Columbia Business School

Investment, infrastructure and competition in European telecom: blue sky thinking

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The purpose of this presentation is to identify new ideas that could contribute to building the future of European telecommunications

- How can the investment framework established yesterday take the technological developments, consumer preferences and business models of tomorrow into account?
- What kind of changes to the investment framework are necessary to ensure deployment of high-speed and ultrafast networks in Europe?
- What more is needed?

The targets defined by the Digital Agenda and the National Plans

- Bring broadband to all Europeans by 2013
- Access to all Europeans to 30 Mbps or above by 2020
- 50 % or more European households with connections above 100 Mbps

NATIONAL BROADBAND PLANS

Country	25-30 Mbps	100 Mbps	Year
Austria		100%	2020
Czech Republic	30%		2015
Denmark		100%	2020
Estonia		100%	2015
Finland		100%	2015
France		100%	2025
Germany		75%	2020
Spain	98%		2020
Sweden		90%	2020
United Kingdom	90%		2015

The current situation shows, so far, weak FTTH and LTE sectors, and increasing attractiveness in cable DOCSIS 3.0

FTTH/B

- Coverage (2012): 11.5%
- As of end of 2012, the EU 27 countries exhibit 6.2 million FTTH/B subscribers and 28.9 million homes passed (only Sweden and France with aproximately 1 million FTTH/B subscribers)
  - France, Spain, Portugal: 36% growth rate
  - Scandinavia, Netherlands: 28% growth rate
  - Rest of EU27: 7%
- Average take up rate among EU 27 is 21.5% (Scandinavia >30%)
- Average FTTH/B coverage among EU27 is 14%

DOCSIS 3.0

- 52% European premises passed by cable delivering between 10 Mbps and more than 100 Mbps
- 7.5 million DOCSIS 3.0 subscribers
- 69% of European internet-capable cable networks have been upgraded to DOCSIS 3.0, but not all end users have CPE
- Countries with high cable coverage include Netherlands (95%), Portugal, Belgium, the UK

LTE

- LTE accounts for less than 1% of total mobile connections in Europe
- The lack of spectrum in the 800 MHz band is hampering network coverage expansion as existing spectrum bands used for LTE services (mainly in 2600 MHz bands) do not allow operators to efficiently deploy the technology outside of the main urban areas
- It is estimated that just under 20% of total mobile connections in the EU27 region will have migrated to LTE by 2017

Blue Sky Reality Check I

- ACHIEVEMENT OF TARGETS WILL RESULT FROM A COMBINATION OF TECHNOLOGY STRATEGIES
  - In countries with cable footprint, DOCSIS 3.0 is the best option for delivering 100 Mbps
  - Most member states can reach 50% coverage of 100 Mbps with the support of copper through vectoring and pair bonding (including phantom mode)
  - LTE through 800 MHz can deliver 30 Mbps in rural areas
- A SUBSTANTIAL RISK RESIDES ON LIMITED UPTAKE WHICH PLACES THE CENTER OF PUBLIC INTERVENTION ON THE DEMAND SIDE
  - Low value proposition of NGN
  - Low ICT literacy
  - Affordability

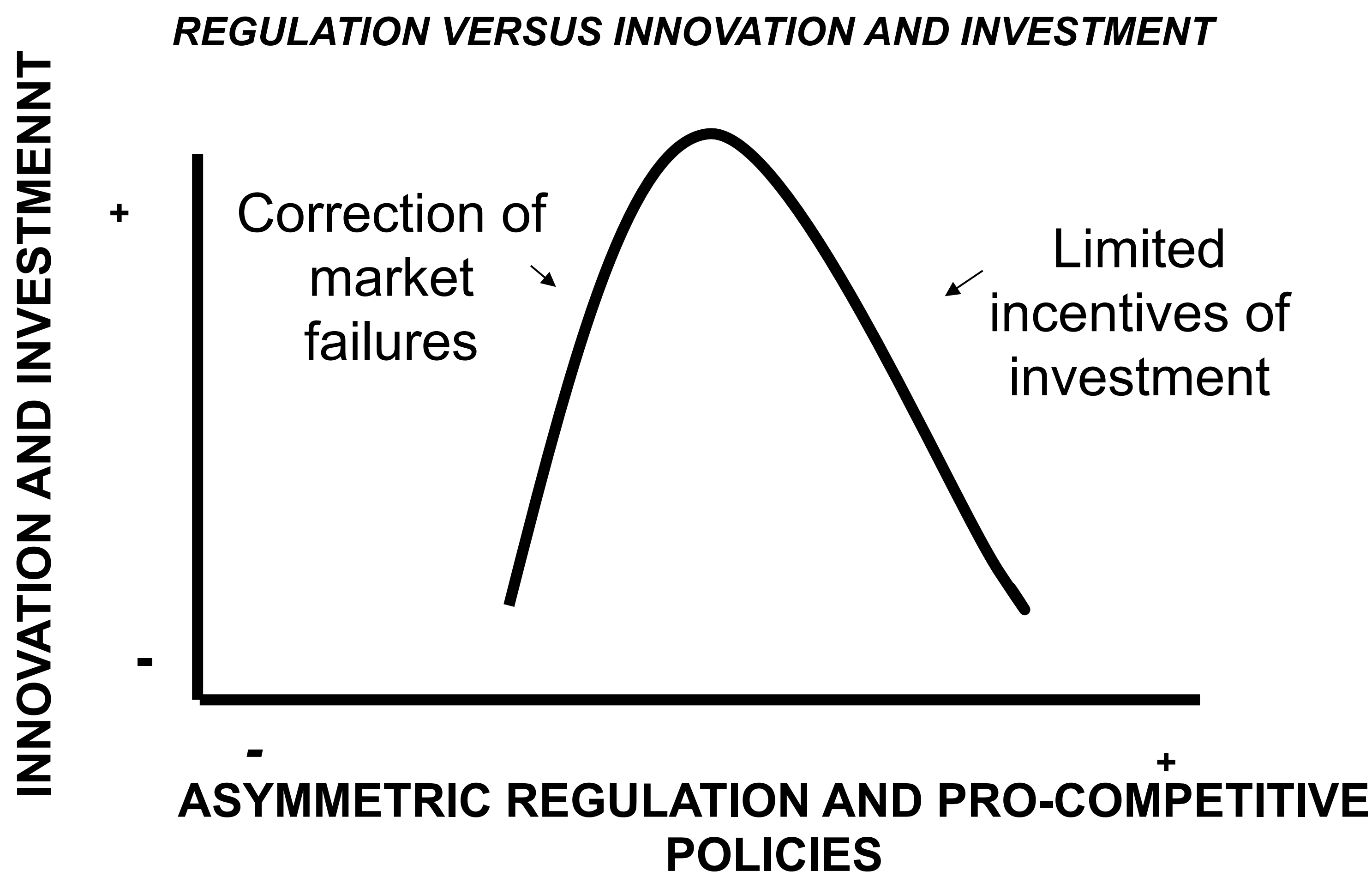
Blue-Sky Reality Check II

- SEVERAL COMMON MISTAKES MADE BY PUBLIC PARTIES IN THE PROCESS OF DEPLOYING NGA
  - Since projects are treated as an infrastructure subsidy by central government, little attention is paid to the robustness of the business plan
  - Competitive retaliation sometimes erode the viability of original business plan
  - Over-optimism in assessment of customer acquisition
  - Lack of initial commitment of project sponsor
- REGULATORY INTERVENTION COULD INCREASE RISK OF ACHIEVING NGA TARGETS
  - Asymmetric regulation of telco incumbent raises the ROIC hurdle rate
  - Sub-loop unbundling and premature disconnect of copper networks will impair vectoring technology
  - Limited spectrum availability to deliver LTE in 800 MHz

Two blue (ish) sky ideas that consider the regulatory variable

- Unless we alliviate regulatory pressure, investment (especially to unserved areas) will not materialize
- Unless we reduce tax burden on equipment purchasing, broadband deployment will be limited (a lesson from the US)

Pro-competition policies in industries with high economies of scale, while helping address market failures, can affect the rythm of innovation and investment



To test this hypothesis, we built a model to explain the rate of adoption of non-voice mobile services

- In competitive markets, consolidation increases incentives for innovation
  - High levels of competition promote a greater focus on operating efficiencies and cost reduction
  - Lower levels of competition reduce the risk of innovation initiatives
- Additionally, certain sector and non-sector specific policies and regulations affect incentives to innovate
  - Policies oriented toward reducing customer switching costs (e.g., number portability) stimulate innovation to preserve loyalty and reduce churn
  - A regulator not being sufficiently independent will reduce the incentive to innovate because a successful differentiation strategy could lead to asymmetric pressures
  - Sector restrictions to FDI could result in limited willingness to innovate
- These policy variables notwithstanding, companies will invest in markets with a higher demand profile

A model was specified to test the impact of industry concentration and other variables on non-voice mobile service revenues

IDMC: indicator of regulatory independence in a given country
MNP: dummy variable indicating the existence of mobile number portability
NMPY: years since mobile number portability has been enacted
OWNCAP: indicator of foreign ownership restrictions in wireless service provider GDP: GDP per capita (measured in US$ PPP)
EF: index of economic freedom
URBAN: urbanization index
POP: percentage population between 15 and 64 years of age

Figure 11.8. PANEL DATA ESTIMATION–FIXED EFFECTS

Revdatait	Coef.	Std. Err.	P > | t |
LHHI1it	0.4957	0.2999	0.0990*
LHHI2it	1.4812	0.4821	0.0020***
MNPit	0.1216	0.0675	0.0730*
NMPYit	0.0575	0.0170	0.0010**
LDGPit	1.4016	0.3206	0.0000***
LED/it	−0.4188	0.6240	0.5030
LUrbanit	3.3711	1.4740	0.2030**
LPOPit	7.1762	3.6486	0.0500*
IDMCit	0.0510	0.0407	0.2130
Cons	−58.8322	14.5801	0.0000***

Sample	282
Periods	7
Observations	43
R^2	0.6274
F-test	23.2 (0.0000)
Heterocedasti	110,000 (0.0000)
Wald X^2 (43)	

*10 percent significance level.
**5 percent significance level.
***1 percent significance level.

Model confirms some of the hypotheses

- Market concentration is directly linked to innovation: consolidation provides operators with a higher certainty of potential returns on investments in wireless data development
- Mobile number portability and years of policy since enactment are directly linked to innovation
- Portability does not necessarily lead to churn, but the threat of churn provides an incentive for operators to innovate to build loyalty
- Regulatory independence and innovation are not significantly linked In the mobile industry: the degree of regulatory independence is not an important variable in explaining new product development
- Market potential is a critical variable driving innovation: all socio-demographic variables are directly and significantly linked to innovation

Two blue (ish) sky ideas that consider the regulatory variable

- Unless we alliviate regulatory pressure, investment (especially to unserved areas) will not materialize
- Unless we reduce tax burden on equipment purchasing, broadband deployment will be limited (a lesson from the US)

Telecommunications and cable TV equipment investment in 2010 in the United States reached $42.1 billion (or $137.12 per capita)

EVOLUTION OF TELECOM AND CABLE TV INVESTMENT PER CAPITA IN THE UNITED STATES (2006-10)

YEAR	2006	2007	2008	2009	2010	Total
Mean Total Investment	$ 141.98	$ 136.12	$ 126.01	$ 116.02	$ 137.12	$ 131.45
Mean Taxable Investment	$ 93.71	$ 89.84	$ 83.17	$ 76.57	$ 90.50	$ 86.76
Std. Dev.	$ 46.15	$ 38.76	$ 38.94	$ 43.01	$ 60.58	$ 46.23
Minimum State	$ 17.03	$ 38.60	$ 29.49	$ 28.39	$ 35.84	$ 17.03
Maximum State	$ 243.57	$ 192.56	$ 214.68	$ 229.50	$ 447.44	$ 447.44

- Approximately 66% of all investment ($27.80 billion or $90.50 per capita) is on equipment subject to sales taxes
- Variance of investment across states is fairly wide and increasing over time
- While market potential and competitive pressure drive investment intensity, sales taxes also play a role

Of the total investment, $1.394 billion was paid in sales taxes (on average 4.02% for telcos and 4.45% for cable)

EVOLUTION OF SALES TAX ON INVESTMENT IN THE UNITED STATES (2006-10)

WIRELESS/WIRELINE

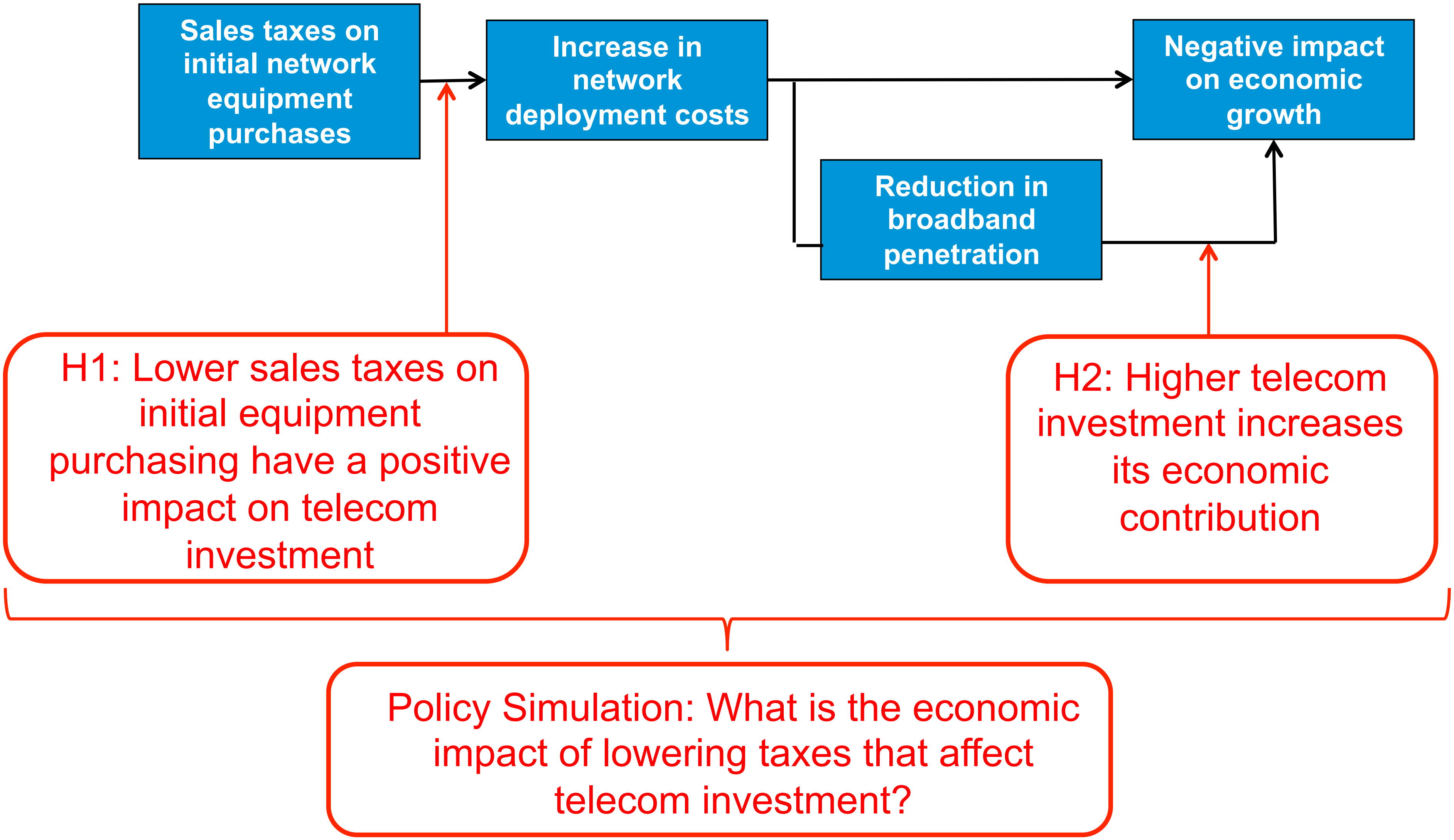
Year	2006	2007	2008	2009	2010
Mean	3.88%	3.94%	3.96%	4.12%	4.02%
Max.	9.25%	9.25%	9.25%	9.25%	9.25%
Standard deviation	3.50%	3.55%	3.58%	3.60%	3.67%
States without taxes	20	20	20	19	20

CABLE TV

Year	2006	2007	2008	2009	2010
Mean	4.14%	4.20%	4.23%	4.42%	4.45%
Max.	9.25%	9.25%	9.25%	9.25%	9.25%
Standard deviation	3.55%	3.58%	3.60%	3.62%	3.65%
States without taxes	20	20	20	19	19

- The five year average sales tax rate is fairly stable over time, although it exhibits an increasing divergence across states
- Taxation on telecommunications equipment purchasing is not homogeneous across the country since twenty states and the District of Columbia do not apply sales taxes to telecommunications equipment, while nineteen do not tax cable TV equipment

The study tested two hypotheses and simulated a policy outcome



A decrease of 1 percentage point in the tax rate would increase investment in cable TV by $0.31 per capita and $0.85 in telecom

Independent Variables: Sales Tax Rate, Median Income, Population, Human Capital, Rural Population, Investment lagged, Age of Population

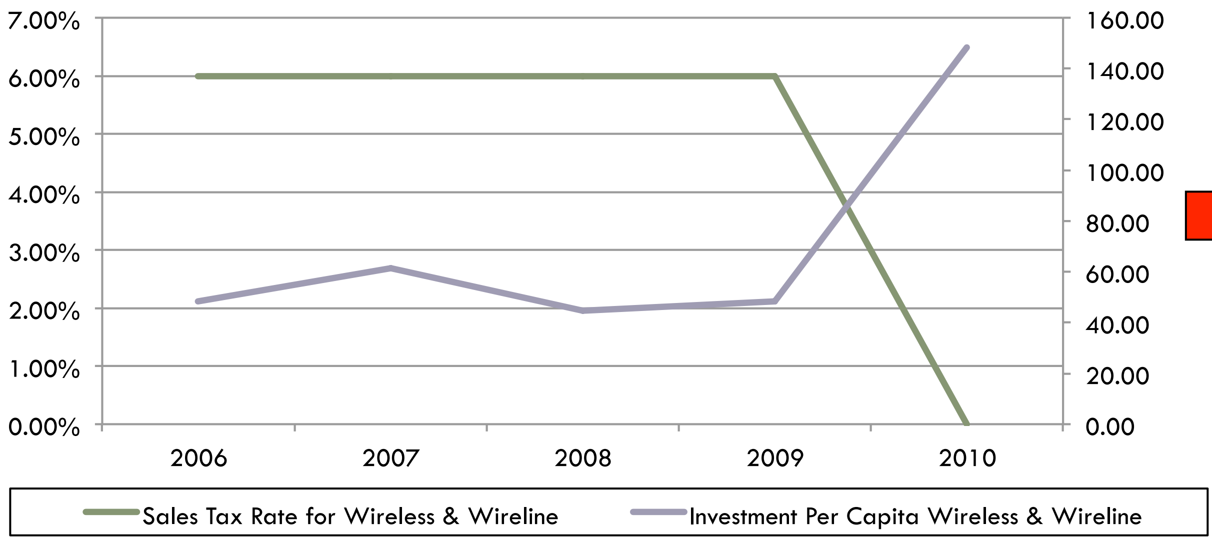
Dependent Variable	Cable Investment		Wireless & Wireline Investment	
Sales Tax Rate	-0.3085	*	-0.8529	*
	(0.1586)		(0.5142)	
Median Income (2010 Dollars)	-0.1655		0.5817	*
	(0.1239)		(0.3524)	
Population	0.2508	**	-0.3662	
	(0.0984)		(0.2690)	
Human Capital	0.2382		0.2689	
	(0.1893)		(0.5602)	
Rural Population	-0.0936	**	-0.0620	
	(0.0441)		(0.1461)	
Investment the last year	0.5019	***	0.4375	***
	(0.0465)		(0.0408)	
60 years or more	-0.3200		-8.7256	
	(0.8200)		(6.3690)	
Between 20/34 years	-0.5230		-3.8209	
	(1.2667)		(6.7247)	
Between 5/19 years	-0.8622		-6.9562	*
	(0.6340)		(3.5852)	
Constant	28.6410		434.7922	
	(47.9686)		(301.4056)	
R^2	0.7984		0.4808	
F (9,190)	50.99		37.61	
Prob > F	0.0000		0.0000	
Number of Observations	200		200	

Note: ***, **, * significance at 1%, 5% & 10% level

This effect can be also verified by examining actual investment behavior in specific states

NORTH DAKOTA: SALES TAX RATE AND TELECOM INVESTMENT (2006-10)

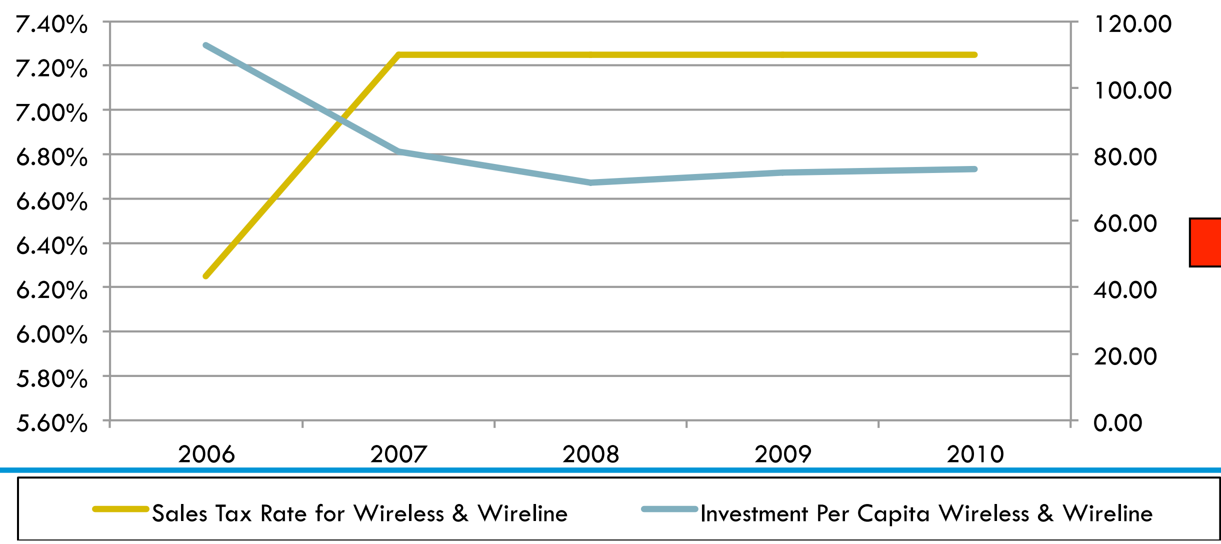
N. Dakota eliminated sales tax on network equipment purchases in 2009



Telecom investment increased three-fold from $48 to $148.30 per capita

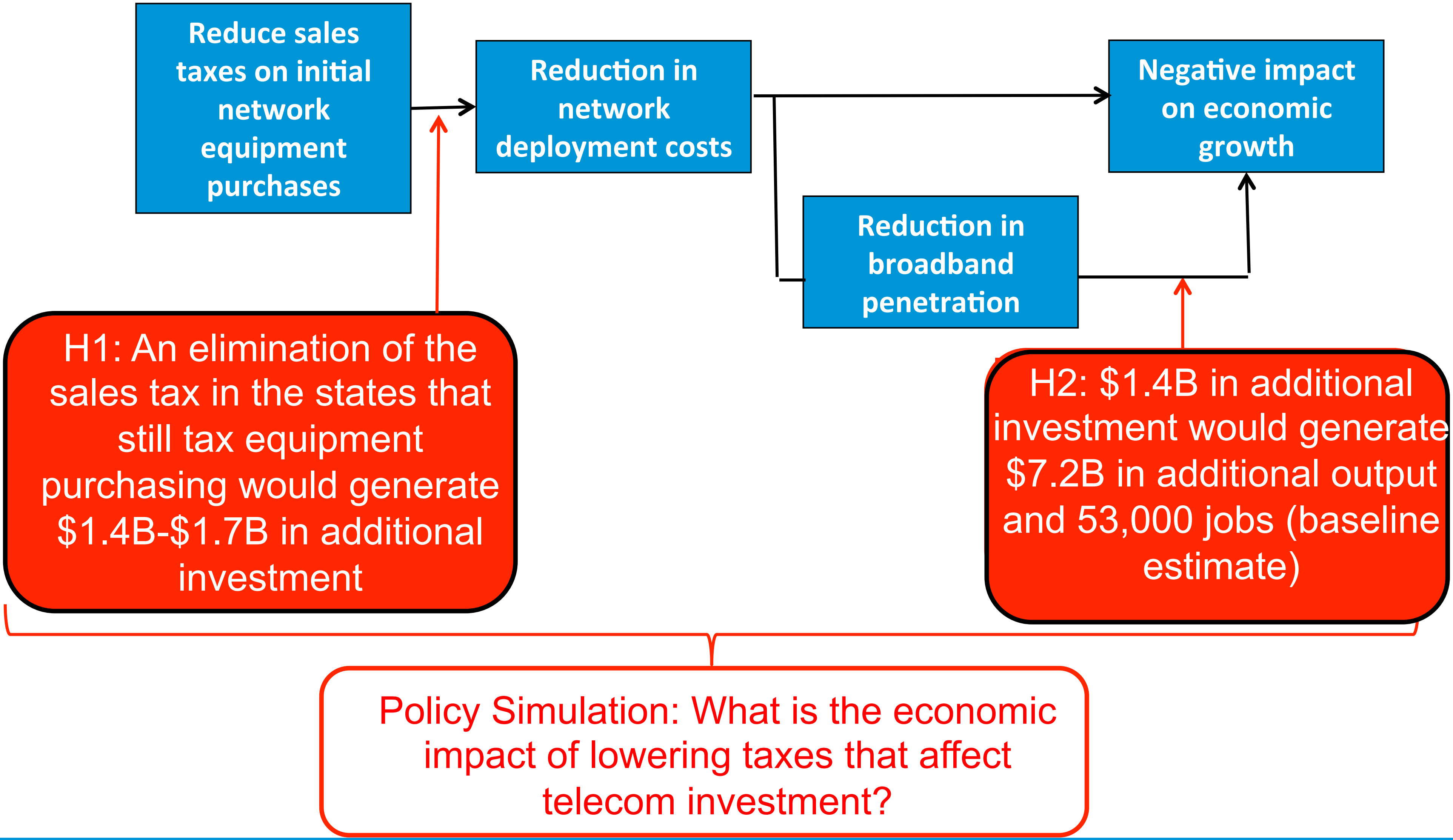
SOUTH CAROLINA: SALES TAX RATE AND TELECOM INVESTMENT (2006-10)

S. Carolina increased the sales tax rate from 6.25% in 2006 to 7.25% in 2007



Telecom investment decreased 33% from $115.37 to $77.44 per capita

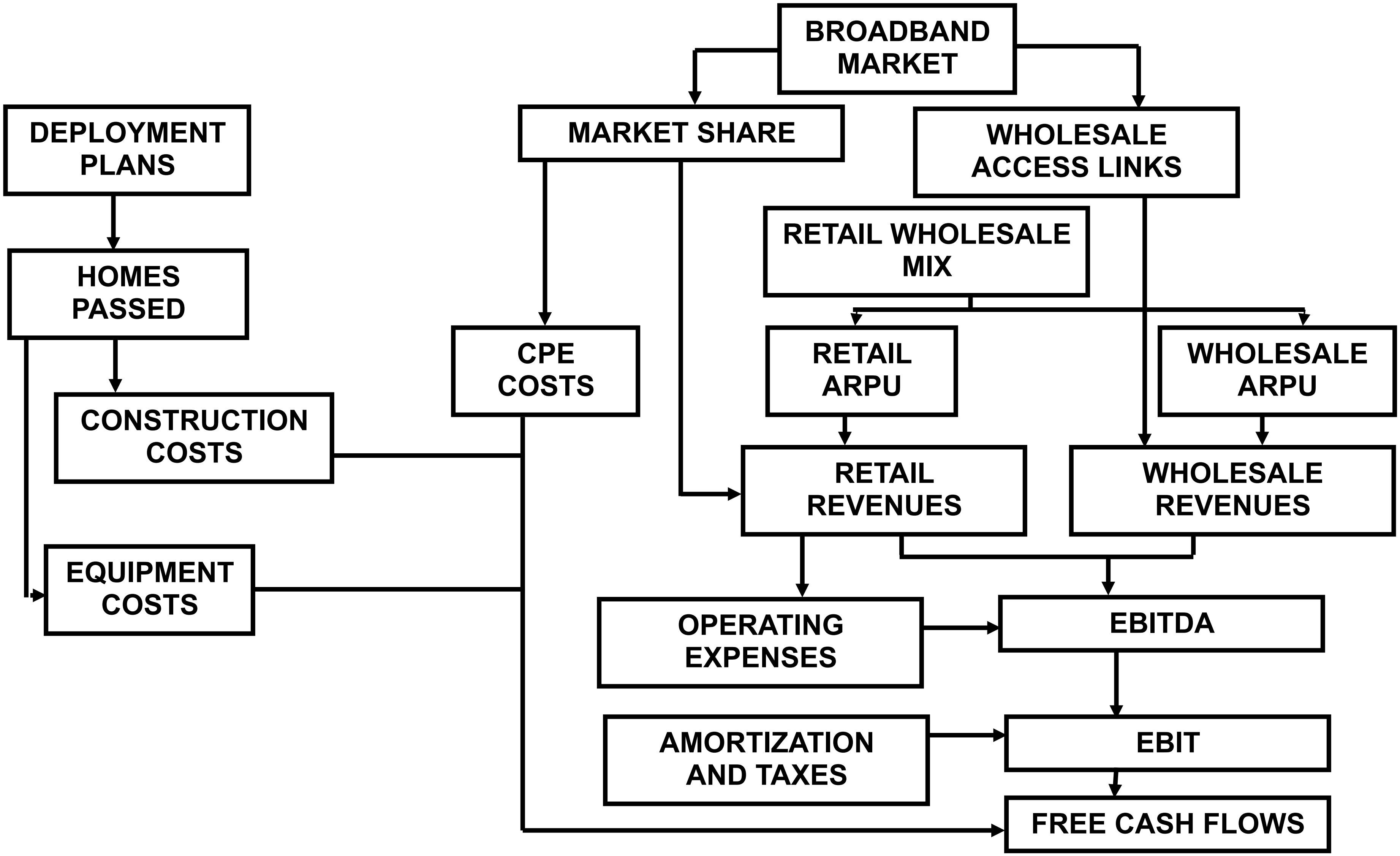
We found that a reduction in sales taxes has a positive impact on telecommunications capital investment



Three blue sky ideas that leave out the regulatory variable

- Unless we change some of the basic assumptions, the FTTH business case is unprofitable
- Unless we modify some financing models, NGN in low density areas will not materialize
- Unless we increase the NGN value proposition, consumer uptake will remain at sub-optimal levels

We constructed an investment model that captures all commercial and financial variables of a FTTH business plan



Investment model assumptions

TYPES	ITEM	ASSUMPTION	RATIONALE
CAPITAL	**EQUIPMENT COSTS**	• **FTTB-G-PON: 289.5 €** • **FTTH-G-PON: 393.4 €**	•Sanford Bernstein estimates 950 € for home connected, split as 650 € for home passed and 300 € incremental for connected •Verizon mentions that at 5 million homes passed, homes passed are 382 € and 213 € incremental for connected
	CONSTRUCTION COSTS (OSP and CO labor)	•**29.5 €**	
	CPE COSTS (ONT, OLT and equipment)	• **320 €**	
REVENUES	**RETAIL ARPU (average over five years)**	•**€ 63**	•Starting point is the ARPU of a digital household (around 62 Euros) •Assumed to increase by adding other value-added services aimed at capturing a portion of the consumer surplus (raising to 73 Euros) •Prices would start diminishing at 2% per annum
	CUSTOMER CHURN	•**1.4%/Month**	•Consistent with international triple play experience (e.g. Cox)
	WHOLESALE ARPU	• **28 €**	•Driven by approximately 40% wholesale/retail ratio
	WHOLESALE/RETAIL MIX	• **89% to 85 %**	• Assumes that 90% of fiber is deployed in areas of competition, triggering ULL provisioning

Investment model assumptions (cont.)

ITEM	ASSUMPTION	RATIONALE
OPEX	• **54 Euros/line/month**	•Operating expenses comprise four categories: customer acquisition costs, provisioning costs (installation and activation of service), maintenance and customer assistance costs, and general costs •These costs are known to be lower than those of the legacy network (approximately 70%) reaching 54 Euros/ line/month
WACC	• **8.26**	•Driven by Beta=1.36 (averaging internet and data transport firms)
g	• **2%**	•Average of analysts assessment for Iliad and CSFB for Fastweb

Our base case estimates costs and revenues for a moderate deployment plan

HOMES PASSED	5,600,000
HOMES CONNECTED	1,400,000 (25%)
CAPITAL INVESTMENT	€ 1,300,000,000

The model output (in million €) for our base case indicates a positive NPV, although most of it resides in its terminal value

	Year 1	Year 2	Year 3	Year 4	Year 5
REVENUES	115	335	563	799	1,022
OPEX	31.4	56.9	84.4	113.6	131.4
EBITDA	83.7	277.9	478.4	685.8	879.4
EBIT	55.1	214.5	374.2	582.5	776.9
FCF	(170.6)	(83.3)	17.24	208.7	349.6

NET PRESENT VALUE (W/O terminal value)	€ 105 MM
NET PRESENT VALUE (W/ terminal value)	€ 3,373 MM

As expected, the investment model is highly sensitive to the percentage of homes passed that are connected

	HOMES CONNECTED/HOMES PASSED (average over five years)	NET PRESENT VALUE (W/O terminal value)	NET PRESENT VALUE (W/ terminal value)
	10 %	€(207) MM	€ 597 MM
	15 %	€(103) MM	€ 1,522 MM
	20 %	€ 1 MM	€ 2,448 MM
BASE CASE	25 %	€ 105 MM	€ 3,373 MM
	30 %	€ 209 MM	€ 4,298 MM
	35 %	€ 313 MM	€ 5,223 MM
	40 %	€ 417 MM	€ 6,148 MM
	45 %	€ 521 MM	€ 7,072 MM
	50 %	€ 625 MM	€ 7,996 MM

Similarly, the business case is very sensitive to retail ARPU (revenues to be generated by household)

	Pricing scenarios	RETAIL ARPU (average over five years)	NET PRESENT VALUE (W/O terminal value)	NET PRESENT VALUE (W/terminal value)
	Broadband prices fall at ~8% p.a.	€ 47.1	€ (166) MM	€ 1,696 MM
	Copper broadband drops 8.6% and fiber 6%	€ 48.8	€ (141) MM	€ 1,851 MM
	Broadband prices decline uniformly 6% p.a.	€ 51.5	€ (99) MM	€ 2,109 MM
	Fiber prices align with copper	€ 54.0	€ (83) MM	€ 2,212 MM
BASE CASE	Baseline case (price tiering)	€ 63.0	€ 105 MM	€ 3,373 MM

When the investment model is stress-tested, it exhibits a high potential to yield negative NPVs

	BASE CASE		
HOMES CONNECTED/HOMES PASSED	25 %	20%	15%
PRICES	Price tiering	Fiber aligned with copper and decline 4.8%	Fiber aligned with copper and decline 6.0%
CAPEX DEPLOYMENT COSTS	As forecast	>10%	>20%

NET PRESENT VALUE (W/O terminal value)	€ 105 MM	(237) MM	(374) MM
NET PRESENT VALUE (W/ terminal value)	€ 3,373 MM	1,202 MM	237 MM

Key take-aways

- The deployment of FTTH under certain specific conditions yields positive NPVs
  - Homes connected/homes passed: 25%
  - Retail ARPU: 63 Euros
  - Wholesale ARPU: 28 Euros
  - Retail/Wholesale mix: 85/15
- However, the investment model is higly sensitiive to two variables: homes connected/passed (a proxy for share in overbuilt environments) and Retail ARPU
- Deployment of fiber in new developments or MDUs with no competing infrastructure is highly profitable
- Deployment of fiber in areas where copper DSL is already offered requires an increase in fiber retail pricing to compensate for cannibalization; this must be approximately 15%
  - Raise prices?
  - Price tiering?
  - Add new services that can be enabled by new infrastructure?

Three blue sky ideas that leave out of the regulatory variable

- Unless we change some of the basic assumptions, the FTTH business case is unprofitable
- Unless we modify some financing models, NGN in low density areas will not materialize
- Unless we increase the NGN value proposition, consumer uptake will remain at sub-optimal levels

Variables Explaining NGA Project Success or Failure

Project Success	Project Failure
• Demand aggregation across neighboring areas in order to achieve critical mass	• Limited support obtained to negotiate financial terms with lender syndicate
• Sharing of deployment costs by competitors or value-chain players	• Since project was treated as an infrastructure subsidy by central government, little attention was paid to the robustness of the business plan
• Focused FTTH deployment on the part of the incumbent	• Competitive retaliation eroded the viability of original business plan
• Financing of FTTH from capex	• Over-optimism in assessment of customer acquisition
• Careful development of business plan (demand assessment, technology decisions, commercial strategy, capital plan, etc.)	• Competitive retaliation of the incumbent could raise the issue that indiscriminate public intervention could pre-empt market forces
• Open access business model utilized to rapidly gain critical mass of demand	• Lack of initial commitment of project sponsor
• Due diligence of credit facility conducted by an outside party on behalf of lenders	

Framework for assessing NGN business models

Three drivers of NGN project success

Project Context

1. *Competitive environment (existing players offering broadband access)*
2. *Competitive substitutes (VDSL, Docsis 3.0)*
3. *Industry structure (number of players, existing service-based players)*
4. *Project sponsor (incumbent, municipality, alternative service provider, etc.)*

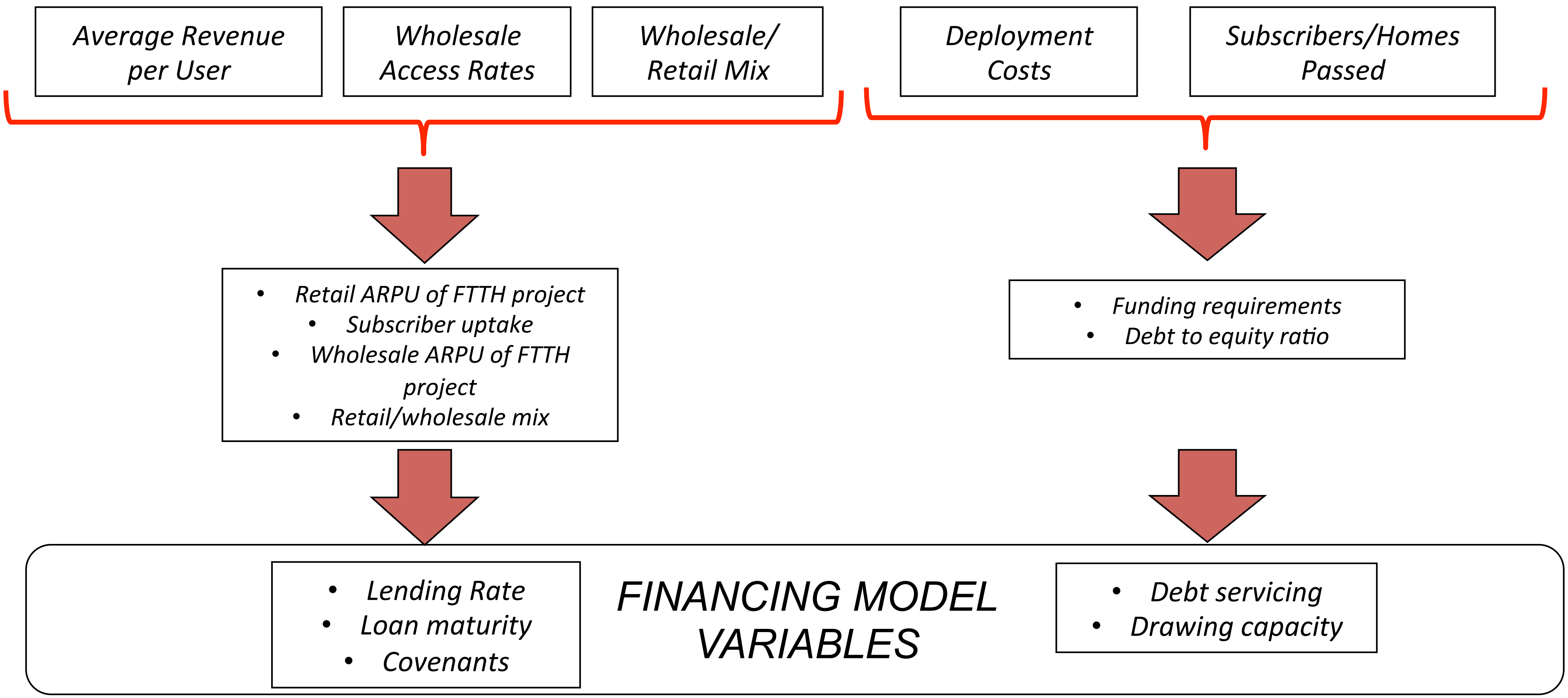
Investment Model

1. *Average revenue per user*
2. *Wholesale access rates*
3. *Wholesale/retail mix*
4. *Deployment costs*
5. *Subscribers/homes passed*

Financing Model

1. *Sources of funds (equity, public funds, debt)*
2. *Financial investors (institutional, banks, venture capitalists, angel investors, governments)*
3. *Lending terms (limited or non recourse, rate and tenor, seniority, collateral, covenants)*

Investment model drives financing model



Pros and Cons of Municipal NGN Models

Model	Description	Advantages	Disadvantages
1. Direct Subsidy	• Public funds pay for FTTH project for an open access business model	• Local government retains ownership of infrastructure • Local government can ensure own needs are covered	• Ongoing financing required • Continued reliance on state aid • Public sector assumes market risk • Competitive encroachment could erode project viability
2. Local Investment	• Local government invests as would a private player in a private venture deploying the infrastructure	• No state aid • Local government bears the failure risk alone • More lenient credit terms (rates, maturity) based on municipal profile	• Need to rely on public funds to invest • Risk of impacting local taxes • Potential competitive retaliation • Highly dependent on income and density/distribution of population
3. Private credit financing	• Same as above, but funds borrowed from private sources • Service revenues are earmarked to service debt	• No impact on taxes • Does not need to reach critical mass in order to qualify for EIB support	• Potentially, but not necessarily, worse credit terms than from public sources • Forces a period of full service ran by local government • Risk of bankruptcy unless favorable covenants are negotiated
4. Public /Private credit financing	• Similar as above, but funds borrowed from public and private sources	• Private lenders tend to follow the more lenient credit terms of public sources, sometimes enabled by partial risk guarantees • No impact on local taxes	• Borrowing from private sources could be affected by restricted access to capital

Pros and Cons of NGN Public Private Partnerships Models

Model	Description	Advantages	Disadvantages
1. Debt-facilitation model	• Public entity facilitates access to tax-exempt financing • No commitment to use public funds	• No public funds are placed at risk	• Potential misalignment of objectives between parties • Limited leverage of public party capabilities (ROW, facilities)
2. Debt-guarantee model	• Government guarantees debt, secured by private party	• Access to better financial terms of debt	• Public funds are placed at risk
3. Public service delegation	• Private player deploys FTTH network with or without partial public subsidy • Player has a concession to resell the passive or active layers to service providers	• Risk is assumed by outside player	• Subsidy is needed to attract the concession holder • Lack of commitment of project sponsor might result in service failure

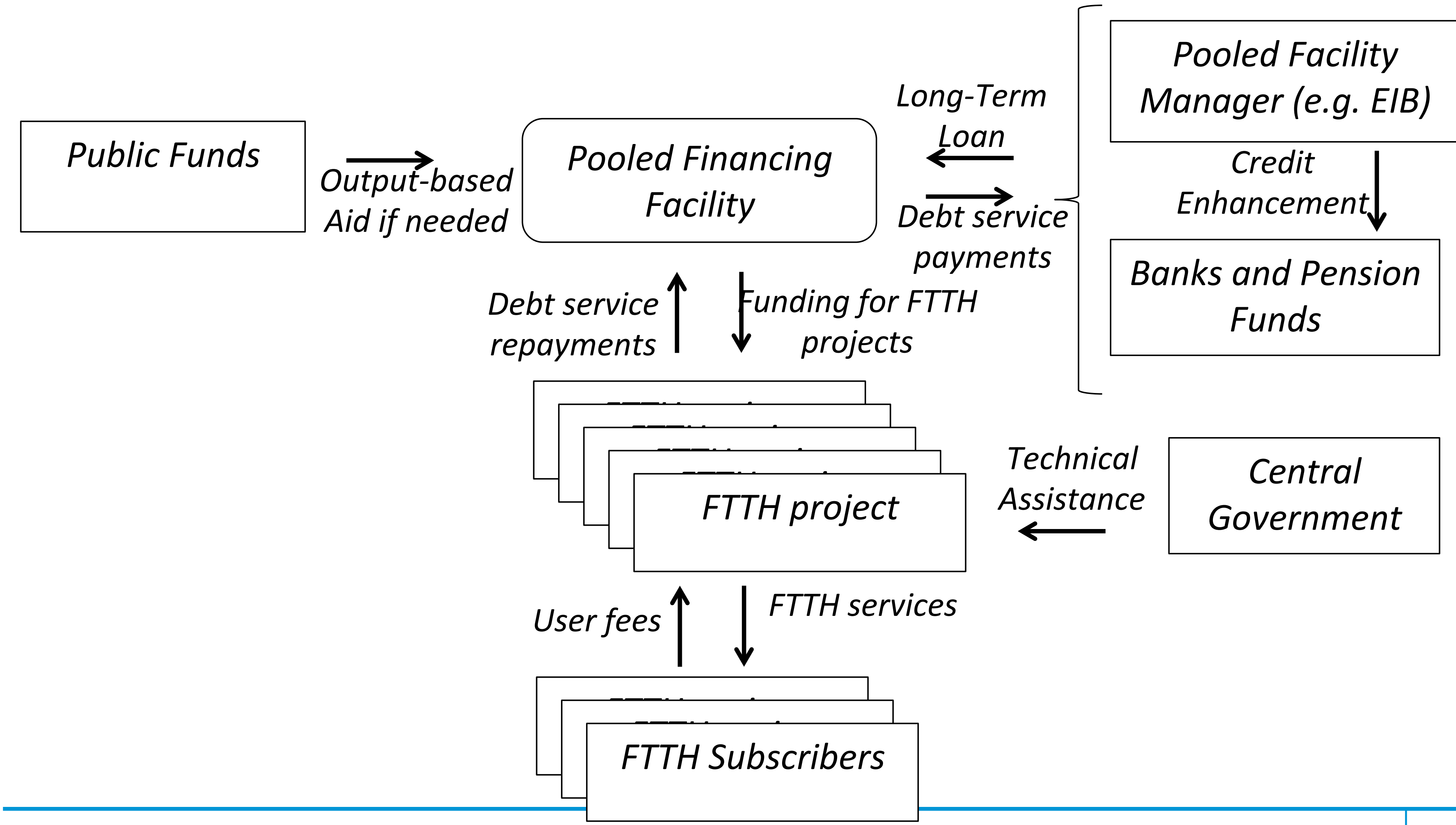
NGN Financing Models have to be selected carefully

<table>
<tr><th colspan="2" rowspan="2"></th><th colspan="3">Geographic Mix</th></tr>
<tr><th>Urban</th><th>Sub-urban</th><th>Rural</th></tr>
<tr><th rowspan="4">Financing Strategies</th><th>Municipal/ Regional</th><td colspan="2">• Municipality as an investor</td><td>• Public/private credit financing</td></tr>
<tr><th>Public Private Partnerships</th><td></td><td></td><td>• Public service delegation</td></tr>
<tr><th>Operator-funded</th><td colspan="2">• Incumbent funded
• Joint venture
• Multi-fibre</td><td>• Cost sharing model</td></tr>
<tr><th>Operator-funded and public policy stimuli</th><td></td><td colspan="2">• Public funding program</td></tr>
</table>

Consider Pooled Financing Approaches for small NGN Projects

- Pooled facility to finance multiple small projects, with several lenders taking their pro rata exposure to each of the projects
- Target size of each facility: US$ 20 million, sufficient to handle 5-6 small NGN projects
- Projects would be majority-owned by public sector sponsors, although the private sector could have an ownership stake
- Facility will have the support from a public lender, which would provide credit enhancements, such as loan guarantees equal to 50% of the total amount
- The pooled facility will be ring fenced
- Projects could apply, through the pooled facility, to receive output-based aid from public funds
- Each project will be structured using a project finance approach
- Project sponsors will develop the NGN projects with technical and operational assistance provided by government entities

Structure of Pooled Financing Facility



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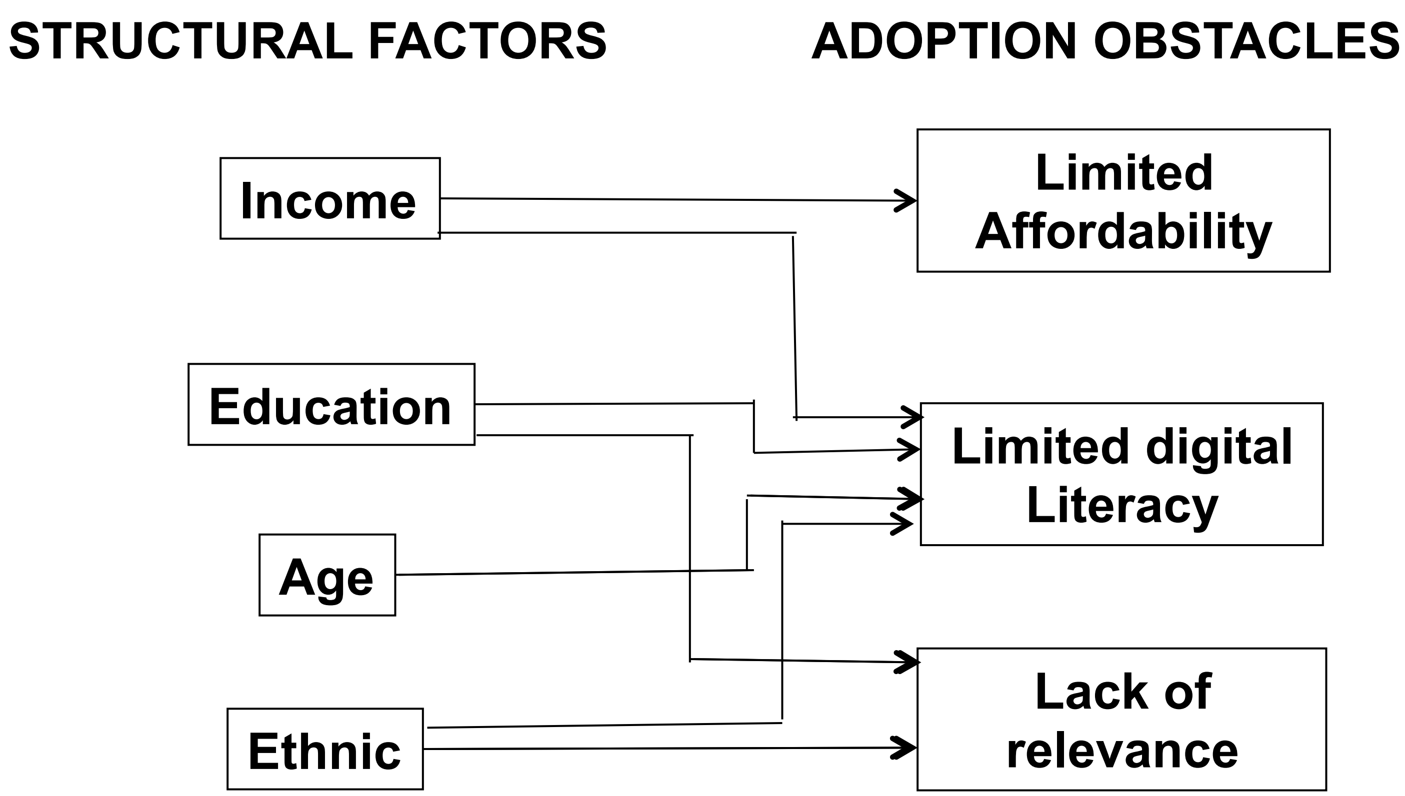
Residential broadband adoption tends to proceed along three clearly defined stages

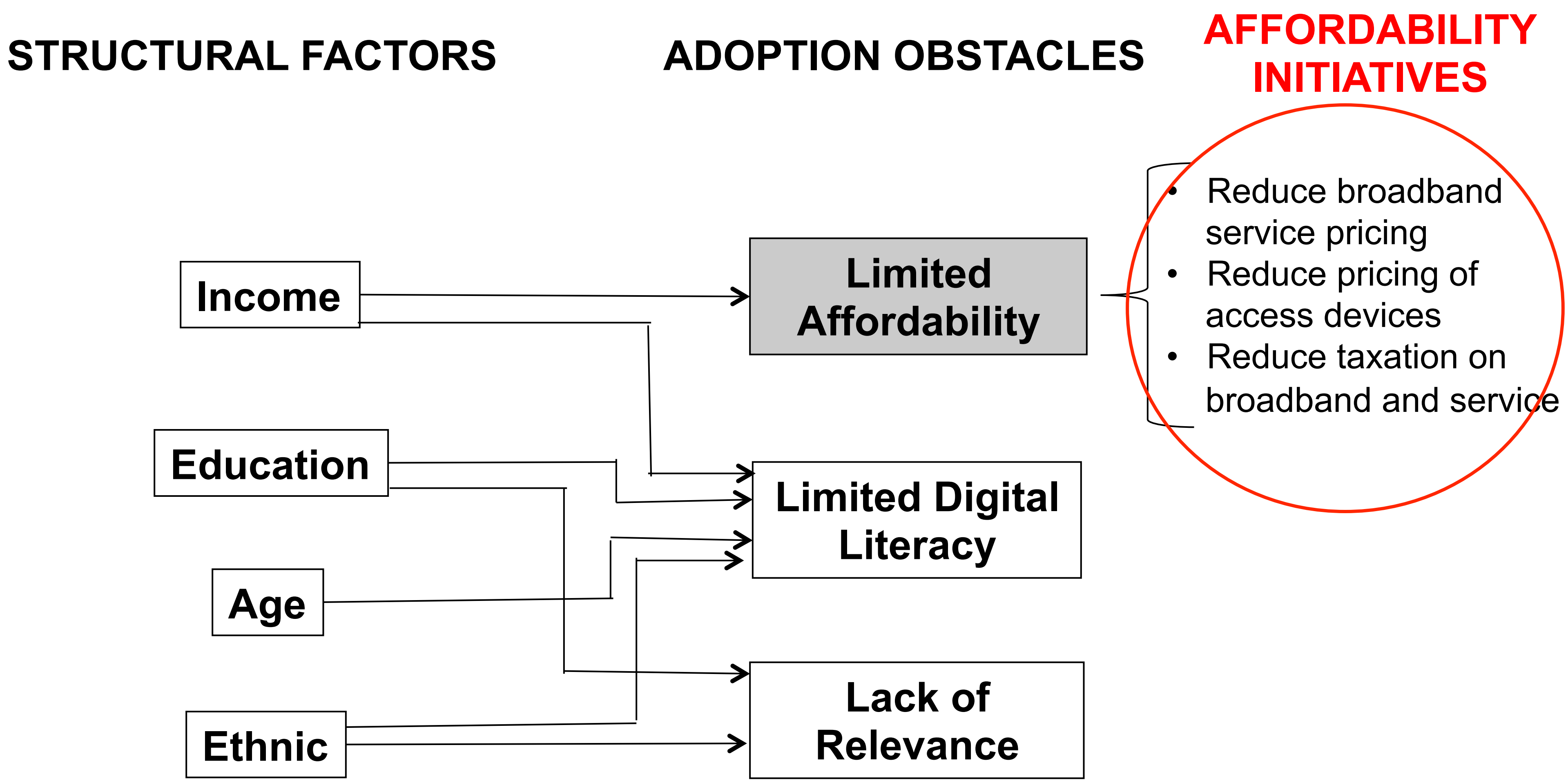
Stages of Broadband Adoption

	Stage 1	**Stage 2**	**Stage 3**
Broadband population penetration	<3%	3% - 20%	>20%
Ownership of access devices (computers, smartphones)	Low adoption	Medium adoption	High adoption
Availability of web applications and services	• Very low	• Limited	• High
Factors driving non-adoption	• Service coverage	• Affordability	• Digital Literacy • Cultural relevance

The broadband demand gap is in general the result of three obstacles

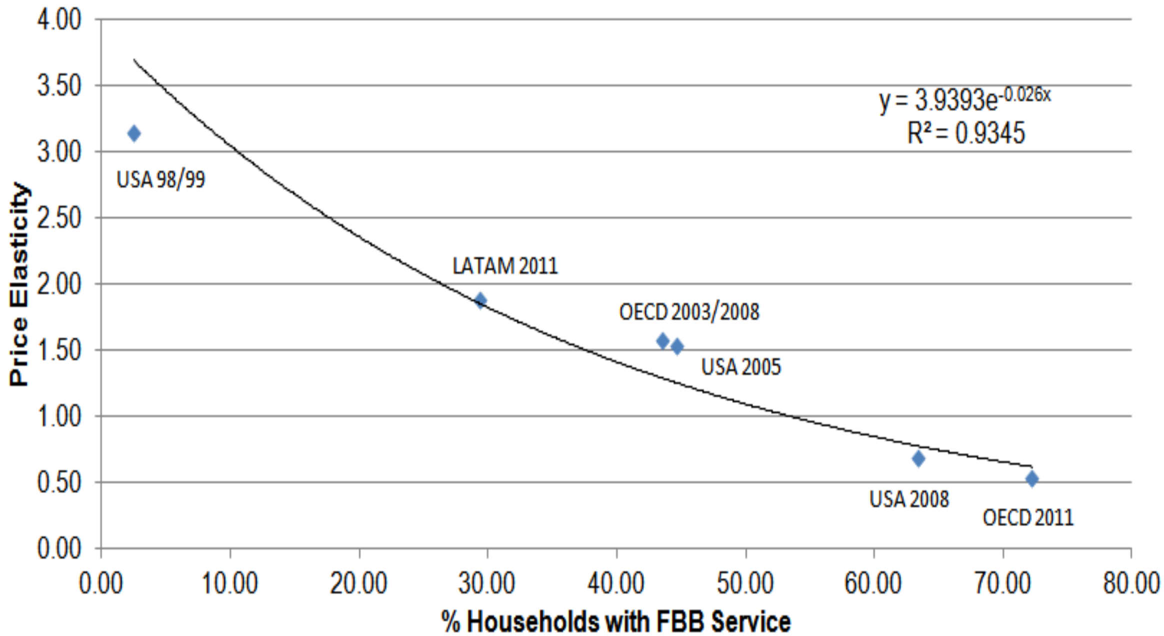


Addressing the affordability barrier of NGN requires putting in place three types of initiatives



Broadband elasticities, identified at lower service levels, should exist within NGA as well

CORRELATION BETWEEN FIXED BROADBAND PRICE ELASTICITY AND SERVICE PENETRATION

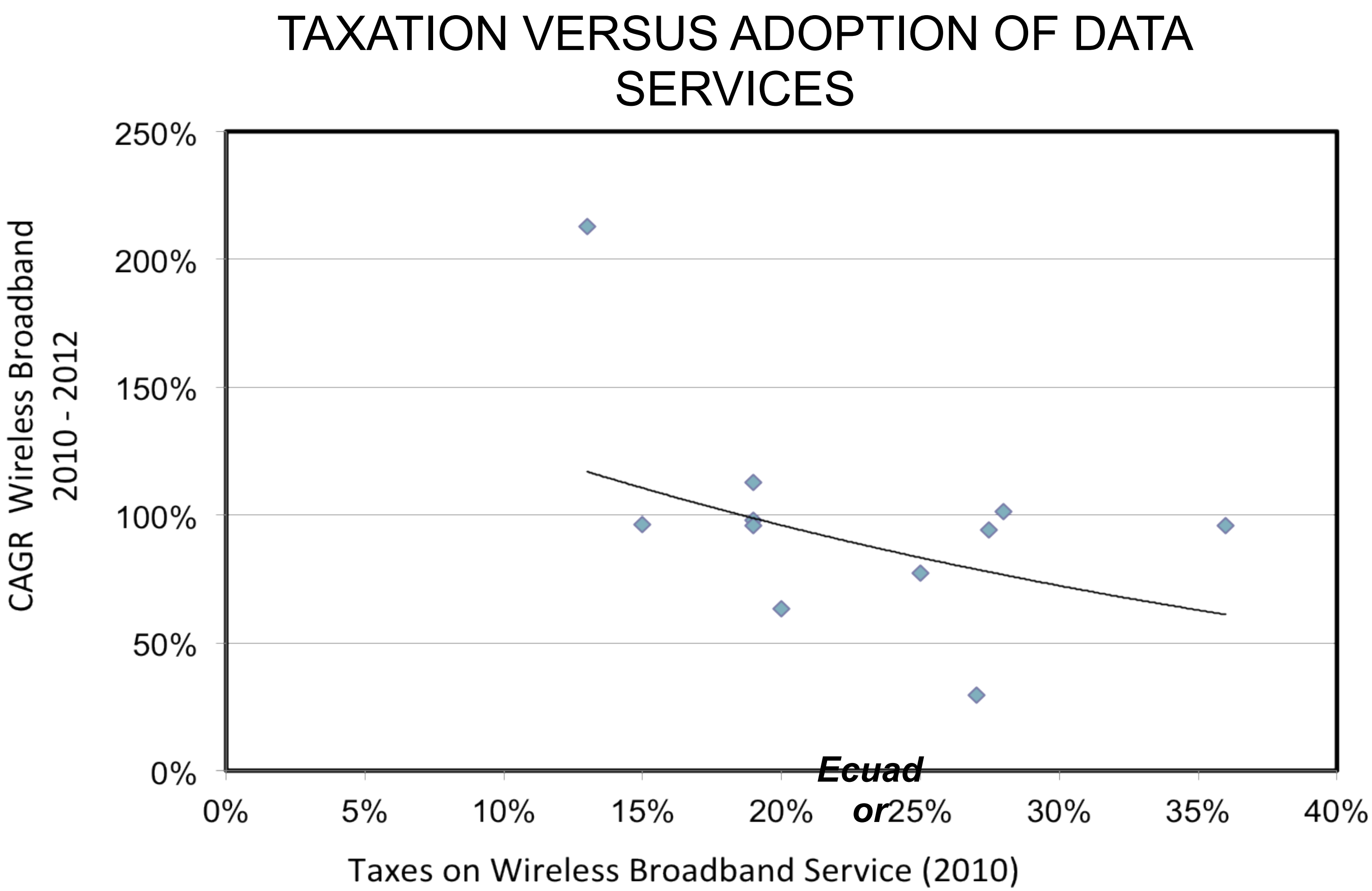


Source: Estimates by the author based on research literature

MOBILE BROADBAND: PRICE ELASTICITY COEFFICIENTS FOR DIFFERENT PRICE PLANS

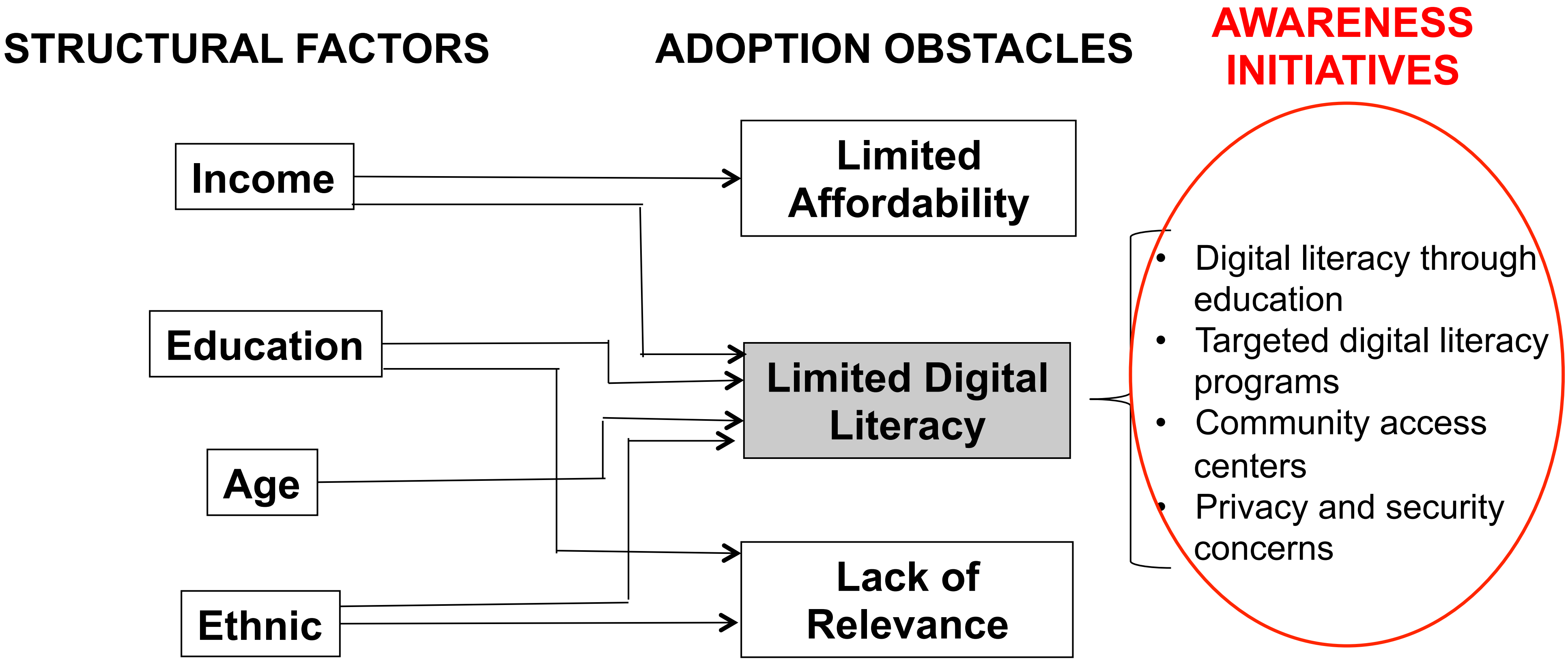
CAP	Handset	Air cards / Dongles
500 MB	-.320	
1 GB	-.305	-.633
2 GB	-.245	-.667
5 GB		-.673

Returning to taxation, an inverse relationship exists between end user taxes and adoption of wireless broadband services

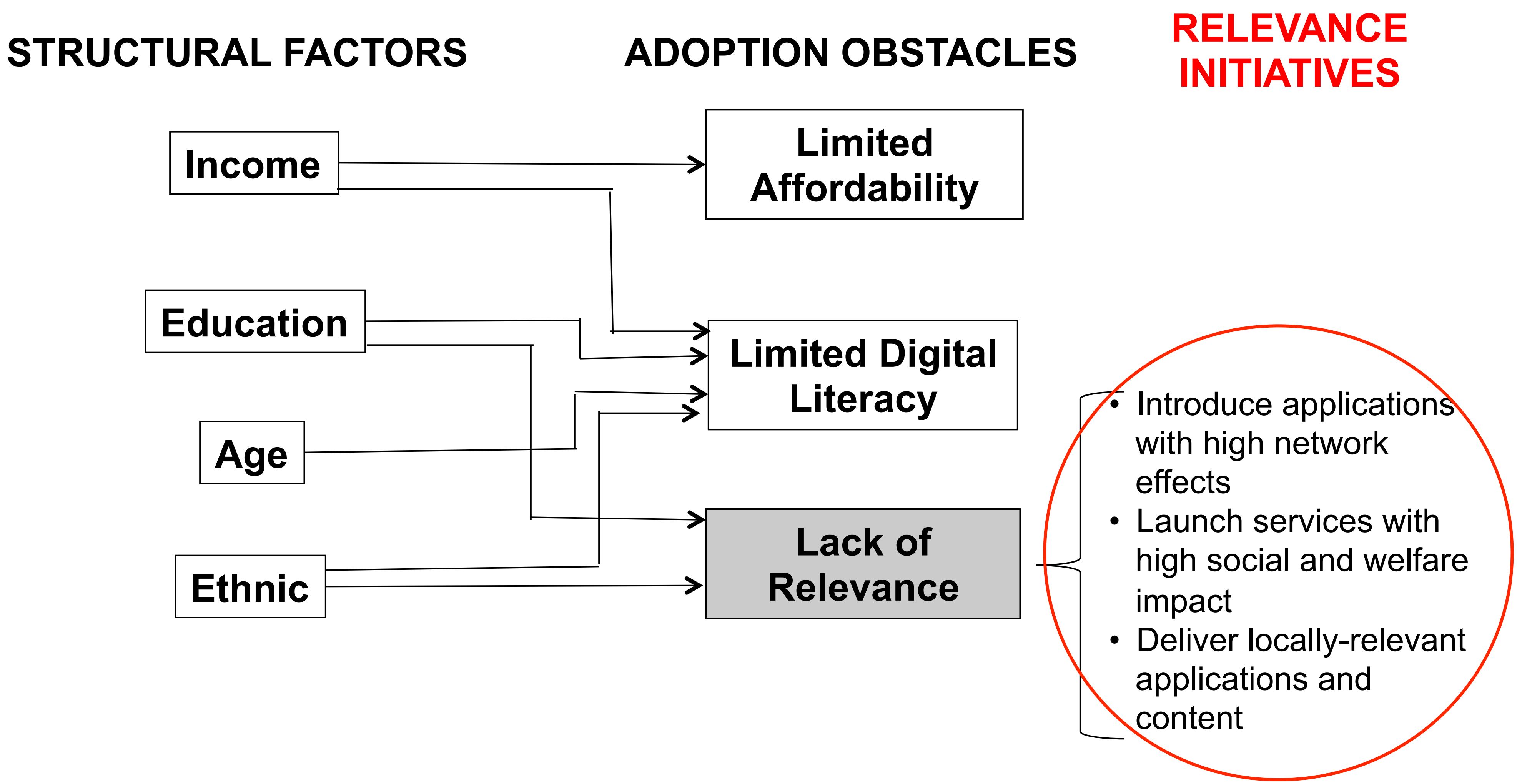


Sources: Katz et al. (2008); Wireless Intelligence

Addressing Digital Literacy for NGN requires developing programs that build an understanding of the service offering



Beyond pricing, NGN demand stimulation centers on enhancing its value proposition around applications



To sum up, it is useful to look within and beyond regulation to increase the likelihood of achieving the DE tragets

- Unless we alliviate regulatory pressure, investment (especially to unserved areas) will not materialize
- Unless we reduce tax burden on equipment purchasing, broadband deployment will be limited (a lesson from the US)
- Unless we change some of the basic assumptions, the FTTH business case is unprofitable
- Unless we modify some financing models, NGN in low density areas will not materialize
- Unless we increase the NGN value proposition, consumer uptake will remain at sub-optimal levels