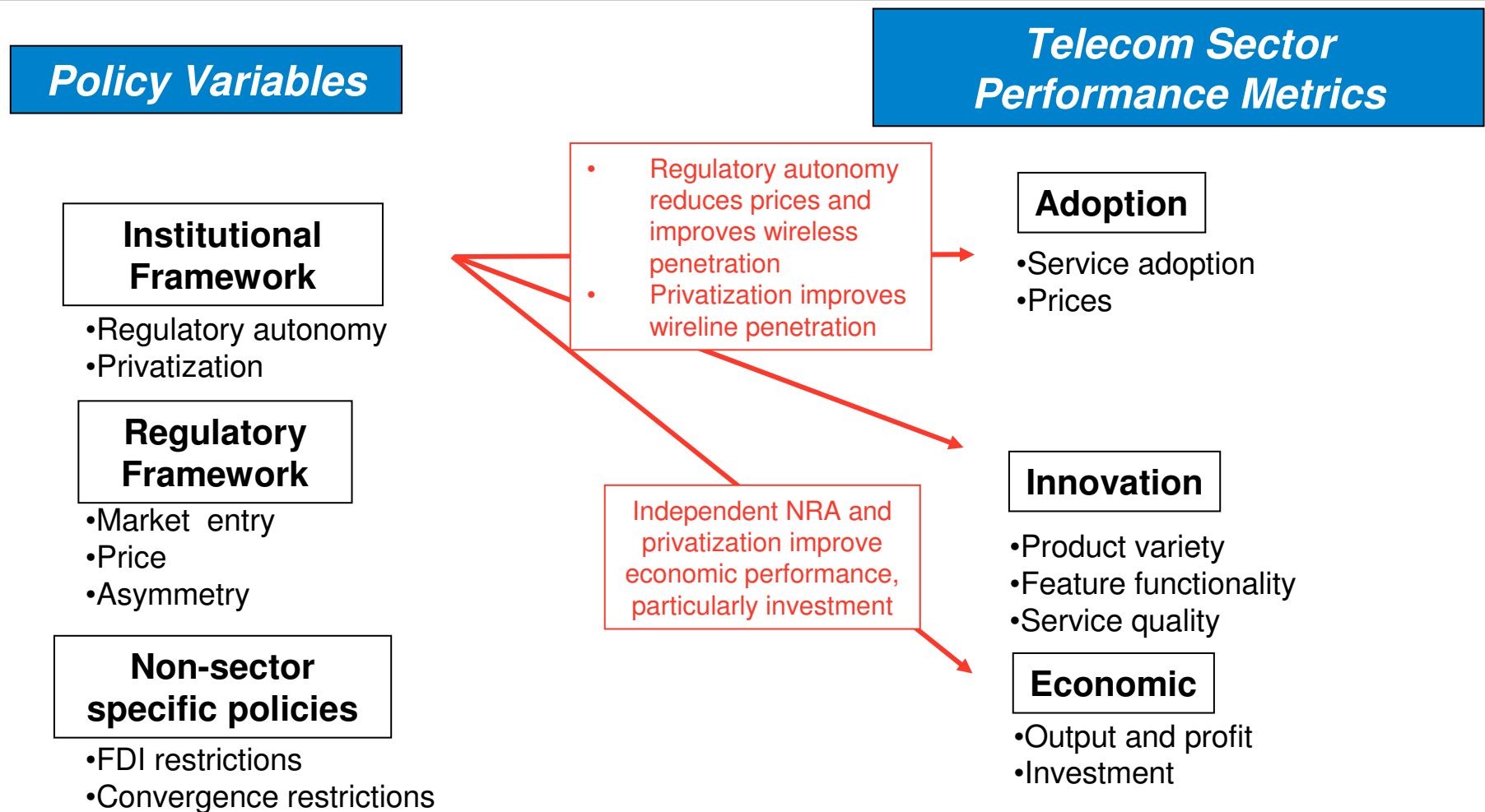
Agenda

- Theoretical framework
- Relationship between policy framework and sector performance
- Impact of policy framework on sector performance: level of investment
- Impact of policy framework on sector performance: degree of innovation
- Conclusion

The research literature indicates that telecom sector performance is driven by three sets of policy variables



There is substantial evidence regarding the impact of the institutional framework on telecom service adoption and economic performance



Similarly, prior research supports the impact of the regulatory framework on economic performance and service adoption

Policy Variables

Institutional Framework

- Regulatory autonomy
- Privatization

Regulatory Framework

- Market entry
- Price
- Asymmetry

Non-sector specific policies

- FDI restrictions
- Convergence restrictions

Telecom Sector Performance Metrics

Adoption

- Service adoption
- Prices

Innovation

- Product variety
- Feature functionality
- Service quality

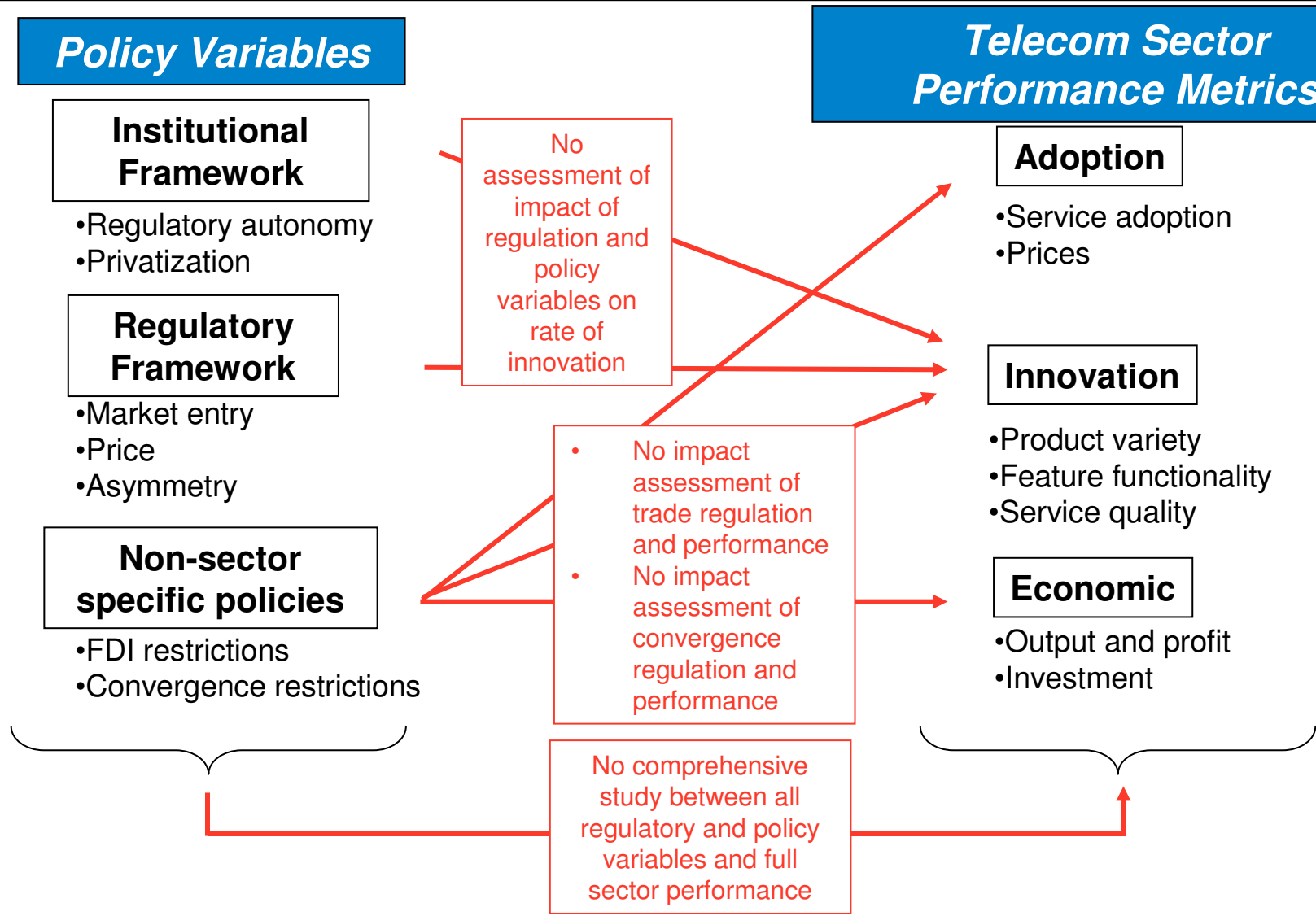
Economic

- Output and profit
- Investment

- Competition increases wireless penetration
- Number portability increases prices in wireless and wireline
- Platform competition drives broadband uptake

- Competition impacts wireline and wireless deployment
- Platform competition drives deployment
- Access regulation discourages investment

However, the impact of policy on innovation as well as the comprehensive impact of policy on sector performance has not been yet analyzed



Therefore, the following analysis focuses on three areas

- Quantitative assessment of impact of all policy and regulatory variables on sector performance
- Econometric analysis of the impact of policy variables on capital investment
- Econometric analysis of the impact of policy variables on the level of innovation

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We have built a composite index of sector performance by aggregating several metrics

INDICES	DESCRIPTION	METRICS
Service penetration	<ul style="list-style-type: none"> Degree to which telecommunications services have been built out and adopted 	<ul style="list-style-type: none"> Fixed telephony lines (per 100 population) Wireless subscribers (per 100 population) Fixed broadband lines (per 100 population)
Service quality	<ul style="list-style-type: none"> Quality of the service provided by network operators 	<ul style="list-style-type: none"> Fixed line faults per 100 lines Percentage of telephone faults cleared by next working day
Productivity	<ul style="list-style-type: none"> The ability of operators to provide and market services efficiently 	<ul style="list-style-type: none"> Full time telecommunications staff (per fixed lines and mobile subscribers) Wireless telecommunications staff (per mobile subscribers) Fixed line minutes (Local + LD)/ number of access lines
Data services	<ul style="list-style-type: none"> The availability and use of data and internet services 	<ul style="list-style-type: none"> Mobile Broadband Penetration Wireless data as a percent of ARPU FTTH penetration (percentage of fiber in broadband connections)
Pricing	<ul style="list-style-type: none"> Cost of telecommunications services (PPP) 	<ul style="list-style-type: none"> Price of mobile service (monthly charges) as proportion of GDP per capita Price of variable costs of mobile services (90 minutes of peak time) Price of fixed line service (monthly charges) as proportion of GDP per capita Fixed line services basket as proportion of GDP per capita (annual basis) [Installation costs+12*(monthly costs+90minutes of peak time)] Price of broadband (Mbit / US\$) PPP

Based on these categories, four “levels” of telecommunications sector relative performance were defined

TELECOM SECTOR PERFORMANCE LEVELS

INDICES	Level 1 Rudimentary	Level 2 Emerging	Level 3 Advanced	Level 4 World Class
Service penetration <ul style="list-style-type: none"> Fixed telephony lines Wireless subscribers Fixed broadband lines 	<ul style="list-style-type: none"> 0 - 16.9 % 0 - 25.9 % 0 - 9.99 % 	<ul style="list-style-type: none"> 17.0 - 32.9 % 26.0 - 49.9 % 10.0 - 19.99 % 	<ul style="list-style-type: none"> 33.0 – 50.0 % 50.0 - 75.0 % 19.9 – 30.0 % 	<ul style="list-style-type: none"> >50.0 % >75.0% >30.0%
Service quality <ul style="list-style-type: none"> Fixed line faults per 100 lines Percentage of telephone faults cleared by next working day 	<ul style="list-style-type: none"> >72 0-28.9 % 	<ul style="list-style-type: none"> >72 – 48 29.0-52.9 % 	<ul style="list-style-type: none"> 47-24 53.0-75.9 % 	<ul style="list-style-type: none"> 23-0 76.0-100 %
Productivity <ul style="list-style-type: none"> Number of Lines per Full time telecommunications staff Subscribers per Wireless telecommunications staff Fixed line minutes (Local + LD)/ number of access lines (Annual Basis) 	<ul style="list-style-type: none"> 0-305 0-1402 0-3292 	<ul style="list-style-type: none"> 306-503 1403-2612 3293-6542 	<ul style="list-style-type: none"> 504-701 2613-3823 6543-9791 	<ul style="list-style-type: none"> >702 >3824 >9792

Based on these categories, four “levels” of telecommunications sector relative performance were defined (cont’d)

TELECOM SECTOR PERFORMANCE LEVELS

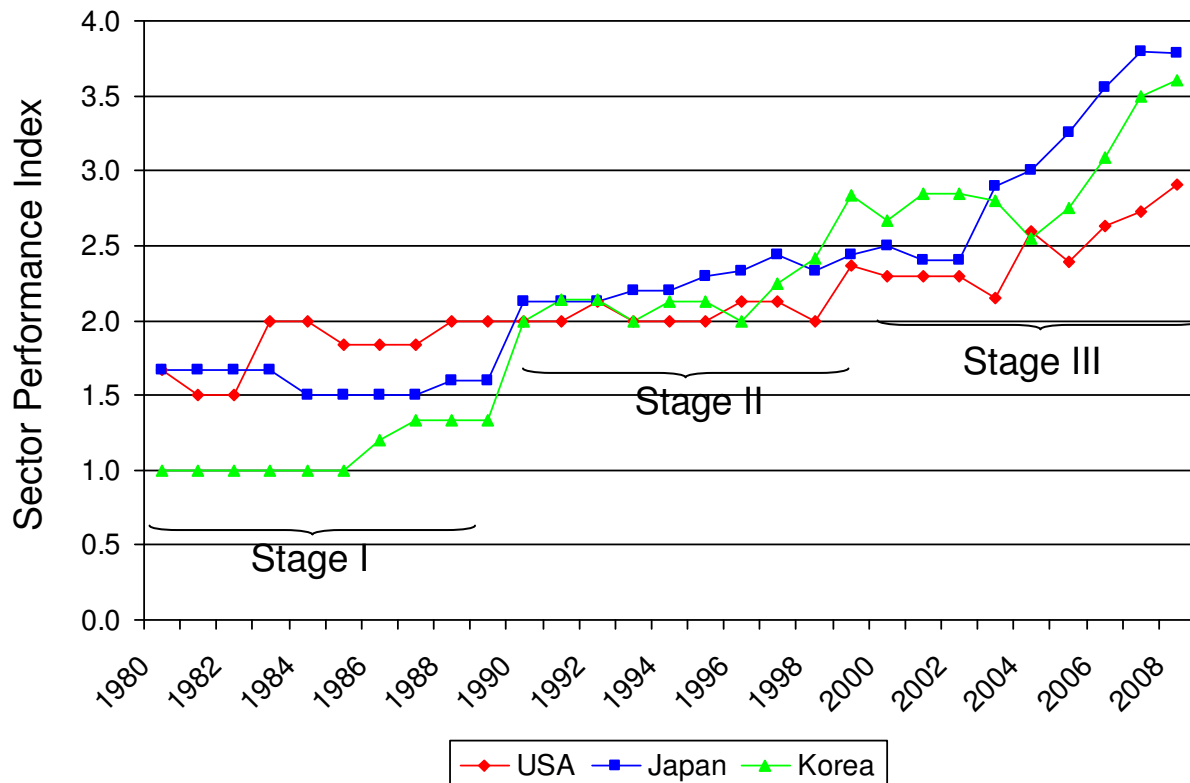
INDICES	Level 1 Rudimentary	Level 2 Emerging	Level 3 Advanced	Level 4 World Class
Data services				
• Mobile Broadband Penetration	• 0 – 17.9 %	• 18.0 – 35.9 %	• 36.0 – 54.0 %	• > 54%
• FTTH penetration	• 0 – 2.99 %	• 3.0 – 5.9 %	• 6.0 – 9.0 %	• > 9%
• Wireless data as a percent of ARPU	• 0 – 14.4 %	• 14.5 – 22.5 %	• 22.6 – 30.0 %	• >30%
Pricing (PPP)				
• Variable Costs of mobile services	• >0.83 %	• 0.83 – 0.57 %	• 0.56 – 0.29 %	• 0.28 – 0 %
• Monthly Costs of mobile service	• >0.11 %	• 0.11 – 0.08 %	• 0.07 – 0.05 %	• 0.04 – 0 %
• Annual Costs of fixed line services	• >8.98%	• 8.98 – 6.00 %	• 5.99 – 3.00 %	• 2.99 – 0 %
• Price of Broadband (Mbit/US PPP)	• >24.66	• 24.66 – 16.73	• 16.72 – 8.80	• 8.79 – 0

We have examined the sector performance improvement trends between 1980 and 2008 to detect independent policy variables affecting change

- How have Korea and Japan performed relative to other industrialized countries? What policy and regulatory variables explain their different relative performance?
- How has the telecom sector of selected Eastern European countries (Estonia, Slovak Republic) performed relative to Western Europe? What explains changes in sector performance?
- Are the “BRICs” behaving homogeneously? Is there a consistent or a divergent development path? Are policies affecting performance?

The telecom sectors of Japan and Korea have passed by the US as a result of focused industrial policies and promotion of platform-based competition in relatively concentrated markets

EVOLUTION OF SECTOR PERFORMANCE: US, JAPAN, KOREA (1980-2008)

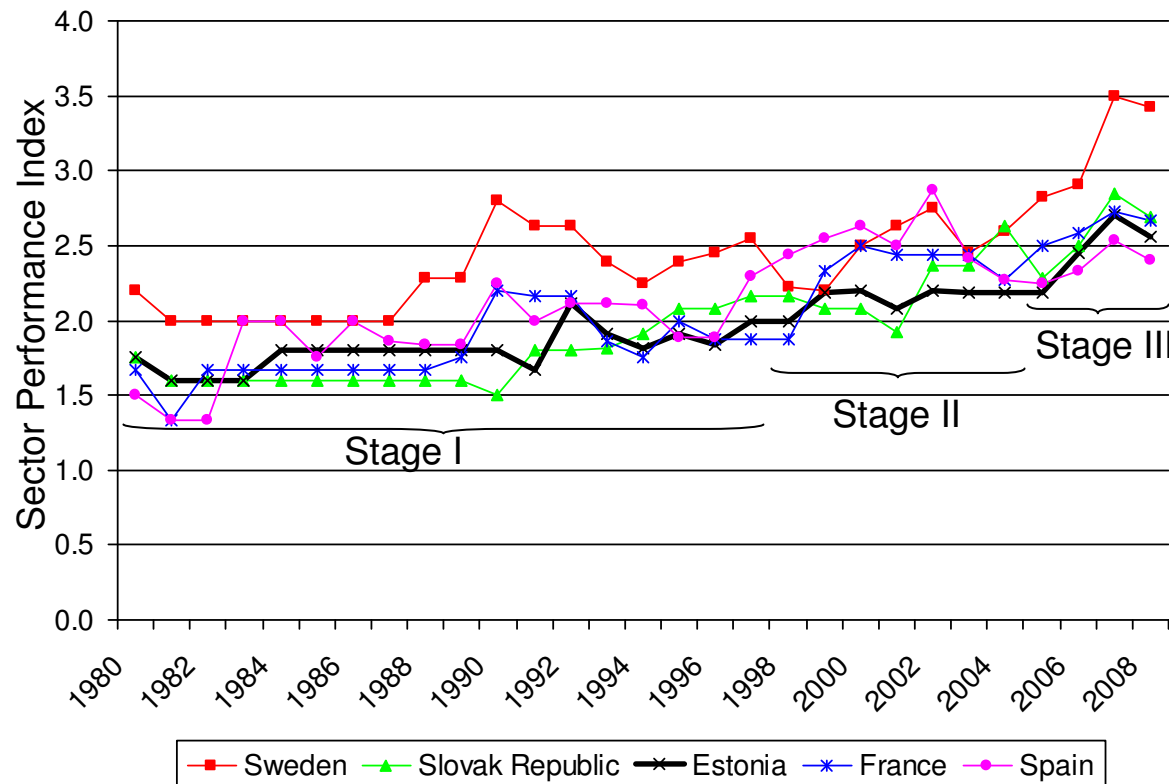


The Asian “catch-up” effect

- A comparative analysis of telecom sector performance between 1980 and 2008 of the US, Japan and Korea indicates three clearly defined stages
 - 1980-1990: above-par performance of the US relative to Japan and Korea
 - 1990-2000: Parity between the three countries
 - 2000-2008: Japan and Korea move ahead the US
- Several policy variables explain this change in leadership position
 - Japan: government sponsored wireless internet standard developed triggered product adoption (1994); platform-based competition in broadband encouraged by allowing cable companies to offer broadband beyond their franchise (1993); government fosters FTTH deployment by only allowing telcos to offer pay-TV if they deploy fiber (1997); the Japanese Development Bank gives “soft loans” for deployment of NGN (2001)
 - Korea: Korea Mobile Telecom was privatized allowing it to capitalize on wireless growth (1994); full fledged competition introduced in mobile industry (1996); consolidation of the mobile market through M&A was allowed enhancing carrier’s investment capacity (2002); creation of Cyber Building Certificate leading to reduction in fiber deployment costs (1997); government funding \$ 1.5 Bn for broadband deployment (2001); enactment of VoIP regulation policy (2002)

Estonia and the Slovak Republic have been able to reach sector performance consistent with that of Western Europe by emphasizing demand programs (training, subsidies) and public-private partnerships

EVOLUTION OF SECTOR PERFORMANCE: EASTERN VS. WESTERN EUROPE (1980-2008)

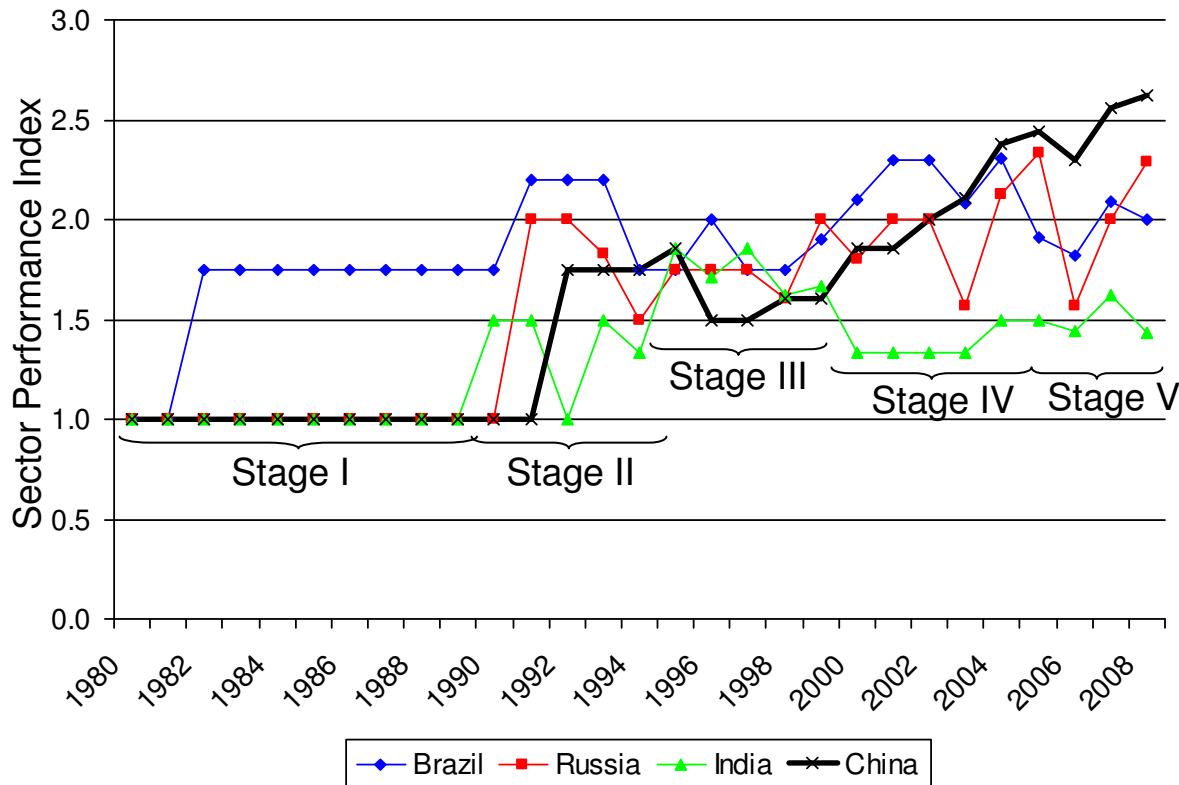


Eastern versus Western Europe

- A comparative analysis of Eastern European (Estonia, Slovak Republic) performance versus selected Western European countries indicates three stages
 - 1980-1998: Eastern Europe's telecom sector has not diverged substantially from the laggards in Western Europe (France and Spain)
 - 1998-2003: the performance of France and Spain dramatically improves with regards to Estonia and the Slovak Republic, when both countries matched the performance of the Swedish sector
 - 2003-2008: Western Europe's sector dramatically improves matching that of France and Spain, although the four under perform relative to Sweden
- Several policy variables explain this change in leadership position
 - Slovak Republic: Government Strategy aimed at achieving the level of developed EU countries in the next 5 to 8 years (2004); effective utilization of common government-owned infrastructure (e.g. railways); government provides direct subsidies to BB internet users (2005); government funding of municipal FTTH networks
 - Estonia: government funds computers and broadband to 75% of school while training teachers with computer skills (1996-2000); development of sustainable infrastructure through collaboration between state, local governments, schools, and community organizations (2001-2006)

China has bypassed the other “BRICs” by promoting Universal Service, policies aimed at reducing equipment costs and allowing carrier consolidation

EVOLUTION OF SECTOR PERFORMANCE: CHINA VS. BRICS (1980-2008)



The Chinese “take off”

- A comparative analysis of telecom sector performance of the BRICs, Korea and the US between 1980 and 2008 indicates how, after 2004, the Chinese telecommunications sector starts to display a performance higher than the rest of the “BRICs”
- Several policy variables explain this change in leadership
 - Government encouraged the state-owned incumbent carriers to expand basic network coverage and lower the cost of service in order to increase penetration and usage (mid 90’s)
 - Implicit USO requirements with essentially mandated rollouts to uneconomic geographies (rural areas) – espoused in Village-Connected campaign since 2004 (“cun cun tong”)
 - Strong-handed control of market access – for both local and foreign aspirants – in order to protect incumbent positions
 - Deliberate lax enforcement of price floors to enable continued price reduction for end-users and ever greater penetration and usage
 - Strong government-backed pressure on international equipment providers and IP owners to continually lower prices and provide global “best price” for China
 - Reorganization of the Telecom companies, reducing the number from 6 to 3 (2008)

In sum, the analysis has confirmed the influence of independent policy variables in driving sector performance; however, policies vary by geography

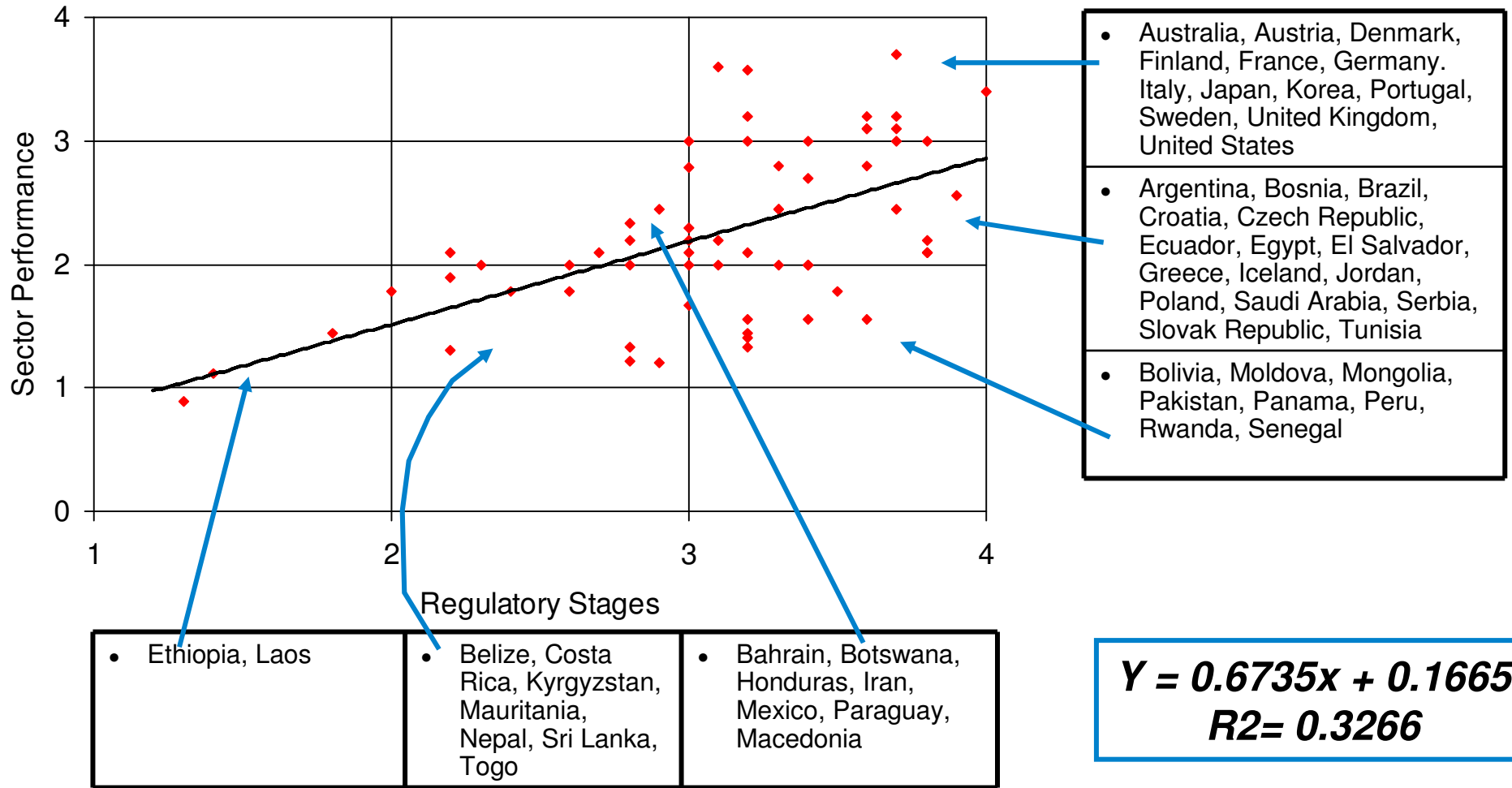
ANALYSIS	POLICY VARIABLES
<p>How have Korea and Japan performed relative to other industrialized countries? What explains their different relative performance?</p>	<ul style="list-style-type: none"> •Government-sponsored standards for wireless internet (Japan) •Platform-based competition in broadband (Japan) •Government funding of NGN deployment (Japan) •Liberalization of wireless sector (Korea) •Government funding of broadband deployment (Korea) •Limited control of wireless service provider consolidation (Korea)
<p>How has the telecom sector of Eastern European countries performed relative to Western Europe?</p>	<ul style="list-style-type: none"> •Leverage of state-owned infrastructure for backbone (Slovak Republic) •Subsidies for ICT adoption (Slovak Republic) •Government funding of municipal fiber (Slovak republic and Estonia) •Emphasis on demand-side programs and Public Private Partnerships (Estonia)
<p>Are the “BRICs” behaving homogeneously? Why is China outperforming?</p>	<ul style="list-style-type: none"> •Implicit universal service policies •Protection of incumbents •Government pressure on suppliers to reduce equipment costs •Supplier consolidation

Countries were also categorized according to nine regulatory indicators

	STAGE I MONOPOLY	STAGE II EARLY COMPETITION	STAGE III MANAGED COMPETITION	STAGE IV FULL LIBERALIZATION
Level of competition	Monopoly operator, except VAS	Monopoly operator in wireline; competition in wireless	Partial competition in wireline; competition in wireless	Full competition in all industry segments
Universal service obligations	No explicit USO policy exists	USO defined for incumbents but no proper allocation mechanisms exist	USOs defined, fair allocation mechanisms exist, services include fixed line	USOs defined for all providers, fair allocation mechanisms exist, services include fixed line and broadband
Privatization of incumbent	State-owned	Partially private (50 %)	Partially private (less than 100%)	Fully private
Regulatory Independence	Ministry departments manage regulatory policy	Regulatory agency exists within Ministry but is not autonomous in the decision making	An independent regulator exist and it is autonomous in the decision making	An independent regulator exist and it is autonomous in the decision making
VoIP regulation	VoIP prohibited	VoIP prohibited	VoIP allowed, but no regulation in place	VoIP allowed, with policies in place
Ownership restrictions of mobile; VAS; ISPs	No competition; no public ownership	Capital structure restrictions apply to foreign investors (50%)	Capital structure restrictions apply to foreign investors (51%)	No restrictions to DFI
Ownership restrictions of fixed; facilities-based	No competition; no public ownership	Capital structure restrictions apply to foreign investors (50%)	Capital structure restrictions apply to foreign investors (51%)	No restrictions to DFI
Regulatory transparency	No interconnection agreement and prices are made public	Agreements are made public. Information about prices and interconnection reference offers are not mandated	Agreements and prices are made public, but the publication of interconnection reference offers is not mandated	Agreements, prices and interconnection reference offers are public

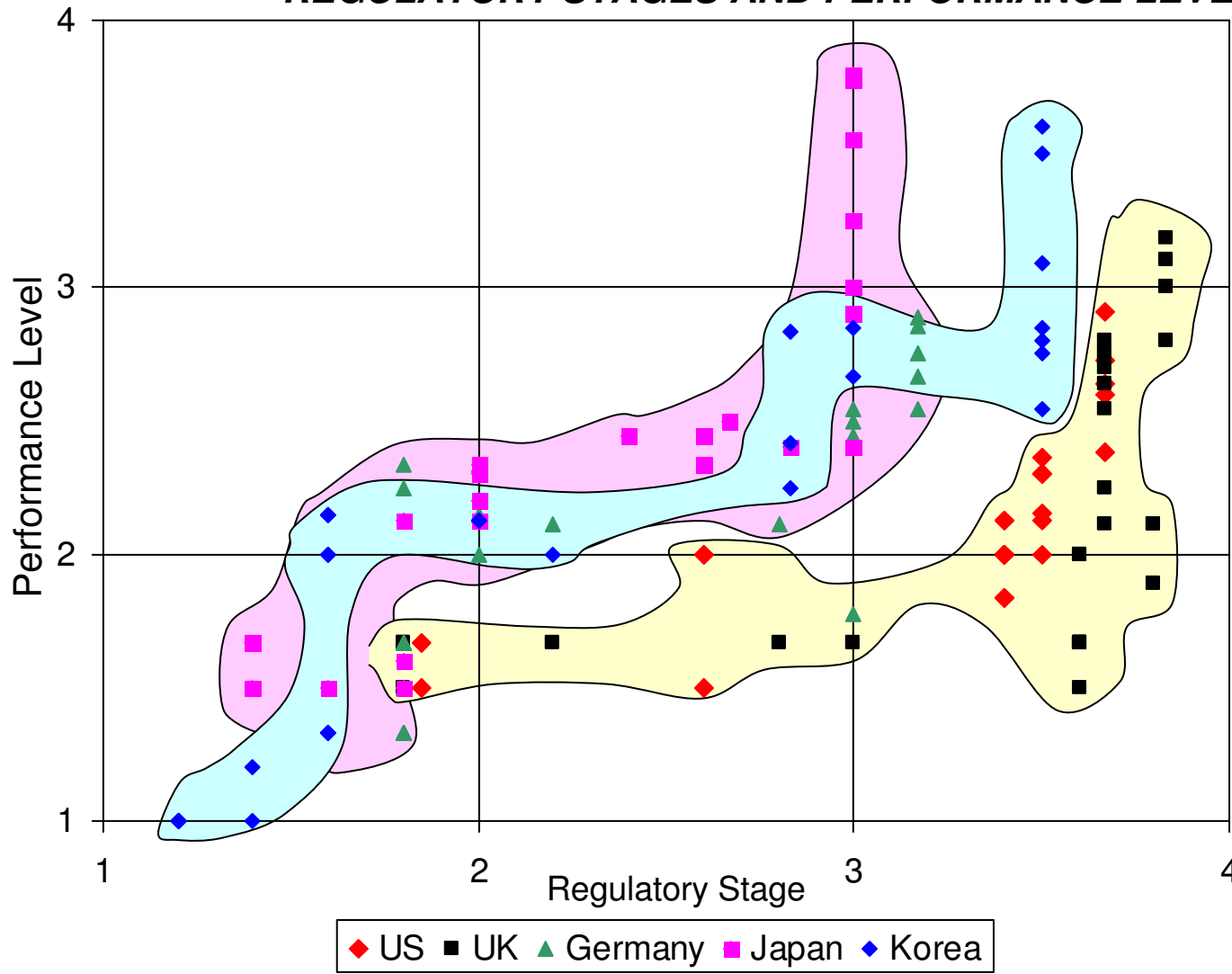
A direct relationship between regulatory stages and sector performance exists, when controlling for economic development

REGULATORY STAGES AND PERFORMANCE LEVELS (2008)



However, countries follow different paths to achieve high sector performance

REGULATORY STAGES AND PERFORMANCE LEVELS (1980-2008)



- While there is a direct relationship between sector liberalization and performance, countries appear to follow different paths
- **The Anglo-Saxon path:** the US and the UK had to extensively liberalize their telecom sector before improvements in sector performance materialize
- **The gradual liberalization path:** in Japan and Germany, the telecom sector can improve performance despite a late/restrained liberalization policy; furthermore, full liberalization is not required to reach the highest performance level (Japan)
- **The developing path:** Korea, a country that initially had fewer resources than the other industrialized nations, had to gradually liberalize the telecom sector, in order to achieve step-by-step an improvement in performance

This also raises the need to study three specific Latin American paths

	Brazil: a fully liberalized country	Mexico: a case of managed competition	Venezuela: a return to state-owned monopoly
Level of competition	4 Full competition in all segments of the industry	4 Full competition in all segments of the industry	4 Full competition in all segments of the industry, except wireline
Universal Service obligations	4 Universal service policy covering wireline	1 No definition of Universal Service policy	4 Universal service policy covering wireline
Privatization stages	4 Fully private sector	4 Fully private sector	1 State-owned wireline/wireless company
Regulatory independence	2 Regulator established but lacking full independence	2 Regulator established but lacking full independence	2 Regulation conducted from Minister of Communications
VoIP regulation	3 Allowed, but country lacks regulatory framework	3 Allowed, but country lacks regulatory framework	1 Prohibited
Ownership restrictions over wireless, value-added services and ISPs	4 No FDI restrictions	2 49% foreign ownership limit for selected sectors	4 No FDI restrictions
Fixed line ownership restrictions	4 No FDI restrictions	2 49% foreign ownership limit for the fixed line telecommunications sector	4 No FDI restrictions
Regulatory Transparency	4 Interconnection agreements and prices are public	1 Interconnection agreements and prices are not public	1 Interconnection agreements and prices are not public

Is full liberalization yielding a step function improvement in sector performance?

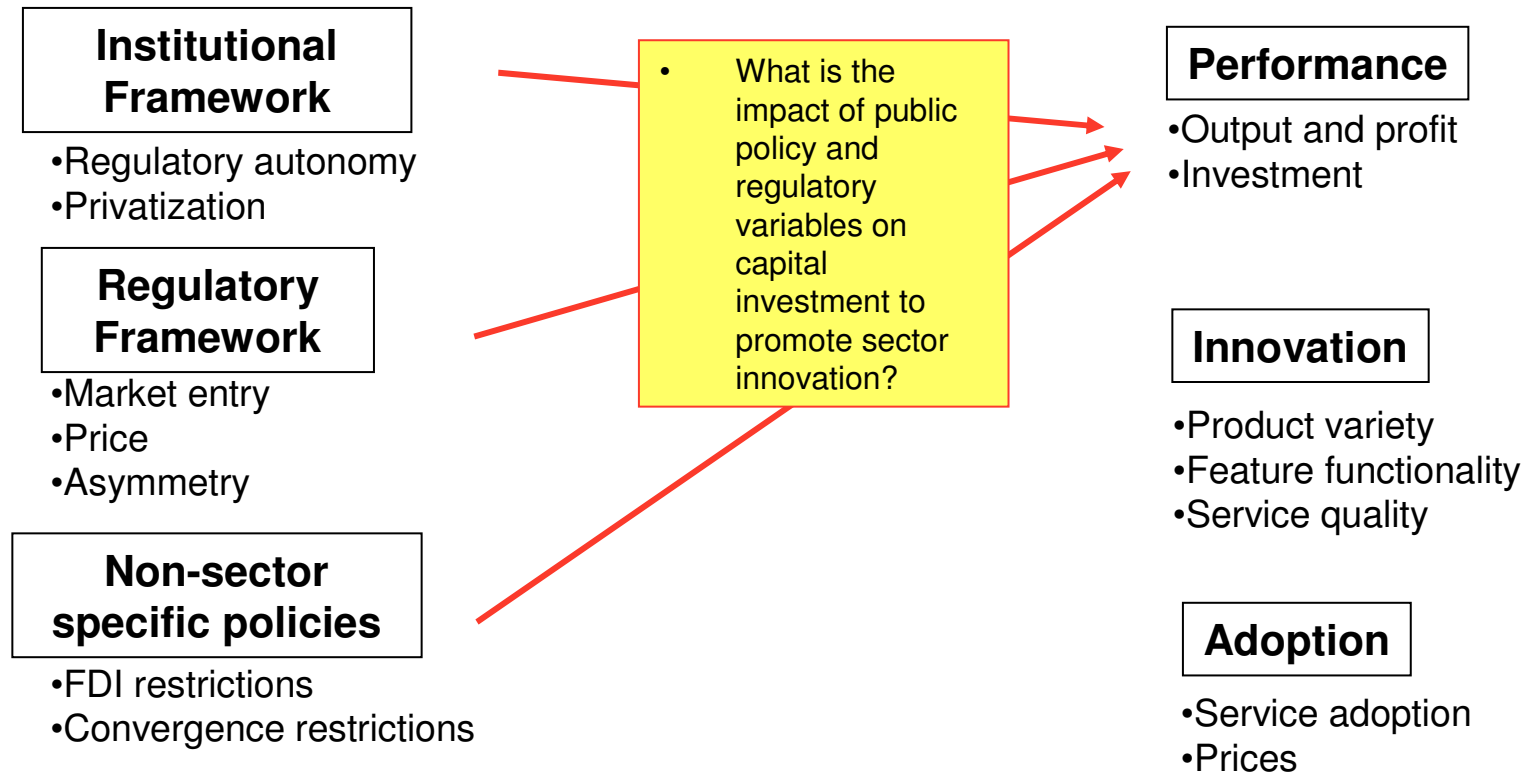
What is the combined impact of foreign investment restrictions and low regulatory transparency/ independence?

Is a return to state-owned wireline monopoly combined with low regulatory transparency/ independence yielding negative effects?

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We try to understand the relationship between policy and investment in new technology: the impact of policy and regulatory variables on the deployment of fiber to the home



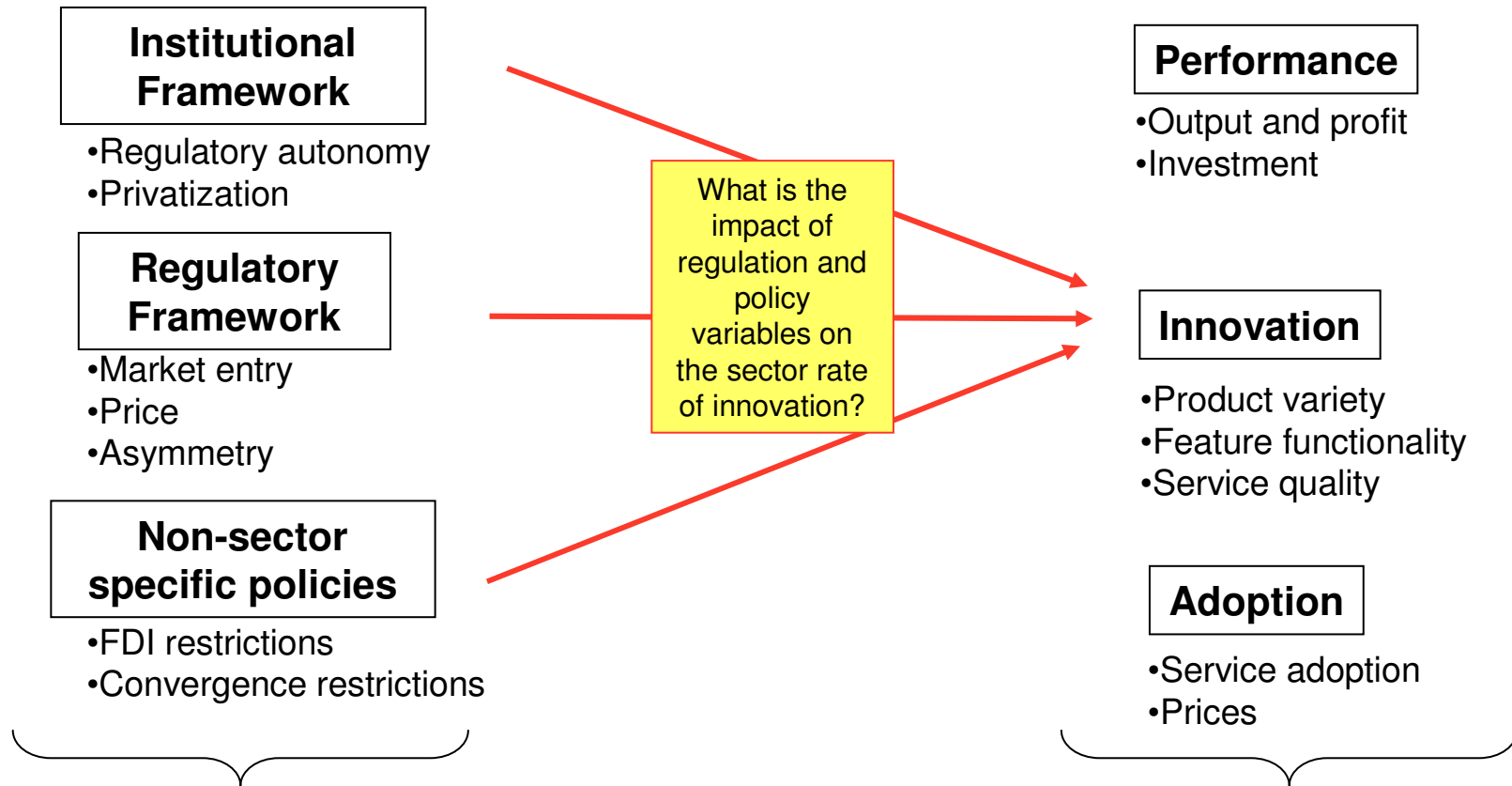
Model results indicate that fiber deployment is negatively related to LLU and the level of competitive intensity

- **Unbundling local loops is negatively related, at a significant level, to the deployment of fiber to the home:** consistent with all the literature previously reviewed, platform-based competition acts as a stimulus of investment in forward looking technologies
- **Population density is positively linked to fiber deployment:** higher density raises the rate of return of capital investment because it allows a larger number of customers being connected to the newly deployed network
- **Pricing of broadband services is negatively related to fiber deployment:** if pricing is an indicator of competitive intensity, the lower retail prices of broadband, the less incentive there is to deploy FTTH because, at lower ARPUs, the NPV of the fiber project diminishes

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We nor try to understand the relationship between policy, regulation and innovation: the impact of policy on the rate of adoption of mobile internet



Model results indicate that sector innovation is directly linked to a certain level of market concentration and the threat of policies that could lead to higher competitive intensity

- **Market concentration is directly linked to innovation:** consolidation provides operators with a higher certainty of potential returns to invest in wireless data development
- **Churn level is indirectly linked to wireless development:** the higher the level of competitive intensity, the lower the incentive of operators to innovate (inverted U theory)
- **Mobile number portability and years of policy enactment is directly linked to innovation:** portability does not necessary lead to churn but the threat of churn provides an incentive for operators to innovate in products in order to build loyalty
- **Regulatory independence and innovation are not significantly linked:** in the mobile market, the market is driving innovation and therefore, the degree of regulatory independence is not an important variable in explaining new product development
- **All socio-demographic variables are directly and significantly linked to innovation:** market potential is a critical variable driving innovation

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This study has led to the determination of the following public policy strategies having an impact on telecom sector performance

- **An emerging market “catch up” strategy:** China
- **The impact of platform-based competition and industrial policy mix:** Korea’s ICT development strategy
- **A demand-focused broadband strategy:** Estonia, Netherlands, Korea, Sweden
- **Pursuing broadband universal service through a combination of government funding and platform-based competition:** Sweden
- **Full liberalization building conditions for a step function improvement in sector performance:** US, UK, Brazil
- **The impact of foreign investment restrictions:** Mexico, Canada
- **A return to state-owned wireline monopoly:** Venezuela
- **impact of platform-based competition on investment and innovation:** United States, Chile



The following model evaluates the impact of policy and regulatory variables on the deployment of fiber to the home

$$F = f (P,LLU,S)$$

FACTORS	VARIABLES	HYPOTHESES
P	<ul style="list-style-type: none"> Variable that defines the average retail price per Mb 	<ul style="list-style-type: none"> The lower the retail price, the more competitive intensity, and therefore, the less incentive to invest in new access technologies
LLU	<ul style="list-style-type: none"> Dummy variable that asserts whether local loop unbundling has been enacted as a policy to facilitate entry of new broadband operators by obliging the incumbent to open up its network and offer access at regulated price 	<ul style="list-style-type: none"> A regulatory obligation to provide access of the network at a regulated price represents a disincentive for the incumbent to invest in new access technologies
S	<ul style="list-style-type: none"> Includes variables such as GDP per capita, and population density 	<ul style="list-style-type: none"> Carriers will invest in markets with higher demand profile and higher density (as a way to affect the rate of return in a positive direction)

Model results indicate that fiber deployment is negatively related to LLU and the level of competitive intensity

Source	SS	df	MS			
Model	188.413476	4	47.103369	Number of obs =	88	
Residual	423.599406	83	5.1036073	F(4, 83) =	9.23	
Total	612.012882	87	7.03463083	Prob > F =	0.0000	
				R-squared =	0.3079	
				Adj R-squared =	0.2745	
				Root MSE =	2.2591	

ftth	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
llu	-1.468644	.6708716	-2.19	0.031	-2.802981	-.1343077
gdp	-3.49e-06	.0000205	-0.17	0.865	-.0000442	.0000373
densidad	.0087334	.0020984	4.16	0.000	.0045597	.0129071
price	-.037539	.0152102	-2.47	0.016	-.0677914	-.0072865
_cons	1.823524	1.034692	1.76	0.082	-.2344377	3.881485

- **Unbundling local loops is negatively related, at a significant level, to the deployment of fiber to the home:** consistent with all the literature previously reviewed, platform-based competition acts as a stimulus of investment in forward looking technologies
- **Population density is positively linked to fiber deployment:** higher density raises the rate of return of capital investment because it allows a larger number of customers being connected to the newly deployed network
- **Pricing of broadband services is negatively related to fiber deployment:** if pricing is an indicator of competitive intensity, the lower retail prices of broadband, the less incentive there is to deploy FTTH because, at lower ARPUs, the NPV of the fiber project diminishes

The following model evaluates the impact of policy and regulatory variables on the rate of adoption of mobile internet

$$T = f (M,P,S)$$

FACTORS	VARIABLES	HYPOTHESES
M	<ul style="list-style-type: none"> Comprises variables such as market structure (degree of market consolidation and competitive intensity) 	<ul style="list-style-type: none"> A competitive telecommunications market fosters the development of products and services in order to generate sufficient differentiation
P	<ul style="list-style-type: none"> Contains variables such as regulatory policies, existence of an independent regulatory authority and restrictions or lack thereof to direct foreign investment 	<ul style="list-style-type: none"> Certain sector and non-sector specific policies represent an incentive to innovate <ul style="list-style-type: none"> – Policies oriented toward reducing customer switching costs (e.g. number portability) will stimulate innovation in order to preserve loyalty – A regulator perceived as not being sufficiently independent from the government will reduce the incentive to innovate because a successful differentiation strategy could lead to asymmetric pressures (e.g. renegotiate licenses, artificially set price caps) – Sector restrictions to FDI could result in limited willingness to innovate
S	<ul style="list-style-type: none"> Includes variables such as income level, size of target market to which the product is addressed and degree of urbanization 	<ul style="list-style-type: none"> Policy framework notwithstanding, companies will invest in markets with higher demand profile; this is therefore, a control variable

Model results indicate that sector innovation is directly linked to a certain level of market concentration and the threat of policies that could lead to higher competitive intensity

Revd _{it}	Coef	Std. Err	P> t
LHHI _{it}	0.75072	0.25299	0.003**
LChurn _{it}	-0.13932	0.07918	0.08*
MNP _{it}	0.14598	0.07069	0.04**
NMPY _{it}	0.59135	0.01799	0.001***
LGDP _{it}	1.30146	0.34303	0.000***
LEFI _{it}	-0.79714	0.67104	0.236
LUrban _{it}	5.55978	1.75629	0.002**
LPOP _{it}	7.14044	3.73842	0.057*
IDMC _{it}	0.06122	0.04178	0.144
Cons	-72.10414	15.70399	0.000***
Sample		272	
Periods		7	
Observations		42	
R ²	0.624		
F-test (9,221)	40.75	(0.0000)	
Heteroscedasticity:	110000	(0.0000)	
Wald χ^2 (42)			

- **Market concentration is directly linked to innovation:** consolidation provides operators with a higher certainty of potential returns to invest in wireless data development
- **Churn level is indirectly linked to wireless development:** the higher the level of competitive intensity, the lower the incentive of operators to innovate (inverted U theory)
- **Mobile number portability and years of policy enactment is directly linked to innovation:** portability does not necessary lead to churn but the threat of churn provides an incentive for operators to innovate in products in order to build loyalty
- **Regulatory independence and innovation are not significantly linked:** in the mobile market, the market is driving innovation and therefore, the degree of regulatory independence is not an important variable in explaining new product development
- **All socio-demographic variables are directly and significantly linked to innovation:** market potential is a critical variable driving innovation