Efficiency of Public Promotion Policies and Broadband Diffusion. A Net Neutrality Perspective

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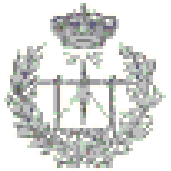
Francesc Miralles
Universitat Pompeu Fabra



Agenda

1. *Introduction*
2. *Main Research Elements*
3. *Governmental activities in promoting broadband dissemination*
4. *Diffusion of broadband networks*
5. *Grouping of countries based on governmental promotional activities and broadband diffusion pattern*
6. *The network neutrality debate*
7. *Conclusions*
8. *Limitations and future research*

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- New high-capacity consuming applications require enhancement of network performance
- Governments and public agencies are focused on the competitiveness of their nations or regions and therefore they feel motivated to promote broadband penetration
- Public promotion initiatives issued by governments have been suggested as one of the key factors in determining the varied penetration rates in the access to established broadband infrastructure.
- Who is going to take care of the new investments to increase network capacity?
- The current fee structure has been told to be inadequate to afford network upgrading

Diffusion of Broadband Networks

- Success factors for broadband uptake have been widely analysed but empirical studies do not provide conclusive results.
- Difficult to find common factors to explain deployment
- Wealth of country and education level are not useful to explain broadband diffusion
- Costs to speed the upgrade: Lock-in and switching costs
- Relative constancy. Consumers can only spend a fraction of their income on Internet services
- Present content doesn't act to persuade consumers to adopt broadband
- Infrastructures are not adequate to provide high quality broadband services

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2. *Focus on Broadband networks*
    1. *Poor understanding of broadband penetration evolution in most of the countries*
    2. *Wide interest in broadband dissemination by most of governmental offices*
3. *Governmental broadband promotion programmes*
4. *Broadband penetration evolution*
5. *Net neutrality*
6. *A segmentation approach to broadband diffusion*

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Research Question

- RESEARCH QUESTION: are there different behaviour patterns in some dimensions of the broadband dissemination evolution process based on broadband penetration and broadband public promotion and taken into account the net neutrality debate?

- GENERAL AIM: if these patterns can be interpreted as sound scenarios and assigned to specific country situations they will be useful in determining how to analyse broadband dissemination in the country and how to approach the net neutrality debate

- NEXT STEP: the validity of these scenarios must be analysed in terms of time evolution

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Governmental Activities in Promoting Broadband Dissemination I

- Public administration are concerned with two main goals in their effort of development of broadband networks:
  - Make broadband access easier and cheaper
  - Accelerate broadband diffusion

- From a more generic point of view, national or regional governments have a strong set of functions in ICT development (*Firth&Mellor, 2005, approach to ICT incubation by Govmnt.)*:
  - Developing a vision and strategy
  - Promoting digital literacy
  - Investing in infrastructure
  - Fostering facilities-based competition.
  - Creating incentives for private investment
  - Offering electronic government services (healthcare, education,…)
  - Promoting universal service through subsidies and grants.
  - Revising and reforming governmental safeguards to promote a high level of trust, security, privacy and consumer protection in ICT services, including electronic commerce.

Governmental Activities in Promoting Broadband Dissemination II

- Public activities on broadband diffusion have been studied from several perspectives:
  - Regulatory activity of the Telco market
    - Example: local loop unbundling (LLU).
  - Intervention in the supply side of the broadband market
    - Main actors in the broadband market:
      - Network operators
      - Service providers
      - Content providers.
    - Infrastructure roll-out and attractive services provision are the most important activity to be developed.
    - The role of governments in this area can have two different focuses:
      - Promoting competitiveness
      - Building public infrastructure.
  - Act as demand stimulators
    - Informing the public about broadband
    - Effective use of broadband connections
    - Creating an environment that fosters broadband innovation
    - Maintaining prices low

Clustering of Promotional Programs I

The programmes collected have been classified according to the different types of intervention (More than one hundred programs have been collected) :

- Overall strategy (Demand stimulation, legal and regulatory issues,Infrastructures roll-out and subsidies and financial support)
- Scope of action (Geographical scope, Services scope and Subjects scope)
- Object of intervention (Rural operators, dark fibre,local or regional networks, wireless network and generic broadband)

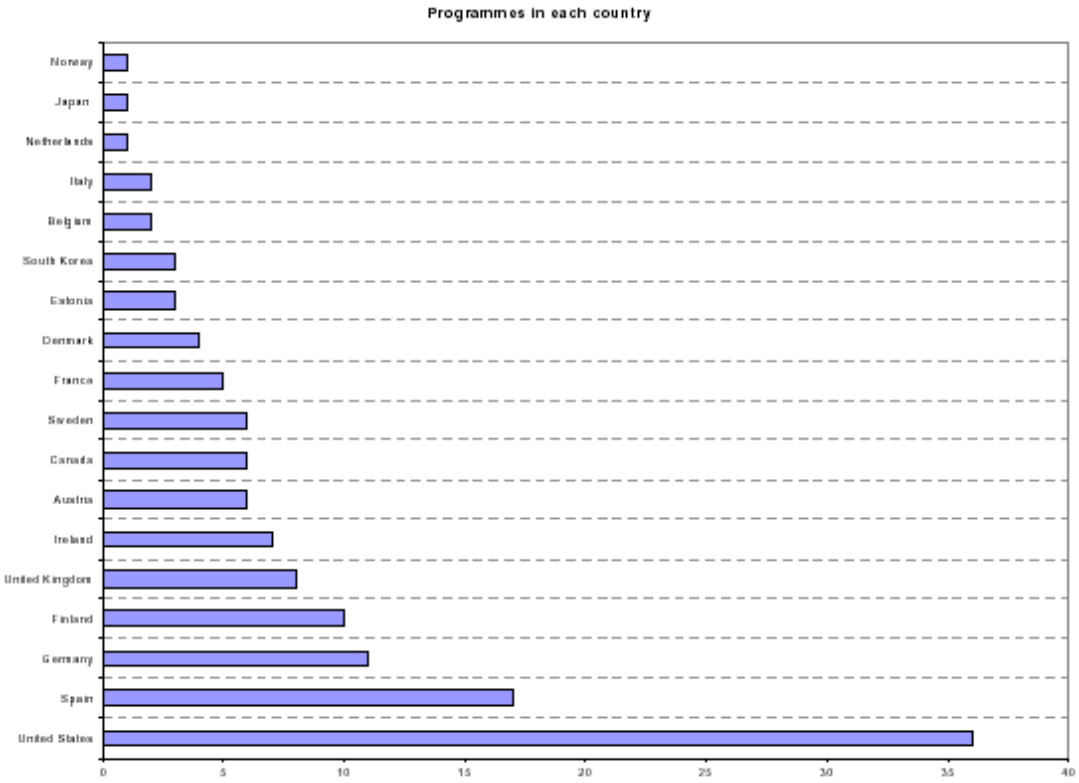
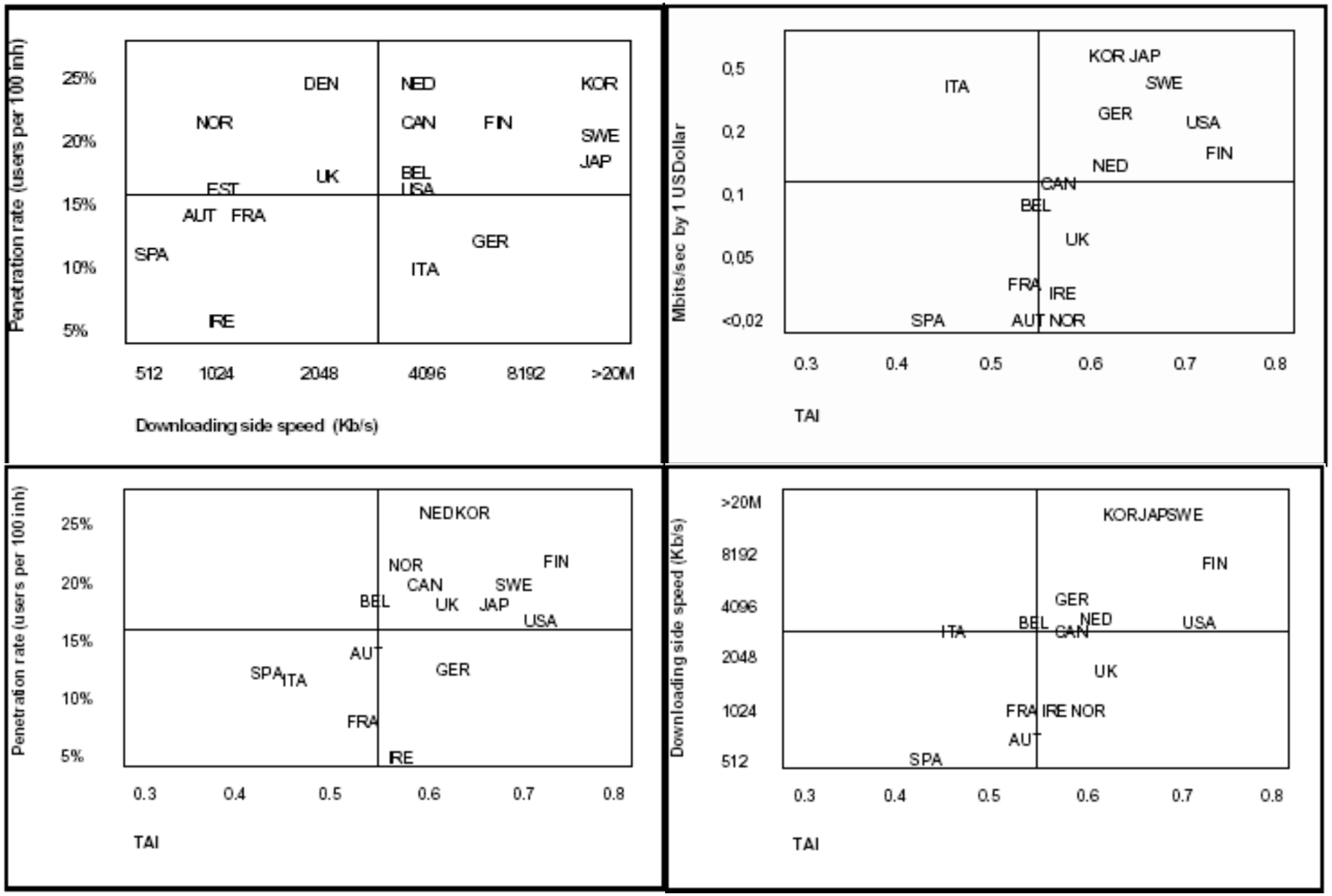


Figure 4.

Clustering of Promotional Programs II



Clustering of Promotional Programs III

- Country behaviour on broadband public promotions can be characterized by five clusters of countries:

TABLE 1	Cluster 1. Information age services	Cluster 2. Demand Stimulators	Cluster 3. Financial support for local and rural networks	Cluster 4. Infrastructure developers	Cluster 5. Subject-oriented
Countries	Denmark, Norway, Finland	Sweden, Italy	Austria, Republic of Korea, USA	Germany, Canada, France, The Netherlands, Ireland and Japan	Belgium, Spain, Estonia, UK
Technological level	High TAI, and High penetration	No specific common characteristics	High TAI	High TAI High GDP	No specific common characteristics
Promotion programs characteristics	Providing services for the information age	Promoting demand stimulation Deployment of infrastructures	Promotion of rural and local initiatives Funding programs	Deployment of infrastructures Specific objects	Giving support to citizens, institutions or companies.

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Broadband Diffusion in OECD Countries I

COUNTRY	y1999	y2000	y2001	y2002	y2003	y2004	y2005	y2006
Australia	0,07	0,39	0,9	1,8	3,5	7,7	13,8	19,2
Austria	0,63	1,7	3,6	5,6	7,6	10,1	14,3	17,3
Belgium	0,5	1,42	4,4	8,7	11,7	15,5	18,2	22,5
Canada	1,9	4,54	8,9	12,1	15,1	17,6	21	23,8
Czech Republic	0	0,1	0,1	0,2	0,5	2,5	6,4	10,6
Denmark	0,22	1,27	4,4	8,2	13	19	24,9	31,9
Finland	0,15	0,58	1,3	5,5	9,5	14,9	22,4	27,2
France	0,08	0,31	1	2,8	5,9	10,5	15,1	20,3
Germany	0,006	0,32	2,3	4,1	5,6	8,4	13	17,1
Greece	0	0	0	0	0,1	0,4	1,4	4,6
Hungary	0	0,03	0,3	0,6	2	3,6	6,3	11,9
Iceland	0	0,7	3,7	8,4	14,3	18,2	26,4	29,7
Ireland	0	0,01	0,1	0,3	0,8	3,3	6,7	12,5
Italy	0,002	0,2	0,7	1,7	4,1	8,1	11,8	14,8
Japan	0,12	0,5	2,2	6,1	10,7	15	17,6	20,2
Korea	0,6	9,2	17,2	21,8	24,2	24,8	25,2	29,1

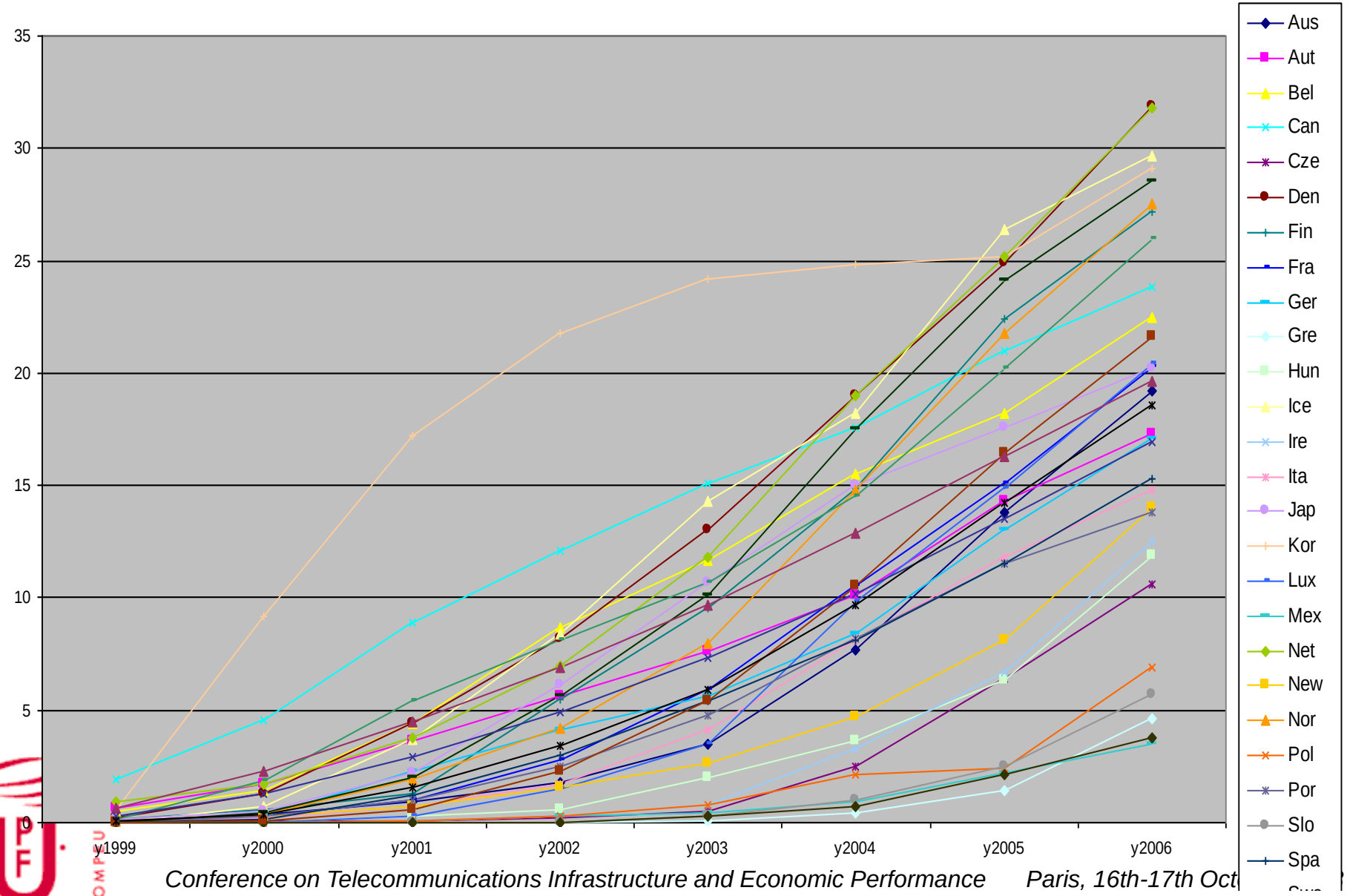
Table 6. Broadband Penetration in home percentage (Source : OECD) (1/2)

Broadband Diffusion in OECD Countries II

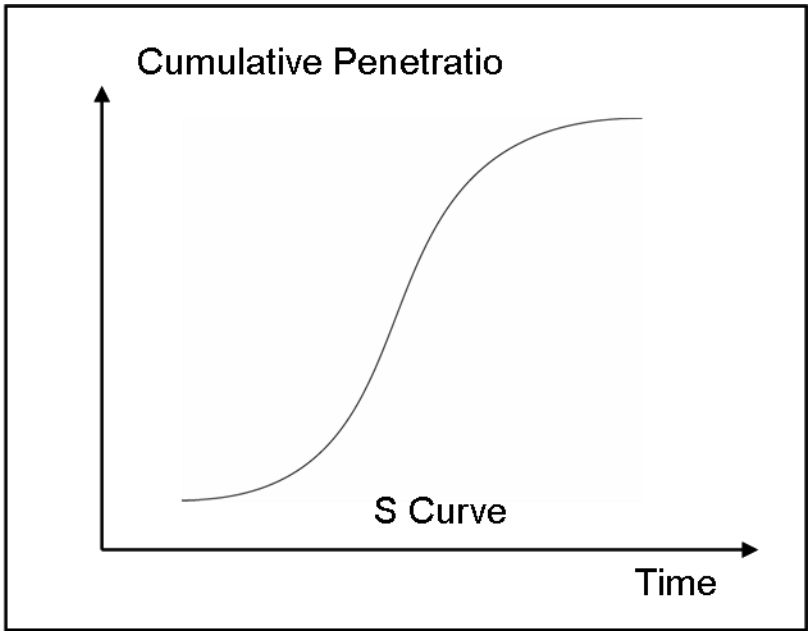
COUNTRY	y1999	y2000	y2001	y2002	y2003	y2004	y2005	y2006
Luxembourg	0	0	0,3	1,5	3,5	9,8	14,9	20,4
Mexico	0	0,02	0,1	0,3	0,4	0,9	2,2	3,5
Netherlands	0,95	1,68	3,8	7	11,8	19	25,2	31,8
New Zealand	0	0,27	0,7	1,6	2,6	4,7	8,1	14
Norway	0,09	0,34	1,9	4,2	8	14,8	21,8	27,5
Poland	0	0	0,1	0,3	0,8	2,1	2,4	6,9
Portugal	0	0,26	1	2,5	4,8	8,2	11,5	13,8
Slovak Republic	0	0	0	0	0,3	1	2,5	5,7
Spain	0,004	0,15	1,2	3	5,4	8,1	11,5	15,3
Sweden	0,12	1,86	5,4	8,1	10,7	14,5	20,2	26
Switzerland	0,001	0,43	2	5,6	10,1	17,5	24,1	28,5
Turkey	0	0	0	0	0,3	0,7	2,1	3,8
United Kingdom	0	0,09	0,6	2,3	5,4	10,5	16,4	21,6
United States	0,65	2,25	4,5	6,9	9,7	12,9	16,3	19,6
OECD	**0,28**	**1,27**	**2,9**	**4,9**	**7,3**	**10,2**	**13,5**	**16,9**
EU15	**0,1**	**0,39**	**1,6**	**3,4**	**5,9**	**9,7**	**14,2**	**18,6**

Table 6. Broadband Penetration in home percentage (Source : OECD) (2/2)

Broadband Diffusion in OECD Countries II



Diffusion Models for Broadband Penetration



Diffusion Models

Bass Model

Logistic Model

$$P(t) = m\frac{1-\exp(-t(a+b))}{1+\frac{b}{a}\exp(-t(a+b))}$$

where

P(t) is the number of consumers that have adopted broadband in a specific country at time t

m is the number of potential adopters in the social system, also known as the saturation level

b is the coefficient of diffusion. In the Bass model is also known as the imitation coefficient

a is the innovation coefficient.

Broadband Diffusion Parameters in OECD I

Country	Saturation	Diff.Coef.	Inn.Coef.	Error (*10^{-3})
Australia	0,245	1,02	0	0,035262
Austria	0,84	0,25	0,013	0,046
Belgium	0,71	0,175	0,029	0,354
Canada	0,511	0,061	0,066	0,091
Czech Republic	0,131	1,441	0,001	0,0067064
Denmark	0,56	0,425	0,026	0,077
Finland	0,338	0,775	0,013	0,183
France	0,275	0,755	0,01	0,0381
Germany	0,64	0,36	0,011	0,0983
Greece	0,225	1,351	0	0,0000368
Hungary	0,451	0,681	0,004	0,029048
Iceland	0,401	0,446	0,067	0,38137
Ireland	0,161	1,431	0	0,075747
Italy	0,17	0,991	0,006	0,00718
Japan	0,21	0,885	0,024	0,0933
Korea	0,191	0,001	0,505	0,67754
Luxembourg	0,241	1,006	0,028	0,1107

Table 7. Parameters of the Bass Model for each country (1/2)

Broadband Diffusion Parameters in OECD II

Country	Saturation	Diff.Coef.	Inn.Coef.	Error (*10^{-3})
Mexico	0,055	1,031	0	0,0041214
Netherlands	0,406	0,713	0	0,0632
New Zealand	0,355	0,739	0	0,038649
Norway	0,35	0,805	0,01	0,0257
Poland	0,541	0,806	0,002	0,11103
Portugal	0,148	1,073	0	0,054464
Slovak Republic	0,134	1,158	0	0,00086251
Spain	0,24	0,57	0,017	0,0337
Sweden	0,88	0,24	0,02	0,214
Switzerland	0,33	0,85	0,13	0,0391
Turkey	0,065	1,125	0	0,0023547
United Kingdom	0,271	0,876	0,016	0,0051285
United States	0,39	0,265	0,039	0,0022
OECD	0,21	0,505	0,036	0,014
EU15	0,28	0,63	0,014	0,00782

Table 7. Parameters of the Bass Model for each country (2/2)

Broadband Diffusion Grouping in OECD I

Country	Cluster	Critical Mass	Saturation	Diff.Coef.
Canada	0	0,04	0,511	0,061
Korea	0	0,16	0,191	0,001
Austria	1	1,16	0,84	0,25
Belgium	1	1,19	0,71	0,175
Sweden	1	1,04	0,88	0,24
United States	1	0,84	0,39	0,265
Denmark	2	1,23	0,56	0,425
Germany	2	1,85	0,64	0,36
Iceland	2	1,43	0,401	0,446
Czech Republic	3	4,75	0,131	1,441
Greece	3	6,19	0,225	1,351
Ireland	3	4,48	0,161	1,431
Mexico	3	5,85	0,055	1,031
Slovak Republic	3	5,67	0,134	1,158
Turkey	3	5,93	0,065	1,125

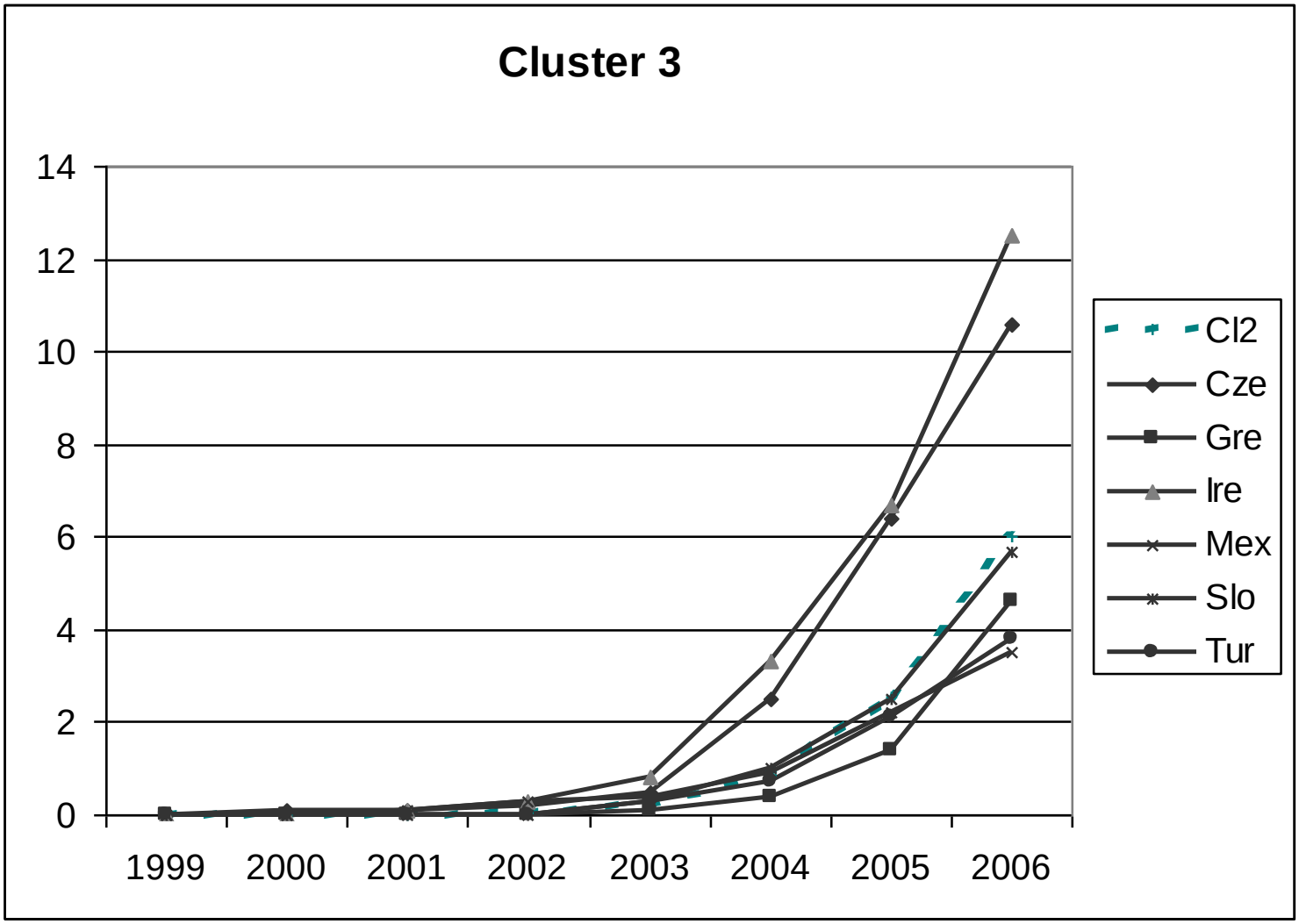
Table 8. Clustering variables for each country (1/2)

Broadband Diffusion Grouping in OECD II

Country	Cluster	Critical Mass	Saturation	Diff.Coef.
Hungary	4	4,00	0,451	0,681
New Zealand	4	3,40	0,355	0,739
Poland	4	4,92	0,541	0,806
Australia	5	3,12	0,245	1,02
Italy	5	3,13	0,17	0,991
Luxembourg	5	3,25	0,241	1,006
Portugal	5	2,67	0,148	1,073
Finland	6	2,17	0,338	0,775
France	6	2,56	0,275	0,755
Japan	6	1,88	0,21	0,885
Netherlands	6	1,15	0,406	0,713
Norway	6	2,04	0,35	0,805
Spain	6	2,44	0,24	0,57
Switzerland	6	2,00	0,33	0,85
United Kingdom	6	2,82	0,271	0,876

Table 8. Clustering variables for each country (2/2)

Broadband Diffusion Grouping in OECD III



Analysis of Broadband Diffusion Grouping

Cluster and Countries	Characteristics		
	"Critical mass" reach year	Average diffusion coefficient growth rate	Penetration rate
0. Canada and Korea	Early 2000	Very low	High
1. Austria, Belgium, Sweden and United States	From late 2000 to early 2001	Low	Between medium-high and high
2. Denmark, Germany and Iceland	Mid 2001	Medium-low	Between medium-high and High
3. Czech Republic, Greece, Ireland, Mexico, Slovak Republic, and Turkey	From mid 2004 to early 2006	Very high	From low to medium
4. Hungary, New Zealand, and Poland	From mid 2003 to late 2004	Medium-high	From low to medium
5. Australia, Italy, Luxembourg, and Portugal	From mid 2002 to early 2003	High	Between medium-high to high
6. Finland, France, Japan, Netherlands, Norway, Spain, Switzerland, and United Kingdom	From early 2001 to late 2002	Medium-high	From medium to high

Table 3. Characteristics of clusters obtained in the analysis of broadband diffusion in each country

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Grouping Interpretation

High penetration rate	Diffusion Coefficient	
Governmental promotion	Low	Medium
Infrastructures	Broadband networks	
	Local, metropolitan and rural networks	
Services	Information age services	
	Support to specific groups of users	

Table 4. Summary of the promotional activity in high penetration rate countries

High Diffusion Coefficient	Penetration rate	
Governmental promotion	Low	Medium
Infrastructures	Broadband networks	
Services		Support to specific groups of users

Table 5. Summary of the promotional activity in high diffusion coefficient countries

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- Most of the definitions proposed for net neutrality work around two main axes
  - Preserving the openness of the Internet so that consumers and content providers can freely access the network in order to access or to provide applications and services
  - This access or provision must be done without the fear that the broadband network provider could deteriorate or degrade the application and services
- Some difficulties in obtainig a framework for agreement in the net neutrality debate
  - Network neutrality has not been soundly defined
  - There is a lack of economic theory to study the network neutrality problem
  - Regulators, network operators, network users, broadband applications and services providers, and Internet service providers (ISP) are the main actors with divergent interests

Research Motivation

- Each country faces a specific situation from the point of view of the net neutrality debate

- This situation can depend (among other factors) on
  - The evolution of broadband penetration (users percentage) and
  - Public broadband promotion attitude

- Net neutrality debate can be forced by the saturation level of broadband network and by the need to face new investments to upgrade the network

- This study drives an exploratory analysis to propose a set of scenarios framed by two factors
  - Broadband penetration rate evolution
  - Public promotion activity in broadband

The focus of our work on Net neutrality

- Dispersion on the level of the net neutrality debate
  - Proponents: “ends”
  - Opponents: “means”

- Multidimensional characteristics of the net neutrality debate: Clear delimitation of each dimension in order to clarify the debate object.

- Two main axes drive our research.
  - 1. Net neutrality has to be seen as a multidimensional problem and therefore it has to be expressed from the perspective of each dimension.
  - 2. Broadband penetration rate in each country will condition the development of the net neutrality debate.

Net Neutrality Dimensions

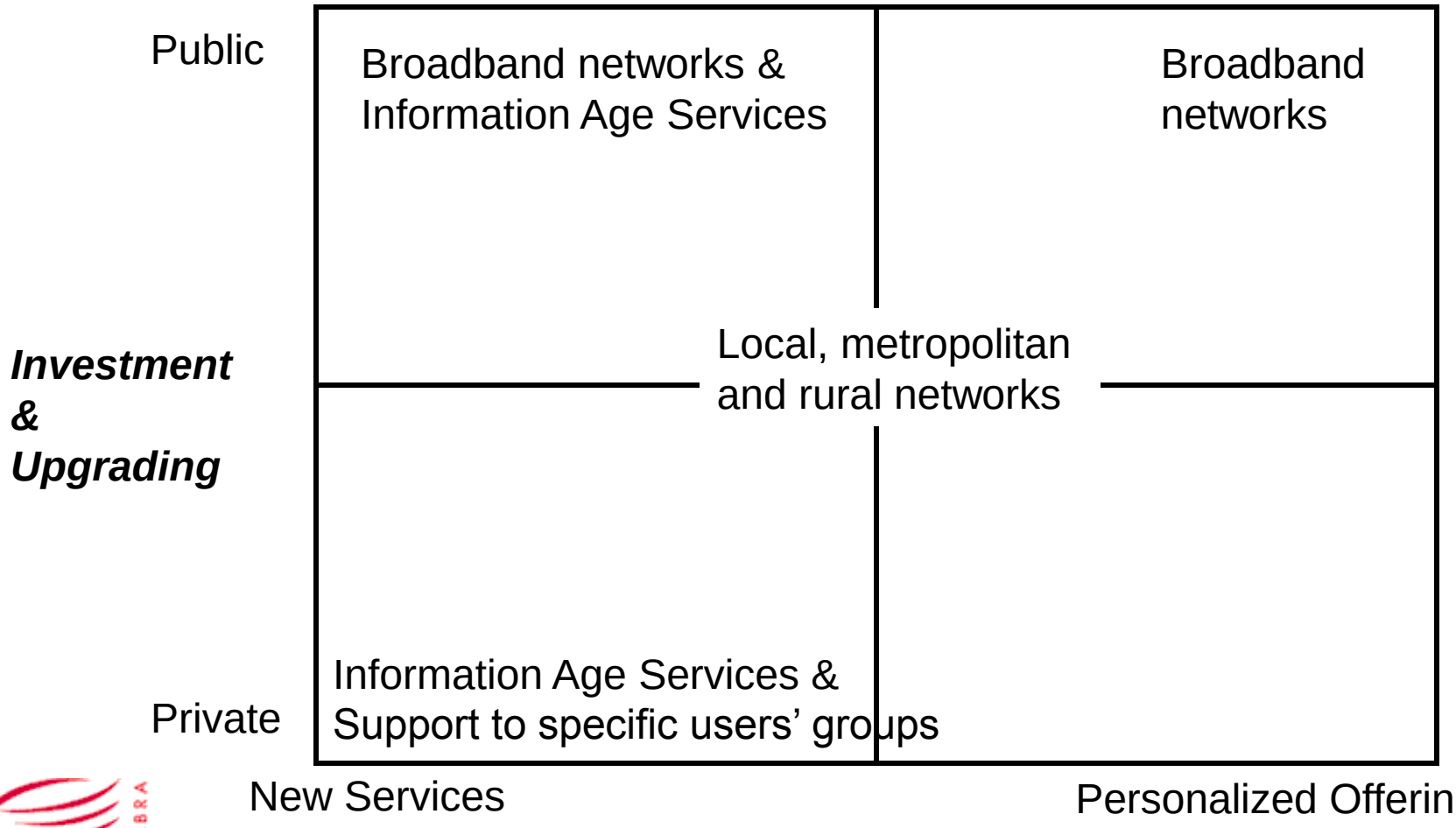
Dimension label	*Proponents' main position*	*Opponents' main position*
Access Control	***Free Access***	***Access Tiering***
Innovation	***Innovation at the edges***	***Innovation at the core***
Vertical Integration	***Dumb pipe***	***Facilities-based compttion***
Classes of applications	***Best effort***	***Bandwidth management***
Invstmnt & Net Upgr.	***Public Network***	***Private Network***
Architectural vision	***Plain packet network***	***Specific treatment for each packet***
Business Interference	***Regulation-based business environment***	***Non-business interfering***
Internet value for customers	***Right to extract the same value***	***Balanced value proposition***
Broadband attraction	***Consumers are attracted by new services***	***Attraction by a personalized offering***

Table 1. List of dimensions in the net neutrality debate

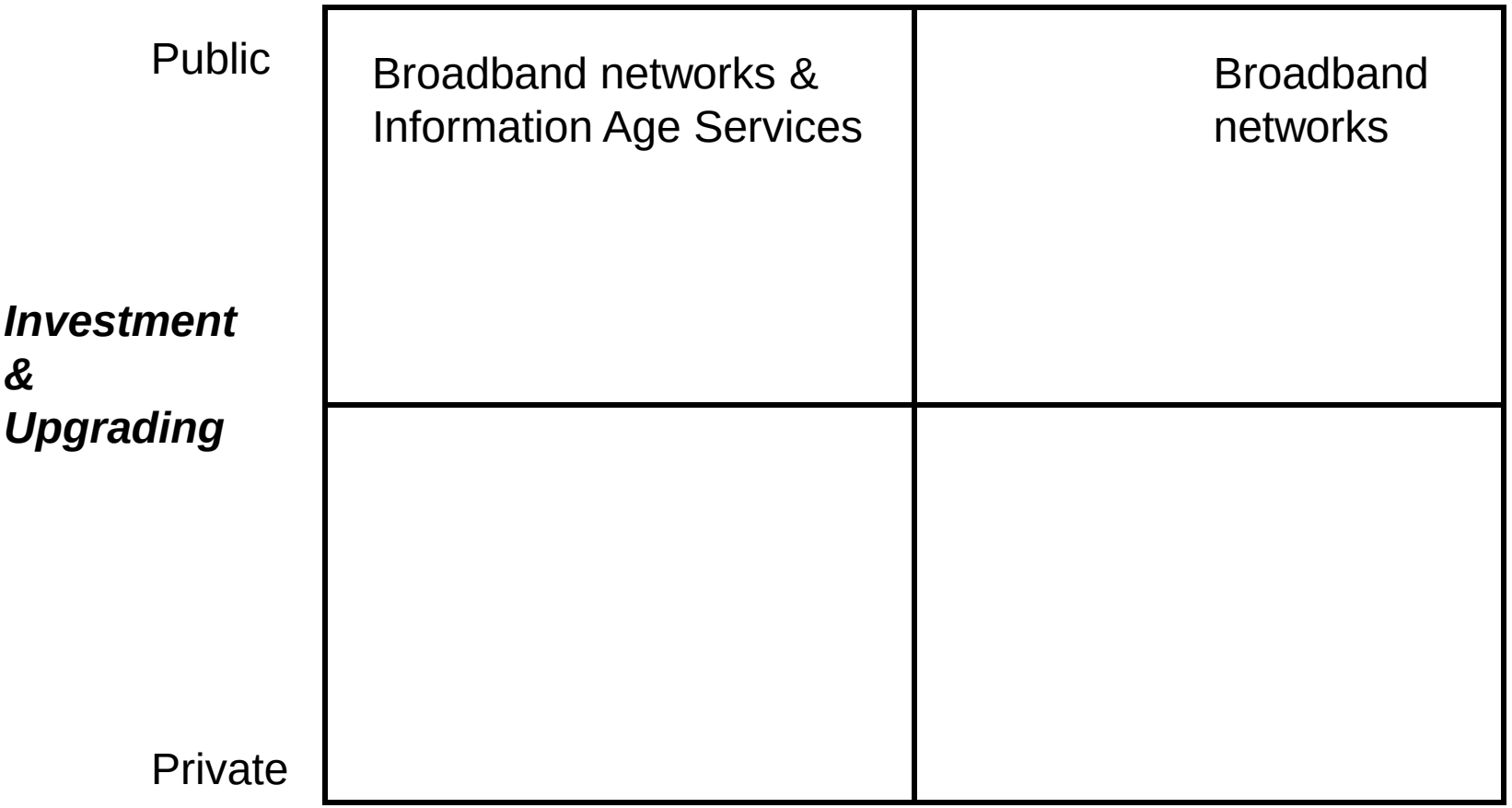
From broadband deployment to net neutrality scenarios

- In each country the net neutrality debate is mediated by
  - the saturation level of broadband networks and
  - the governmental activities to promote broadband diffusion
- These two factors influence two dimensions:
  - Investment and network upgrading, and
  - Broadband attraction.
- Using cluster analysis techniques, a set of patterns are proposed for the two factors
- Scenarios are built taking into consideration the dimensions affected by the two factors we are analysing.

High Penetration Rate



High Diffusion Coefficient



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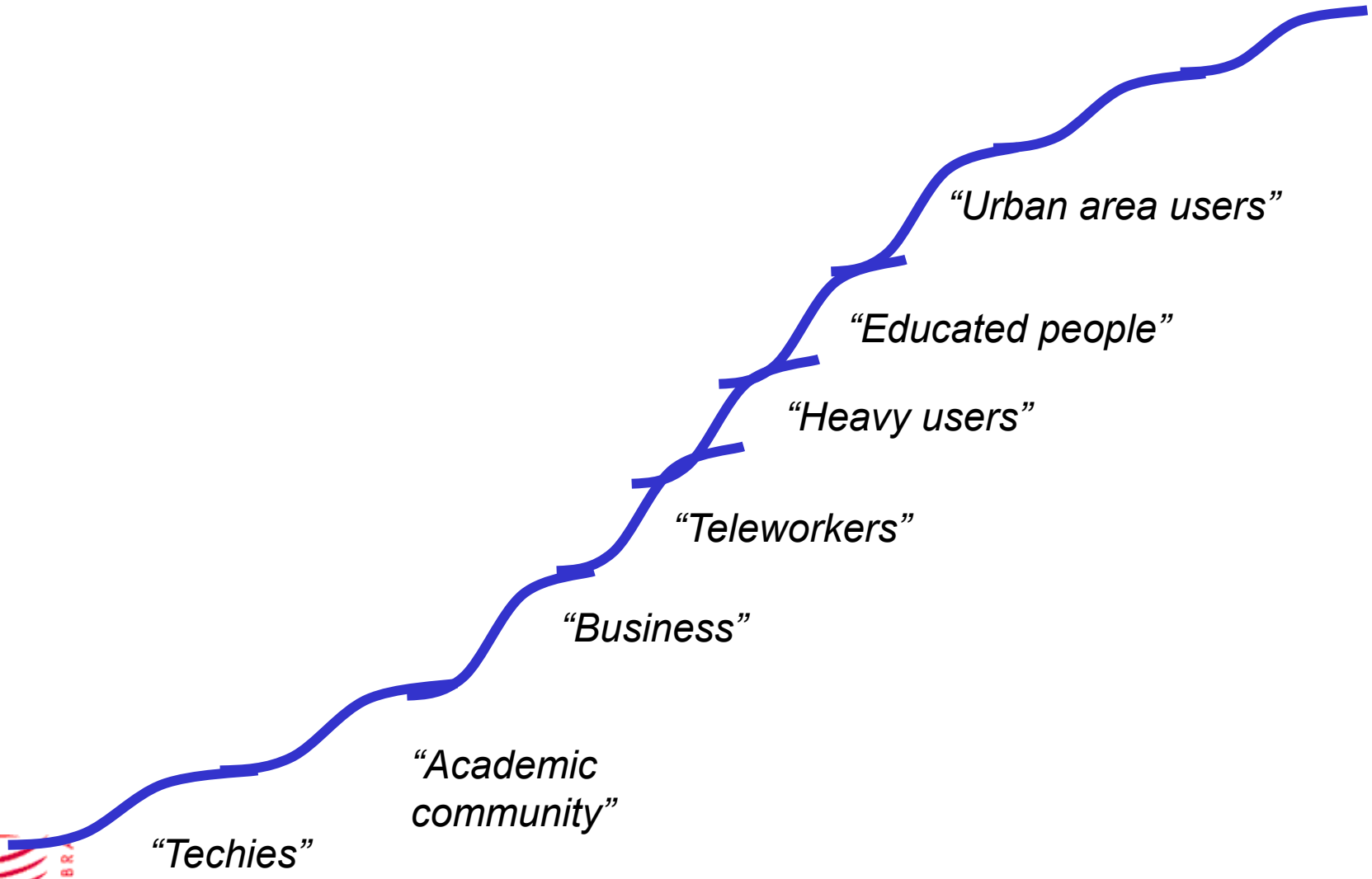
- A clustering strategy to build scenarios in the net neutrality debate has been conducted
  - Governmental promotion programs
  - Broadband diffusion
- Grouping of countries based on their behaviour
- A multidimensional view of the net neutrality debate has been used to propose a set of scenarios
  - High diffusion coefficient countries
    - Public investment on network upgrading
    - Information age services
  - High penetration rate
    - Promotion of private investment
    - Support specific users' groups

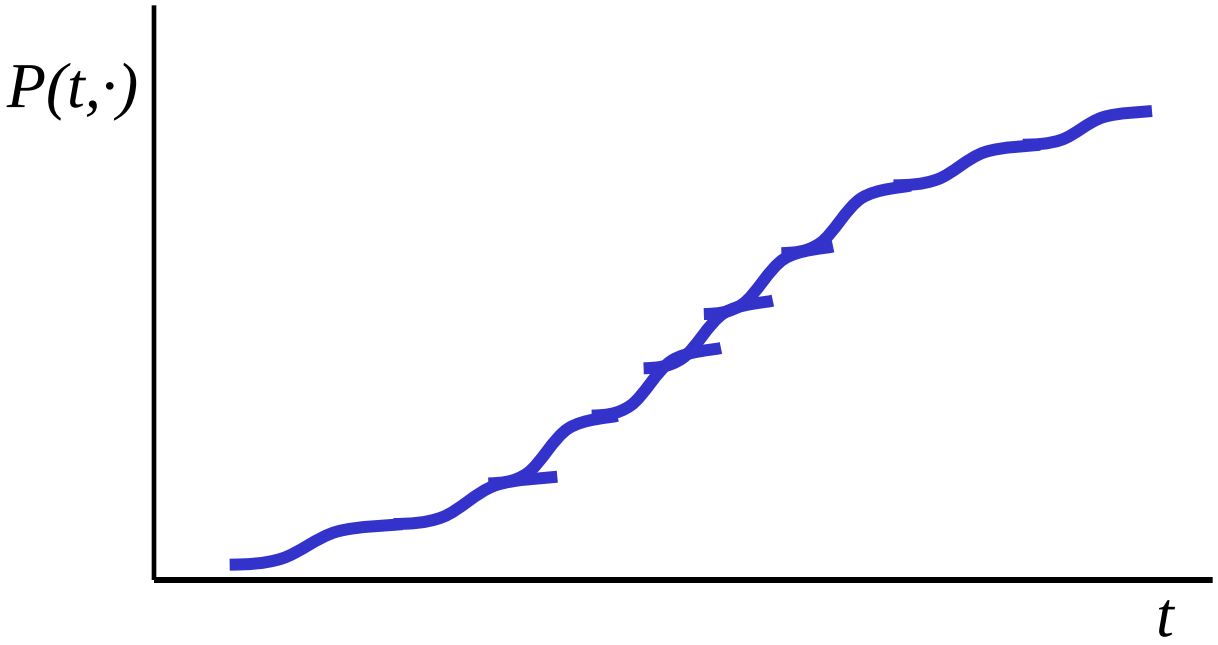
- Limitations
  - A limited number of countries were included in the collection of the broadband promotion programs analysis.
  - This study has been limited to a first approach for the proposal of scenarios.

- Future research
  - Trying to complete the information about promotion programs for those countries that have not been included in the current analysis.
  - The set of scenarios need to be compared with the actual trends in the regulation of each country
  - A segmentation approach to broadband diffusion

Segmentation approach to broadband diffusion



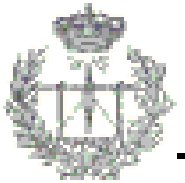
Segmentation approach to broadband diffusion



$$P(t,\cdot) = m_t \frac{1-\exp(-t(a_t+b_t))}{1+\frac{b_t}{a_t}\exp(-t(a_t+b_t))}$$

Segmentation approach to broadband diffusion

- Massini's work (Massini, 2004, The diffusion of Mobile Telephony in Italy and the UK: An Empirical Investigation)
  - S curve
  - Number of potential adopters and diffusion speed depend on economic and technological variables
    - Price of handset
    - Tariff
    - Consumption expenditures
  - Based on Griliches (1957; 1980)



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Thank you very much

INTRODUCTION II

- Governmental activities can have a three-pronged orientation:
  - Legislative or regulatory activities can frame the restrictions that delimit the industry.
  - Demand-side stimulation activities can enhance services attractiveness by promoting or aggregating demand.
  - Supply-side stimulation activities facilitate the transition from narrowband to broadband services and promote offers of new services at attractive prices.

BROADBAND DEFINITION

- The initial definition of broadband was issued by the ITU as transmission capacity that is faster than primary rate ISDN
- Other widely used definition is a minimum threshold for broadband of 256 Kbps for downstream and 64 Kbps for upstream (OECD).
- Cable and DSL were the predominant technologies, newer technologies like WiFi and WiMax are being used to give high speed access to information age services.
- Broadband can affect businesses, public administration offices, and NGO's.

BROADBAND DEFINITION II

- “Broadband” refers to a set of networks devices and communication lines that offer high-speed, high-capacity communication providing Internet access.

- “Broadband access presents the benefit of collapsing space and time when it comes to the transfer of information and establishing communication between two subjects anywhere on the globe” (Tajiri and Okazaki, 2006).

- This benefit allows for the transformation and development of the economy and the society in any region.

- “Broadband connectivity is considered a key component in development, adoption and use of information and communications technology (ICT)” (OECD, 2003)

- “Broadband”

- “Broadband”

- “Broadband”

- “Broadband”

Broadband Penetration in the World

- Penetration is defined by ITU as a measurement of access to telecommunications, calculated by dividing subscribers by the population and multiplying by 100.

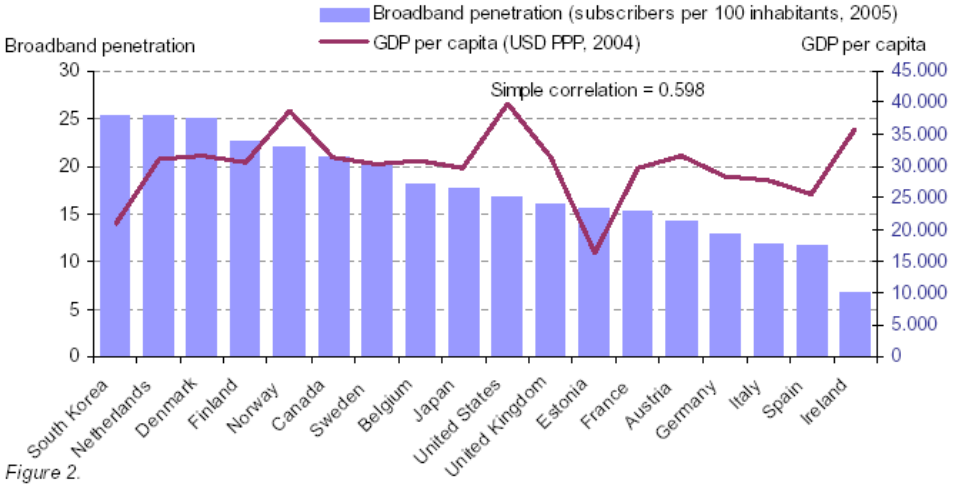
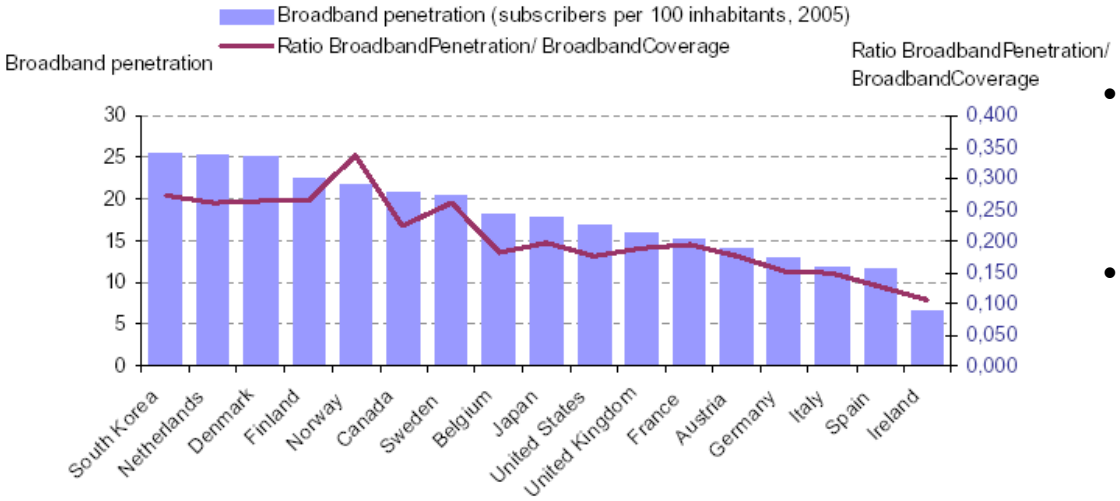


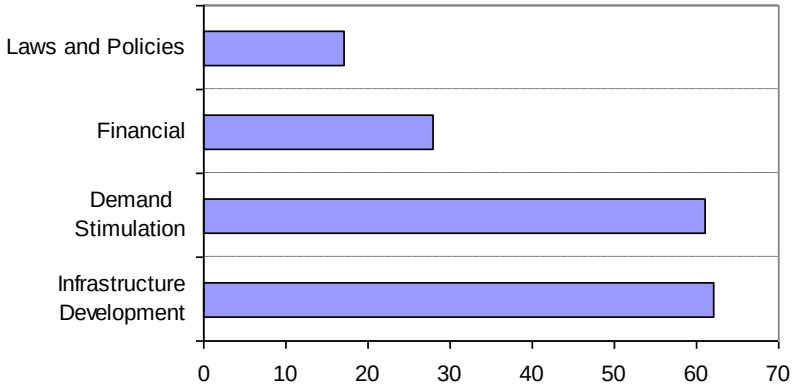
Figure 2.



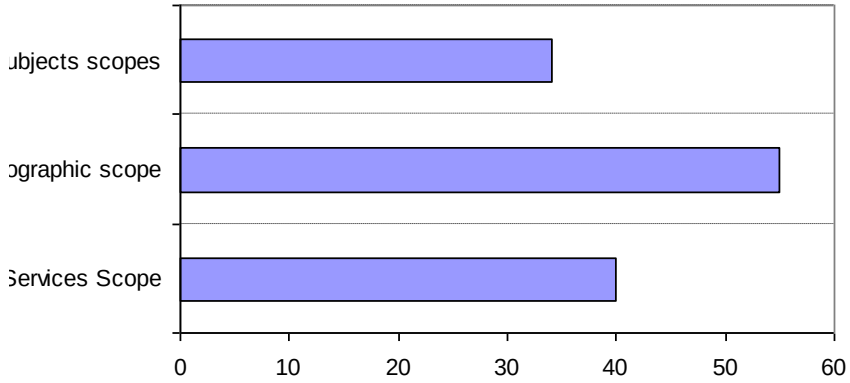
- Broadband penetration is not correlated to the GDP per capita
- Ratio between broadband penetration and broadband coverage is not uniform
- Broadband networks are not a product by itself but an instrument to get access to contents or other services.
- Broadband coverage depends on the effort to deploy network infrastructure
- Penetration depends on perceived utility of services by subscribers.

DATA ANALYSIS II

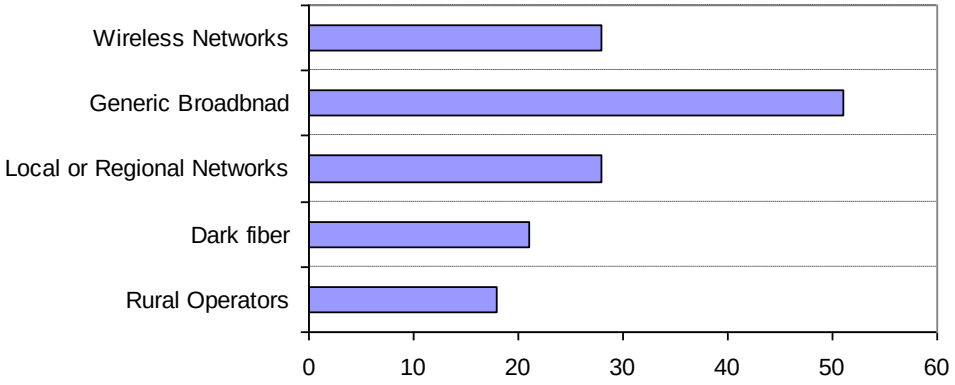
Programmes depending on general strategy



Programmes depending on scope of action



Programmes depending on object of intervention



A multidimensional perspective of net neutrality

- Each dimension can be analyzed with the arguments that are used in the two ends of the debate and with the threats that each end foresee in the rival's position.
- Broadband attraction has been included as a dimension in the net neutrality debate because, in some countries, regulators have been considering the effect of broadband usage on country's competitiveness as one of the pillars in their regulatory efforts. When broadband diffusion reach higher levels of usage network infrastructures could become saturated and country's competitiveness can be stifled. Some voices claim that this circumstance can make worst the take-up of broadband in some countries (MIT, 2005). In this situation, network operators can be forced to invest in increasing network capacity but, at the same time, they could doubt about foreseen investment returns if they could not rely on the neutrality regulation that governments could promulgate.

Broadband development vs net neutrality in each country

- This work proposes to separate some dimensions of the net neutrality debate and to conduit an analysis from the point of view of the effect of broadband development in each country. In order to frame the research, two main factors have been taken into consideration to govern broadband development. The first one is base on the broadband promotional activity of governmental agencies. Most of the countries in Europe and Asia consider that broadband deployment can help their country competitiveness. In this vein, they are issuing programs to help the deployment of high capacity network infrastructures. This kind of activity has been implemented by some American regional and metropolitan administration. The main goal of these initiatives is to substitute network operators and to incentive broadband usage. The second factor is the situation of the broadband penetration rate in a specific country. As it has been stated, broadband penetration has been considered a dimension in the net neutrality debate. Broadband network saturation can force the renewal of network infrastructures and that can leads regulators to consider their position in the net neutrality debate.

From broadband development to net neutrality scenarios

- To investigate the relationship between these two factors and the neutrality debate, in the following chapters of this paper we propose to analyze broadband promotion programs and broadband diffusion models using a cluster analysis technique. In both cases, a set of patterns are proposed. These patterns are used to build a set of scenarios that map the net neutrality debate. These scenarios are built taking into consideration the dimensions affected by the two factors we are analysing. In this case, we consider that these two factors influence two of the above mentioned dimensions: Investment and network upgrading, and broadband attraction.

DATA ANALYSIS III

- To reduce the weight of countries with many programs or the influence of programs with a wide range of interventions, the variables have been rated by the number of programs in each country.
- All variables have been standardized in order to have a common space of dimensions.
- A correlation analysis was performed on the data matrix in order to find overepresented behaviour.
- Some independent variables have been included to incorporate the effect of macroeconomic variables or technological development effects:
  - Technological Achievement Index
  - Broadband Penetration rate
  - Monthly price of a broadband line of 100kbts/sec
  - Maximum speed in the downloading side

CLUSTER ANALYSIS

- Multivariate methods (dependent or interdependent) have been used to find relationships within a data matrix.
- Cluster analysis comprises interdependent techniques (deal with all variables simultaneously and equally) for classifying objects.
- Clustering methods can be classified between:
  - heuristic methods
  - hierarchical methods
- In this analysis the K-means algorithm has been used.The K-means algorithm is a heuristic clustering method that is stepwise optimal.
- In this case, cluster analysis was conducted to explore options of grouping the countries based on the profile of the public promotion programmes in each country.