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Monitoring the Implementation of Broadband Plans

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The development of a Broadband Plan impact system is aimed at *ex ante* assessment as well as *ex post facto* monitoring

- In general terms, nations have some capability to measure results of an ICT policy *ex post facto*
- On the other hand, the capability of conducting an *ex ante* impact analysis is limited
- This creates an important issue given that the cost to the State of misallocated resources or the opportunity cost if the policy fails is quite high
- Furthermore, the creation of a monitoring capability allows for refining or refocusing policies in course of implementation
- This is critical because the margin of error for implementing ICT policies is more and more limited
- The limited availability of data and tools limits the possibility to conduct such analyses

Assessing the Impact of Broadband Plans is a multi-dimensional problem

- To monitor implementation of a Broadband Plan, the monitoring metrics (e.g. targets) have to be defined *ex ante*
- The definition of targets requires the ability to conduct impact assessment to determine:
  - Objectives to maximize (Social welfare? Economic impact? Focus on regional engines of growth? Focus on isolated and rural areas? Increase government efficiency? Focus on small and medium enterprises?
  - What is the expected payback (e.g. Impact) of each strategy?
  - Under a limited resource context, how do we manage trade-offs?
- Once the targets are defined, and the Plan is launched, the issue is to determine how do we measure fulfillment?
  - Is data available? If not, can it be imputed?
  - How do we normalize it to allow for robust estimations?
  - How do we build the technical and human capability to conduct the monitoring?
- Based on the monitoring process, how do we feed results back into the policy-making process?
  - Fine-tunning and realignment
  - Accomodate for changes in the environment (e.g. Technology)

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The definition of Broadband Plan targets is typically conducted without rigorous analysis: example of broadband speeds

TARGETS OF COVERAGE AND DOWNLOAD SPEED FOR NATIONAL BROADBAND PLANS

COUNTRY	Coverage Targets (as a percent of households)	Speed Targets (as a percent of households)
United States	100 % (2012)	• 4 Mbps (100%) (2012) • 50 Mbps
Germany	100 % (2014)	• 1 Mbps (100%) (2014) • 50 Mbps (75%) (2014)
Singapore	100 % (2012)	• 100 Mbps (95%) (2012)
Australia	100 % (2012)	• 12 Mbps (100%) (2012)
United Kingdom	100 % (2012)	• 2 Mbps (100%) (2012)
Malaysia	75 % (2010)	• (33%) 50-100 Mbps • (42%) 1.5 Mbps
Brazil	50% urban households and 25% rural households	• 75% (512-784 kbps)
European Union	100 % (2013)	• 30 Mbps (100%) (2020) • 100 Mbps (50%) (2020)

Sources: National Broadband Plans

Furthermore, target definition rarely decouples social versus economic objectives, or supply and demand goals

- Social objectives focus on rural/isolated areas, and bottom of the socio-demographic pyramid population (affordability, digital literacy, content and applications)
- Welfare objectives focus on efficiency of the delivery of public services (education and health)
- Economic objectives focus on economic growth, development clusters, small and medium enterprise technology assimilation
- Supply targets address coverage and speed
- Demand targets tackle adoption (service acquisition) and use (what users do with broadband)

First, it is critical to differentiate between social and economic targets for broadband supply and demand

TARGET DEFINITION FRAMEWORK

		Type of Target	
		Supply (scope: service coverage)	**Demand** (scope: broadband adoption)
Perspective	**Social** (objective: Universalization)	Reach universal coverage (I)	Achieve, at least, a penetration consistent with economic development level (II)
	Economic (objective: maximize impact)	Focus deployment of networks and services in areas of high economic impact (III)	Increase technology adoption in order to reach multiplying economic impact (IV)

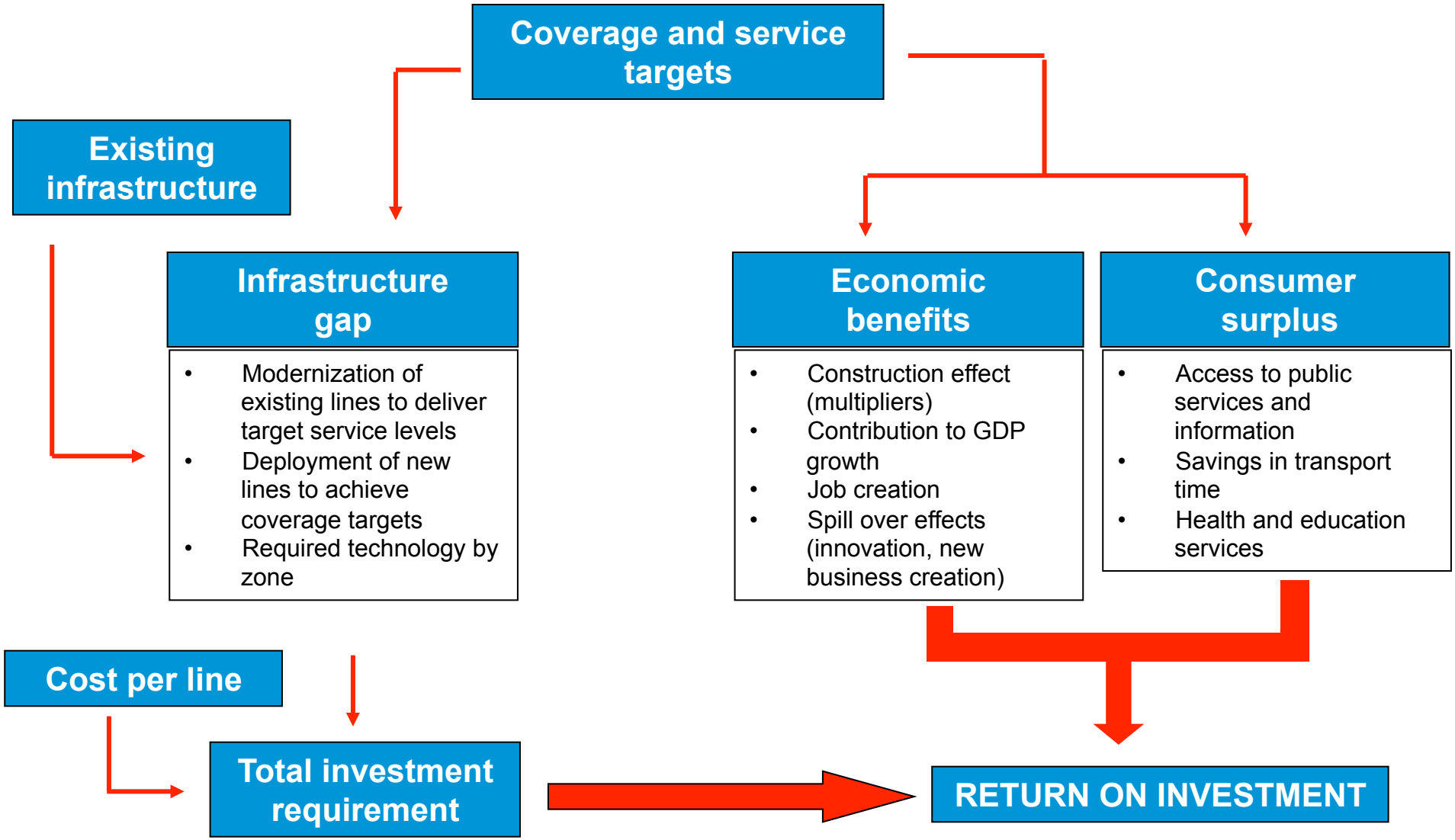
Second, it is important to differentiate entities delivering public services, specifying penetration and speed

EXAMPLE: COSTA RICA BROADBAND STRATEGY
EDUCATIONAL AND HEALTH INSTITUTIONS TARGETS (2016)

Targets	Penetration	Speed
Percent of Universities	100%	20 Mbps-100 Mbps symmetrical
Percent of secondary schools	100%	6 Mbps-20 Mbps download
Percent of primary schools	100%	6 Mbps-20 Mbps download
Percent of research centers	100%	20 Mbps-100 Mbps symmetrical
Percent of public libraries	100%	6 Mbps-20 Mbps download
Percent of cultural centers	100%	6 Mbps-20 Mbps download
Percent of hospitals	100%	20 Mbps-100 Mbps symmetrical
Percent of clinics	100%	6 Mbps-20 Mbps download

Source: Rectoria de Telecomunicaciones

Third, coverage and service targets need to be defined on the basis of analysis of level of investment and social and economic returns



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- Broadband Plan target definition
- Assessing impact *ex ante*
- Monitoring results *ex post facto*

Assessing impact *ex ante* entails forecasting the expected results of the Broadband Plan policies and targets

- What is the expected economic impact of recommended supply and demand targets?
  - Economic growth
  - Job creation
  - Poverty reduction
- What are the expected social effects resulting from achieving the Broadband Plan?
- What will the resulting industry structure and level of competition be at the completion of the Plan?
  - Impact on quality of service and diversity of offerings
  - Impact on service price decline

Impact analysis *ex ante* brings empirical evidence to the development of National Broadband Plans

- Evidence-based policy is public policy formulated on the basis of rigorously established objective evidence
- Evidence-based policy approaches can be applied to telecommunicactions policy making
  - Tests why a certain policy recommendation is more cost-effective and what the impact of the policy will be if it is successful
  - Includes a counterfactual: what will occur if the policy is not implemented?
  - Incorporates a quantitative measurement of the impact of the policy
  - Examines both direct and indirect effects that occur because of the policy ("Law of unintended consequences")
  - Separates the uncertainties and controls for other influences outside of the policy that may have an effect on the result
  - Impact assessment should be able to be tested by a third party
- The overall methodology can be fit under the category of cost-benefit analysis used to estimate a net payoff if the policy is implemented

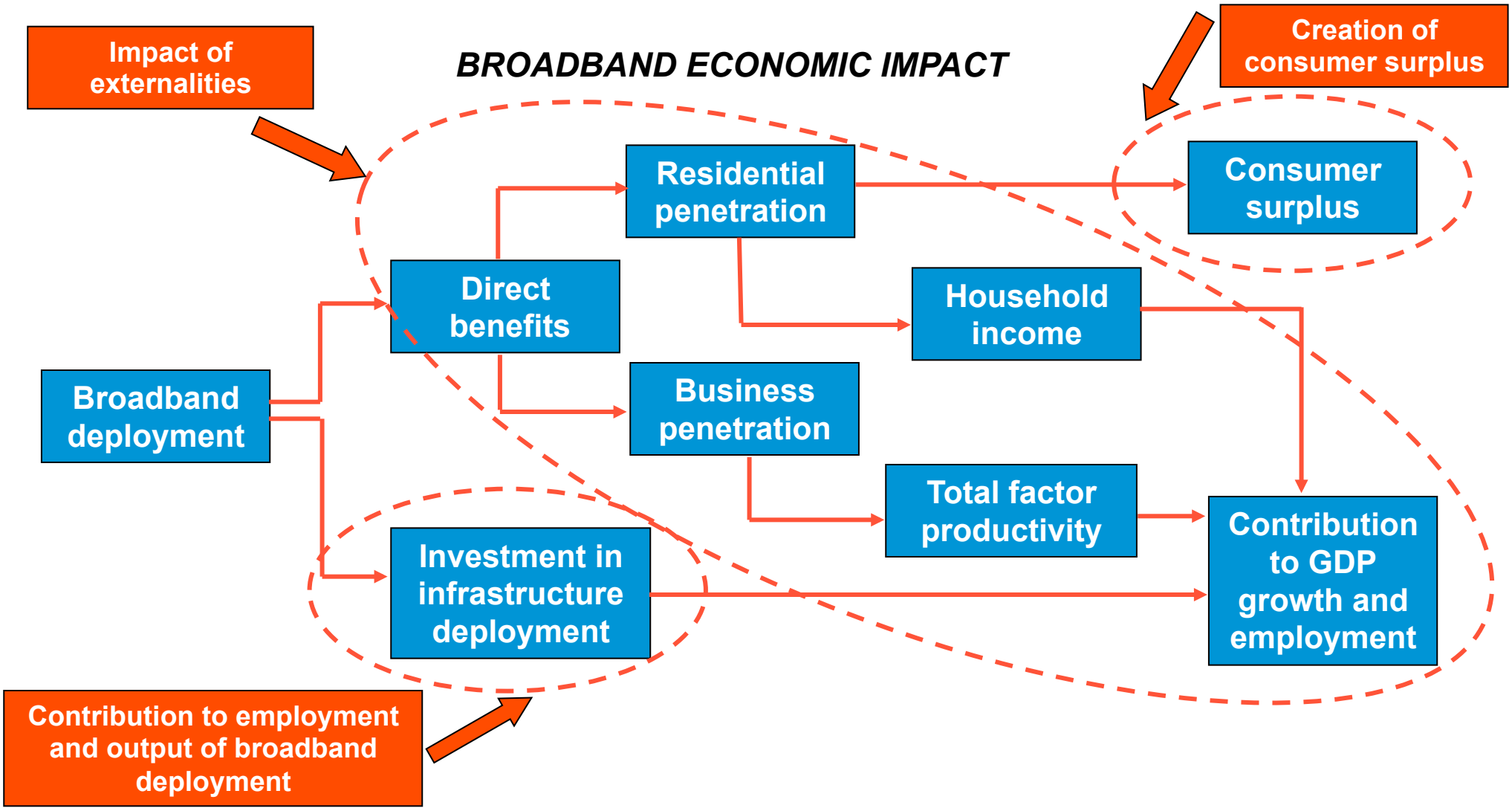
ICT data is the required basis for conducting rigorous policy cost-benefit analysis

- Cost-benefit analysis feeding regulatory decisions requires accurate data
- Limited data introduces considerable "noise" in the analytical process
- Considering the amount of investment in ICT, and their economic impact, the amount of data and analysis leading to decisions is typically sub-optimal
- In our view, given the little data sometimes policy makers have about economic impact of ICT, this is not an issue of how "to optimize regulation under imperfect information", but how do we gain a better understanding of these effects

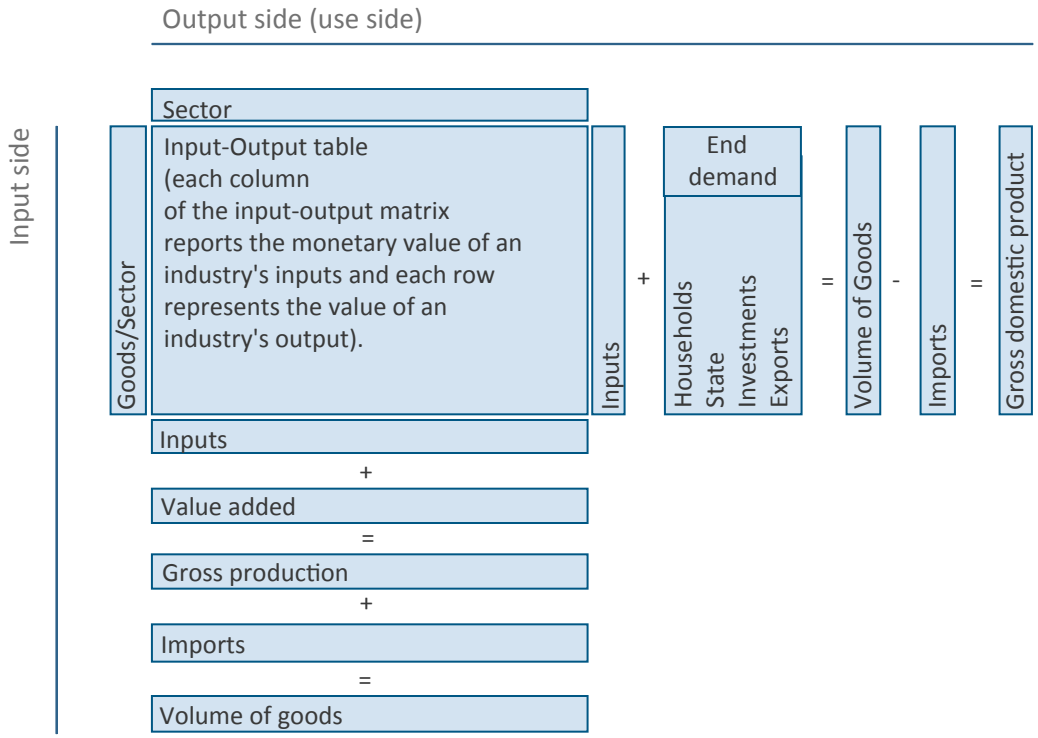
Lack of ICT data fosters policy imitation

- One or more incentives for imitiative behavior can be identified
  - Reduction of uncertainty: the more countries adopt a policy, the higher the value of example
  - Promote reputation
  - **Cost of information: herding allows to short-cut the analytical work or use of rigorous data analysis leading to the formulation of a regulatory model**
  - Learning from opinion leaders: leaders that are outside the country of decision maker increase legitimacy of decision

In order to conduct the economic impact assessment of the Broadband Plan, it is necessary to differentiate among effects



Infrastructure effect: The input/output-matrix assesses the value added of additional demand based on a multiplier



With input-output tables it is possible to calculate the effect of additional investment in telecommunications

The result is a multiplier indicating how much additional value added will be generated due to the fiber deployment.

What measure Multipliers? Multipliers measure the total additional production in the economy due to a unit increase in demand in a specific sector (e.g. construction).

Infrastructure effect: Input-output model in general terms

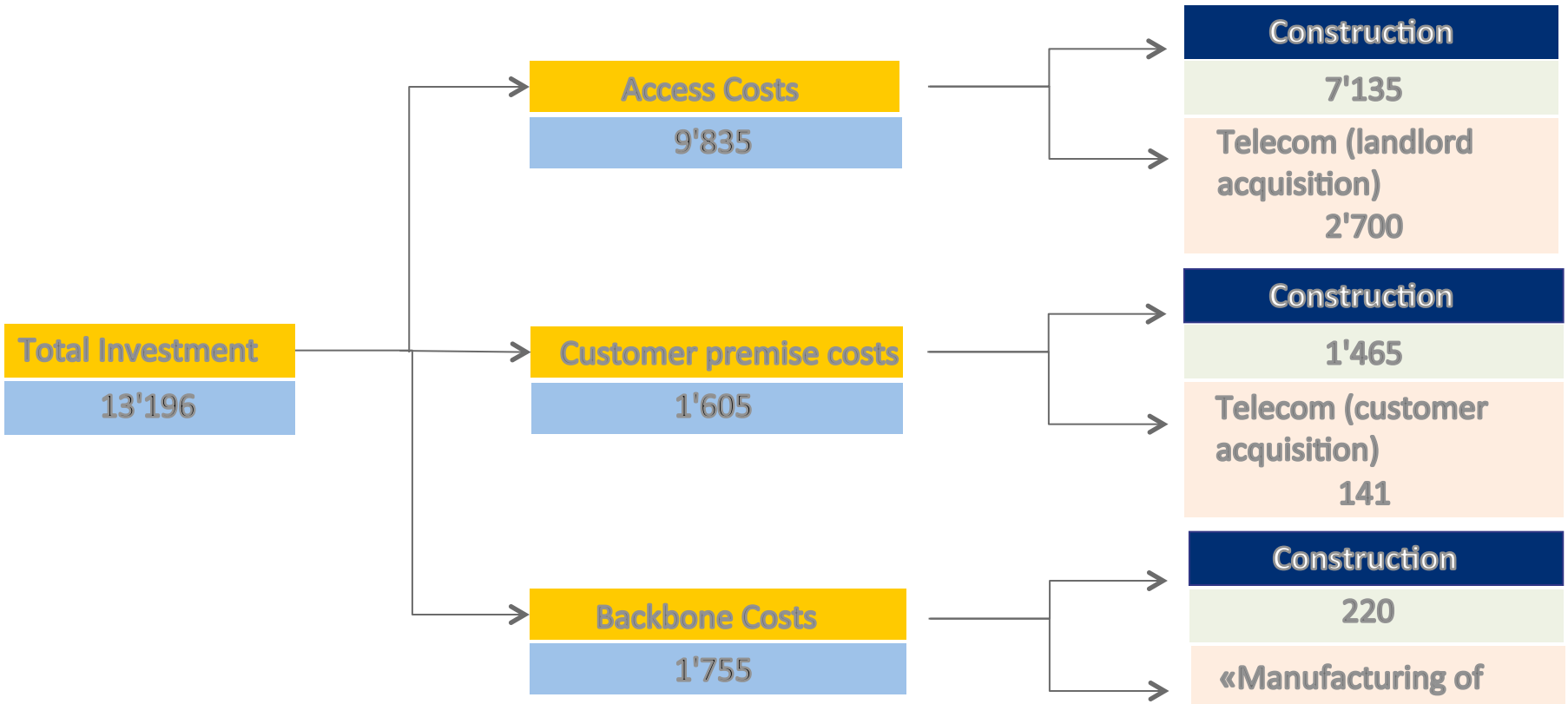
- The input-output model of economics uses a matrix representation of a nation's economy. It is designed to predict the effect of additional demand in one industry (e. g. telecommunications) on others.
- The input-output analysis considers inter-industry relations in an economy. It depicts how the output of one industry goes to another industry where it serves as an input, and thereby makes one industry dependent on another both as customer of output and as supplier of inputs. An input-output model is a specific formulation of input-output analysis.
- The mathematics of input-output economics is straightforward, but the data requirements are enormous because the expenditures and revenues of each branch of economic activity has to be represented.

Infrastructure effect: data to support a quantification of investment (input) and the I-O matrices are required to estimate this

DATA UTILIZED IN INPUT-OUTPUT STUDIES

DATA	REMARKS	AVAILABILITY	RATIONALE
Investment in broadband program	Breakdown of investment by sectors (i.e. manufacturing of electronic equipment, construction, telecommunication)	To be calculated based on benchmarks	This is the investment input that will trigger growth in output and/or jobs
Input-output-table	Requires reformatting to estimate employment effects	To be supplied by government statistical units and/ or Central Banks	Required to understand inter-sectoral relationships
# of employed persons	In the same classification as the input-output-table	To be supplied by government statistical units	Required to calculate employment effects

Infrastructure effect: Example: Total investment in broadband needs to be split across sectors



* Numbers according to operator's cost allocation; we need this split to assign the different industries in the input/output-matrix

Infrastructure effect: the I/O matrix analysis enables the quantification of output and jobs resulting from broadband deployment

EXAMPLE: SOUTH AFRICA CONNECT IMPACT ON JOBS

			INVESTMENT
Investment (Rand in millions)			**65,000**
Employment creation	Direct effect	Jobs in equipment manufacturing, construction and telecoms	227,024
	Indirect effect	Jobs in other sectors	102,161
	Induced effect	Household spending induced from direct/indirect effects	106,701
	Total effect	**Jobs in all sectors**	**435,886**
Multipliers	Type I Multiplier	(Direct + indirect)/direct	1.45
	Type II Multiplier	(Direct + indirect + induced)/ direct	1.92

Sector	Effect
Electronics equipment	47,989
Construction	131,360
Communications	47,675
Total	227,024

Sector	Effect
Distribution	15,396
Finance	4,461
Metal products	6,907
Electrical Eq.	4,604
Other services	24,461
Other	46,332
Total	102,161

Source: Methodology reviewed in Katz (2012)

Note: The estimation was made using the input/output matrix of United States. Then the results are corrected using the added value of South Africa in relation to the United States (32.42% vs 56.17%)

Externalities: The impact of broadband as a general purpose technology can be understood at three levels

EFFECT	DESCRIPTION	EMPLOYMENT EXAMPLES
Productivity	• Improvement of productivity as a result of the adoption of more efficient business processes enabled by broadband	• Marketing of excess inventories • Optimization of supply chains
Innovation	• Acceleration of innovation resulting from the introduction of new broadband-enabled applications and services	• New applications and services (telemedicine, Internet search, e-commerce, online education, VOD and social networking) • New forms of commerce and financial intermediation
Value chain recomposition	• Attract employment from other regions as a result of the ability to process information and provide services remotely	• Outsourcing of services • Virtual call centers • Core economic development clusters

Externalities: data requirements for econometric analysis of externalities include both ICT and economic

DATA UTILIZED IN ECONOMETRIC STUDIES

DEPENDENT VARIABLES	INDEPENDENT VARIABLES	CONTROL VARIABLES
•Annual or quarterly rate of change of GDP •Annual or quarterly rate of change of employment •Annual or quarterly rate of change of unemployment •Annual number of SME's	•Annual or quarterly rate of change of broadband penetration	•GDP at starting time of period •Level of education: Percent of population with tertiary degrees; Illiteracy rate; Years of schooling; participation rate in secondary school •Regional Investment as percentage of regional GDP •Percent of households with electricity or running water •Number of projects and added value of construction projects financed by the state •Number of hospitals per inhabitant; number of beds in hospitals per pop. •Access to financial services: Number of banking offices and bank credit p.c. •Industry concentration: Contribution of financial services, commerce and manufacturing sectors to regional GDP •Importance of tourism in the region (number of domestic tourism trips) •Cost index for interstate trade costs •Cost to create new business •Regional Gini Coefficient •Percentage of people living in urban centers •Total road length per hundred sq. Km by area; Road development index •Population growth rate •Globalization Index; Globalization Index per region

Network effects: The impact of broadband externalities is measured through a structural model

EXAMPLE: PANAMA ECONOMIC IMPACT OF BROADBAND

Variable	Explanation	Source
GDP	Gross Domestic Product in constant USD (2000)	World Bank
GDPC	Gross Domestic Product per capita in constant USD (2000)	World Bank
K	Gross fixed capital formation in constant USD (2000)	World Bank
L	Labor force with secondary education	World Bank
BB_Pen	Fixed broadband penetration (in 100 people)	World Bank
BBPr	Fixed broadband price per month	Local Operators (CW Panama)
BB_Rev	Fixed Broadband Telecommunications revenue	ITU
Urb	Urbanization	World Bank

Variables	**Fixed Broadband Model**
Growth (GDP_{it})	
Labour force (L_{it})	1.148***
Fixed Capital Stock (K_{it})	0.234***
BB Penetration (BB_Pen_{it})	0.045***
Constant	-
Demand (BB_Pen_{it})	
BB. Price ($BBPr_{it}$)	-2.121***
GDPC ($GDPC_{it}$)	2.443***
Constant	-18.536**
Supply (Mob_Rev_{it})	
GDPC ($GDPC_{it}$)	0.556***
Urbanization (Urb_{it})	0.374***
Constant	13.910***
Output (ΔBB_Pen_{it})	
BB Revenue (BB_Rev_{it})	4.606***
Constant	-95.451***
Year Effects	YES
Obs	40
R^2	(1)
Growth	0.99
Demand	0.92
Supply	0.97
Output	0.40

Source: Katz and Koutroumpis (2012)

Consumer surplus: this approach can be used either historically or forward-looking

HISTORICAL STUDIES	FORWARD-LOOKING
Greenstein and McDevitt (2009) analysis of broadband bonus in the United States	Crandall and Jackson (2001) analysis of consumer surplus generated by broadband adoption in the United States
Greenstein and McDevitt (2010) comparative analysis of consumer value generated by broadband diffusion in China, Mexico, Spain, Canada and the United Kingdom: **scale of value creation is proportionate to deployment**	Katz et al. (2008) comparative analysis of consumer surplus to be generated in Switzerland by alternative fiber deployment strategies: **consumer surplus is maximized in competitive models that promote infrastructure based competition**

Advantages and disadvantages of each methodology

	ADVANTAGES	DISADVANTAGES
Input-output analysis	• Easy to communicate • Based on proven interlinks	• Static models • Numerous caveats on induced effects • Dependent on up to date I-O matrices
Econometric analysis	• Ability to link projections of broadband penetration to growth	• Length of data sets • Data disaggregation
Consumer Surplus	• Useful to calculate economic impact not captured GDP numbers • Results are quite valid in the short run because the analysis assumes stable demand	• Analysis could be conservative because it excludes gains to early consumers, shifts in demand due to GDP growth, falling prices of PCs, etc.

To sum up, data requirements for assessing broadband economic impact range from aggregate macro to the micro-data data

- Disaggregated data for ICT, broadband and economic indicators
  - Increase the number of observations
  - Deal with fixed effects
- Quarterly data
  - Gain better understanding of timing of effects
  - Ability to conduct analysis for monitoring of effects
- Data on broadband download speeds
  - Understand return to broadband speed
  - Frame investment and broadband target requirements
- Data on wireless internet access
  - Capture a growing trend and shift in broadband platform
- Broadband coverage data
  - Understand uptake trends
  - Gain more evidence to support formulation of demand gap policies
- Variables to control income endogeneity (prices, competition, government, investment)
  - Gain better understanding of causality

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The development of a Broadband Plan impact system for monitoring purposes needs to meet six requirements

- Assess the cost-benefit of a successful broadband plan
- Analyze scenarios of expected outcomes if the policy is not implemented
- Be capable of providing a quantitative assessment of the policy impact (jobs created? Improvement in social indicators?)
- Examine not only the direct effects, but also the indirect ones (for example, considering the “law of unintended consequences)
- Identify those factors that can influence policy outcomes, upon which the government does not have adequate control
- Have the capability to support the analysis of independent entity (for validation and replication purposes)

Along those lines, governments need to develop systems oriented to gather data and conduct the policy impact assessment

- This platform needs to be sufficiently flexible to allow multiple types of analysis (social, economic, political)
- Its components are not merely technological; they include the human capability needed to conduct all types of analysis
- The platform needs to comprise the following components:
  - Formal data gathering methodology
  - Data warehouse
  - Analytics team: human capacity to conduct the analysis relying on state of the art econometric and statistical techniques
  - Technology tools
- Of these four components, the most critical ones are the data gathering methodology and the human capacity
- Additionally, since not all analytical options can be defined upfront, it is critical for the platform to preserve a certain level of flexibility

The approach to develop such a system comprises two parallel workstreams

NATIONAL BROADBAND PLAN MONITORING PLATFORM DEVELOPMENT

	Methodology	Deliverables
I. FORMALIZATION OF SYSTEMS REQUIREMENTS	• Analysis of international experience in terms of policy impact assessment • Interviews of local users and information providers • Map requirements and possibility of conducting analysis • Conceptualize data flows from all public and private sources • Data normalization and analytical methodologies	• Functional requirements comprising: – Conceptual map of information sources – Data flows (format and frequency) – Structure of data warehouse
II. PILOT PROJECT	• Select a specific aspect of the National Broadband Plan to be analyzed • Determine information sources and methodology to be utilized to assess the selected policy	• Assessment of progress of selected area • Preliminary prototype of Broadband Plan Monitoring Platform

Example of a pilot project in Colombia: how many jobs has the *Vive Digital* Program created so far?

- Questions to be answered:
  - What has the aggregate impact on job creation of the Broadband Plan been?
  - In what industrial sectors?
  - In what provinces / states?
  - What type of employment?
- Once the questions are defined, data gathering needs to be conducted with all relevant administrations, and private sector
- If information is not available, data “proxies” will have to be specified
- The pilot will serve not only to tackle a critical issue regarding the plan but also as a first step in the development of the monitoring platform

The econometric analysis indicates an impact of broadband deployment in the employment rate of 0.0003 percentage points

EXAMPLE: IMPACT OF VIVE DIGITAL (COLOMBIA) ON JOB CREATION

Crecimiento de tasa de empleo (%)

Variable Dependiente: Crecimiento de tasa de empleo entre 2006 y 2010

Variables Independientes: Crecimiento accesos B.A., PBI 2003 y Crecimiento Población

	Total		Baja Penet.		Alta Penet.
Crecimiento accesos B.A. (%)	0.0003004	**	0.0002951	**	0.0006572
	(0.0001359)		(0.0001547)		(0.0005495)
Crecimiento Población (%)	0.0159829		-0.2538734		0.5937073 *
	(0.5114836)		(0.7899623)		(0.3761862)
PBI 2003 (Millones de Pesos)	0.0053431		-0.1084577		0.0003309
	(0.0077051)		(0.1308956)		(0.0090124)
R^2 ajustado	0.0110		0.0318		0.0338
Prob > F	0.0730		0.0321		0.4351
Número de Observaciones	132		64		68

An increase of 10% in broadband connections increased employment rate in 0.003%

Job creation appears to be concentrated in low penetration departments

While impact appears to be higher in highly penetrated departments, results are not statistically significant

To sum up, developing National Broadband Plan monitoring systems is a critical task

- Necessary input for developing targets
- Critical for assessing trade-offs among objectives to maximize
- Necessary platform to assess progress, refine and/or refocus efforts