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Ex-ante Evaluation of European ICTs Policies: Efficiency vs. Cohesion Scenarios

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Abstract

Normative interventions in the ICTs sector at the European level are in fact mainly driven by the idea that the impacts of advanced telecommunications technology adoptions are related both to their capacity to increase competitiveness and to their potential influence on regional disparities, enhancing growth rates and development of weaker and less developed regions. The result is that the well-known trade-off between efficiency and cohesion emerges quite evidently. In this paper, the aim is to provide an ex-ante evaluation of EU ICTs policies on regional development and regional disparities, through a scenario building methodology which allows to calculate the increase in per capita GDP at NUTS 2 level for all 15 EU member states according to efficiency or cohesion policy options. In particular, the aims are to provide a cost assessment of efficiency and cohesion ICTs policies and to detect different regional response to ICTs policies, by highlighting different behavioural attitudes and reacting capacities of regions in front of alternative ICTs policy scenarios.

1. Introduction

Infrastructures have always been recognised in regional economic theories as important weapons for regional development: since the “balanced development” theory of Hirshmann, the role of infrastructure as necessary conditions for regional growth has been envisaged, relaunched by a series of approaches like the theory of the stages of development, the centrality/peripherality approach, the export-base model, the growth pole approach. In more recent times, much emphasis has been put especially on transport and communications infrastructures as strategic elements upon which the competitiveness of regions depends¹.

Moreover, in the last two decades, it has been widely recognised that all advanced economies are moving towards an Information Society, in which information and knowledge act as key elements for the competitive advantages of firms and the comparative advantages of regions. In this perspective, ICTs networks become the competitive resources upon which the competitiveness of firms and territories lies, given the basic principle that, through ICTs networks, territories can achieve information and knowledge, despite their location and their physical accessibility.

For these reasons, it has long been the aim of policy makers within Europe to use ICTs networks to increase regional competitiveness and regional cohesion by supporting regional and local development and promoting integration. On the normative side, the importance of infrastructure on regional development has always been reflected in the allocation of huge financial resources to the development and upgrading of infrastructure endowment by national and supranational public bodies. In recent years, the technological development in both transport and telecommunications has exacerbated the needs for investments in transport and communications networks and services; the development and upgrading of high speed trains and of advanced information and communications networks and services (ICTs) have become the primary aim for all European Countries, witnessed by the large financial efforts developed by the European Union and by National Governments.

Normative interventions at the European level were in fact mainly driven by the idea that the effects of advanced telecommunications technology adoptions were not only related to their capacity to increase competitiveness, but also to their potential influence on regional disparities, enhancing growth rates and development of weaker and less developed regions. Among European Union technology development programmes (RACE, ESPRIT, BRITE, STAR, DRIVE, ...), some were specifically developed with the aim of stimulating regional competitiveness in less favoured regions of the Community through the implementation of

telecommunications technologies (i.e. the STAR Programme). The driving force of these policies was to endow regional systems of the most strategic “weapons” upon which the competitiveness of firms and of regions critically depended².

The general goals of normative actions are related to the fundamental policy principles of “efficiency” and “cohesion”: goals of economic growth are addressed to efficiency, whereas the promotion of social equity and solidarity to cohesion. Needless to say that the well-known trade-off between efficiency and cohesion emerges quite evidently; in fact the allocation of financial resources in those areas where the marginal rate of investment is higher does not coincide with the need to concentrate financial efforts in backward regions in a cohesion perspective.

Many studies have been developed on ex-post evaluation of EU ICTs policies on regional development³. In this paper, the aim is instead to provide an ex-ante evaluation of EU ICTs policies on regional development and regional disparities, through a scenario building methodology which allows to calculate the increase in per capita GDP at NUTS 2 level for all 15 EU member states according to efficiency or cohesion policy options.

In particular, the aim of the work is twofold:

- to provide a cost assessment of efficiency and cohesion ICTs policies, through the measurement of the impact of these policies on regional growth and disparities. Efficiency costs are quantified in terms of reduced per capita GDP growth rate; by the same token, cohesion costs are measured in terms of increased regional disparities (sec. 2-4);
- to detect different regional response to ICTs policies, by highlighting different behavioural attitudes and reacting capacities of regions in front of alternative ICTs policy scenarios (sec. 5).

The different impacts provoked by alternative ICTs policy scenarios on regional disparities will be somehow expected, being highly dependent on the hypotheses made on the spatial distribution of financial resources; the interesting aspect of the paper is the identification of the costs (measured in terms of efficiency or cohesion losses) associated to possible alternative policy options.

The paper is structured as follows. In the next section, the conceptual framework on which the scenario methodology is built is presented, and the ICTs policy hypotheses on which scenarios rest are highlighted (sec. 2). Sections 3 and 4 contain the results of the spatial economic impact assessment. Section 5 describes different regional responses to ICTs policy scenarios while Section 6 presents some concluding remarks.

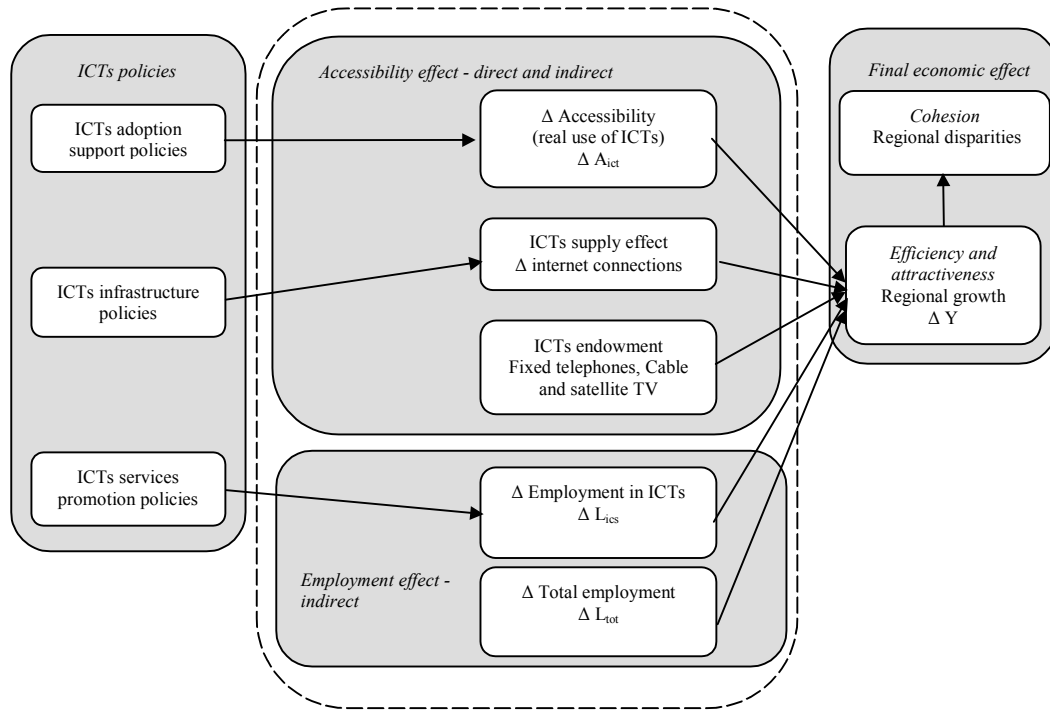
2. Conceptual Framework

2.1. The STIMA Model

From the methodological point of view, scenarios are based on the estimate of a *quasi production function*, which allows to measure the role that ICTs play on regional performance through the estimate of an econometric model labelled STIMA (Spatial Telecommunications Impact Assessment)⁴. On the basis of some hypotheses on the distribution of EU financial resources among regions and among possible policy actions (network endowment, support to service use, investments in skills and people in ICTs sector), the model is able to provide an estimate of future GDP growth and on its spatial distribution.

From the conceptual point of view, the framework of analysis is based on the idea that ICTs infrastructures and services are production factors which, together with the traditional labour and capital factors, explain GDP level. Therefore, a change in ICTs investments produces a change in ICTs endowment which enters the quasi production function and estimates changes in per capita or absolute GDP growth rate (Fig. 1).

Fig. 1. Conceptual Framework for ICTs spatial economic impact assessment



2.2. ICTs Policy Scenarios

Policy scenarios are built according to the eEurope 2002 Action Plan of the Community, which envisages three main normative actions (European Commission, 2000):

- A cheaper, faster and secure Internet, i.e. a focus on ICTs investments on ICTs infrastructure;
- Investments in people and skills, i.e. an adoption support policy;
- A stimulus for the use of the Internet service development (e-government, e-commerce, intelligent transport systems), i.e. an ICTs policy oriented towards service promotion.

The nature of these intervention policies is rather different, since they act on different aspects. First of all, ICTs are in fact expected to act on accessibility, allowing to overcome territorial peripherality, and generating the popular perception of a “death of distance” (Castells and Hall, 1994). Especially in remote areas, ICTs are generally perceived as an opportunity to overcome geographical disadvantages, being connected in real time to the “core”. Moreover,

ICTs are expected to act on regional attractiveness, and therefore on territorial competitiveness; *coeteris paribus*, an area with highly advanced communication infrastructure is easily expected to be a more preferable location for firms and productive activities than other, less endowed, regions.

The first policy action mentioned by the eEurope 2002 plan – a cheaper, faster and secure Internet - certainly has a positive impact on attractiveness, and therefore on regional performance. What really makes the difference on regional performance is, however, an increase in accessibility, which requires an intense and strategic use of ICTs, based on skills and local knowledge by no means available everywhere. The second and third policy actions of the eEurope 2002 plan are more devoted to this aim, by enhancing imagination, entrepreneurial capability, huge organisational capability in managing internal transformations, necessary for a strategic and intense use of ICTs.

Different impacts on regional performance are therefore expected from the three policy actions:

- the first policy action generates an increase in ICTs endowment, but not necessarily on real use of ICTs, and therefore not necessarily on accessibility. This policy can be applied to lagging areas to fill in the infrastructural gap, and to non-lagging areas in order to overcome the bottlenecks that characterise these areas. In operational terms, this policy corresponds to an increase in Internet connections;
- the second policy action is a medium term policy, since it helps in the medium term to diffuse everywhere the necessary skills and knowledge for an innovative and strategic use of ICTs. In our model, this policy influences the high tech employment share;
- the third policy action is a long-term policy; it aims at developing advanced ICTs services (and their employment) in the economy, influencing long term efficiency of the whole productive system. In our model, this policy corresponds to an increase in accessibility.

Given a certain level of financial resources devoted to ICTs⁵, three scenarios can be envisaged on the basis of the policy actions chosen, with a time reference of 20 years (Table 1). The results will be compared with a do-nothing scenario, in which the per capita GDP growth is equal to 0; in order to highlight ICTs policy impacts, in our model ICTs policies are the only factor that affects GDP growth.

Scenario A: Indiscriminate ICTs scenario

This scenario envisages a widespread diffusion of ICTs infrastructures and services throughout Europe, with the implementation of all three European ICTs policy actions in all Countries and regions of the Communities, despite their economic level and their ICTs endowment level. Funds are subdivided among regions according to their population share, and then devoted in equal parts to the three policy actions.

Scenario B: Efficiency ICTs scenario

The second scenario envisages the implementation of ICTs policy actions according to the marginal efficiency of investments⁶. In this scenario, 80% of financial resources in ICTs are devoted to non-lagging regions, that are more efficient, while the remaining 20% of investments goes to the lagging regions. Moreover, 70% of financial resources within each subgroup of regions is devoted to the policy action with the higher marginal efficiency of investment. Therefore, once investments are weighted by population, they are divided within each subgroup of regions as follows:

- in Objective 1 areas, 70% of regional ICTs European resources are devoted to increase accessibility, while the remaining part to increase infrastructural development (30%);
- in advanced areas, 70% of regional ICTs European resources are invested in infrastructure development, while the remaining 30% in ICTs accessibility.

Table 1. Distribution of investments by regions and ICTs policies according to the different scenarios

ICTs Scenarios	Regions	ICTs Policies
<i>Scenario A</i> <i>Indiscriminate scenario</i>	<u>All regions</u> Investments distributed according to regional population	<u>All regions</u> 33% Accessibility 33% Internet 33% High tech employment
<i>Scenario B</i> <i>Efficiency scenario</i>	<u>Lagging regions</u> 20% of total investments Investments distributed according to the share of lagging regions population <u>Non lagging regions</u> 80% of total Investments Investments distributed according to the share of non lagging regions population	<u>Lagging regions</u> 70% Accessibility 30% Internet <u>Non lagging regions</u> 30% Accessibility 70% Internet
<i>Scenario C</i> <i>Cohesion scenario</i>	<u>Lagging regions</u> 100% of total investments Investments distributed according to the share of lagging regions population	<u>Lagging regions</u> 33% Accessibility 33% Internet 33% High tech employment

Scenario C: Cohesion scenario

This third scenario envisages the implementation of ICTs policies only for lagging regions, as has been the case in the past with the STAR and Telematique projects run by the EU. In this case, all the resources are devoted to objective 1 regions, one-third for each policy action.

The three scenarios, two of them rather extreme, allow us to measure per capita GDP growth rates and subsequent changes in regional disparities under different policy options, and therefore to quantify the costs associated to each policy choice, both in terms of cohesion and efficiency losses.

3. Methodological Framework and Econometric Results

3.1. The Database and the Indicators

The estimate of the STIMA model is based on a database covering two main areas: the economic data and the ICTs data. For the economic data, our main source is the Eurostat

REGIO theme (Eurostat, 2000). These data cover many different areas: GDP, employment, patents, human resources in high tech sectors, population. Moreover, data are in most cases available in at least 5-year time series.

The crucial aspect is the availability of ICTs data at a territorially disaggregated level. The main source of these data is the European Commission to EOS Gallup. This survey took place in the second half of 1999 and was based on over 44,000 household interviews in 130 regions of the 15 Member States⁷. It is by far the largest survey at a European level that has been undertaken in the sector. A second survey is taking place at the moment, but the results will not be available until the beginning of 2004. The areas considered are NUTS-2 regions. Unfortunately, the EOS Gallup survey covers only the 15 EU member states, limiting the analysis to the 15 existing EU members.

A dummy variable is built in order to analyse the regional disparities. This dummy splits regions in lagging and non-lagging, following the criteria expressed by the European Commission for the definition of Objective 1 NUTS-2 regions for the period 2000-2006⁸.

For what concerns ICTs, three kinds of indicators are necessary: one concerning the physical endowment of infrastructures, one concerning the degree of accessibility, based on the intensity of use of the ICTs, and the latter concerning employment levels. As a measure of physical endowment, several indicators are available at NUTS2 level⁹: number of Internet connections, number of cable and satellite TV, fixed telephony penetration, expressed by the share of households equipped with such technologies.

A particular accessibility indicator is necessary, able to capture the effects of ICTs use on the physical distance of regions. For this reason, an index is built on the basis of a gravitational model, in which the population is used as mass, and the share of households using Internet as e-commerce vehicle is used as the inverse of the spatial friction:

$$A_{ICT_{rt}} = (\sum_s P_{st} / d_{sr}^{g_{rt}}) \quad (1)$$

where:

$A_{ICT_{rt}}$	= accessibility of region r in year t	g_{rt}	= spatial friction between r and s,
r, s	= regions		measured by the inverse of the intensity of ICTs use
P_{st}	= population of region s in year t	$u_{rt} = 1/g$	= percentage of households using Internet
d_{sr}	= distance in km between region s and region r $\forall s \neq r$		as e-commerce vehicle
	(if $s=r$, d_{sr} is assumed to be = 1, because a division by zero is not allowed)		

Moreover, indicators of total employment and high-tech employment are directly applied in the simulation model.

3.2. The Econometric Results of the STIMA Model and the Model Calibration

The estimated STIMA model is the following:

$$Lgdp99p = f(Lacc, Lfixtel, Lcabsat, Ltotemp, Lhitech) \quad (2)$$

where L indicates the conversion in natural logarithm (ln), and

$Lgdp99p$	= per capita GDP 1999	$Lcabsat$	= percentage of households with a cable or satellite TV in 1999
$Lacc$	= accessibility 1999	$Ltotemp$	= total employment in 1999
$Lfixtel$	= percentage of households with a fixed telephone in 1999	$Lhitech$	= high tech employment in 1999
$Lintcon$	= percentage of households with a Internet connection in 1999		

Results are presented in Table 2 (columns 1 and 2). Interesting enough, all ICTs variables are significant and present the expected positive sign. The fit of the model is quite good, with a R^2 index around 0.67.

However, when working with territorial data, a problem of spatial dependence between the observations may arise¹⁰. Statistical tests to detect the presence of spatial dependence were run, and witnessed the presence of both spatial lag and spatial error¹¹. Table 2 (columns 3 and 4) contains the results of the model corrected for the spatial dependence.

Table 2. STIMA Model Results

Variables	<i>Normal model</i>		<i>Spatial lag model</i>	
	Coefficient value	T-value	Coefficient value adjusted for spatial dependence	Z-Test value
Constant	-3.386	(3.38)**	-3.552	(-4.07)**
Lacc	0.042	(2.38)**	0.051	(3.31)**
Lfixtel	0.733	(4.09)**	0.574	(3.61)**
Lintcon	0.049	(2.45)**	0.037	(2.07)*
Lcabsat	0.107	(5.30)**	0.061	(3.13)**
Lhitech2	0.061	(1.96)*	0.004	(0.12)
Ltotemp			0.457	(3.65)**
ρ			0.437	(5.14)**
R-square	0.67			

Observations 185 - Dependent variable: Lgdp99p

* = significant with $p < 0.05$

** = significant with $p < 0.01$

Finally in order to obtain a better fit with real data, the model was calibrated as shown in Table 3.

Table 3. Calibration of the Spatial Lag Model

Indicators	Estimated coefficients	Calibrated coefficients	Differences
Constant	-3.552	-3.552	0.000
Lacc	0.051	0.055	+0.004
Lfixtel	0.574	0.650	+0.076
Lintcon	0.037	0.037	0.000
Lcabsat	0.061	0.070	+0.009
Lhitech2	0.004	0.005	+0.001
Ltotemp	0.457	0.640	+0.183
ρ	0.437	0.300	-0.137

Dependent variable: Lgdp99p

3.3. Future Financial Resources and Marginal Efficiency of Investments

In order to be able to forecast per capita GDP at 2020, our methodology requires some hypotheses on the magnitude of future investments of the EU in ICTs.

ICTs investments at the National level between 1990 and 2000 in the 15 EU member states, at 2000 prices, reach a volume of around 50 billion euros per year¹² (Table 4). Given the financial efforts made by the EU in those years, which were equal to 4% of the total investments made by National Governments, and given the entrance of the new Accession Countries, we assume that the EU financial effort in this field in the next 20 years will be equal to 2% of total investments made by 15 EU member states, reaching a level of around 1 billions euro per year. This amount, multiplied by 20, provides a 20-year investment scenario¹³.

Table 4. European Country Investments in ICTs

Country	Average annual investments in ICTs 1990-2000 (in € at 2000 prices)
Austria	1.563.787.293
Belgium	1.157.658.681
Denmark	742.494.404
Finland	792.154.994
France	6.442.682.384
Germany	13.287.718.072
Greece	793.073.081
Ireland	397.119.895
Italy	7.699.435.038
Luxembourg	89.723.676
Portugal	1.275.765.608
Spain	3.949.101.599
Sweden	1.208.488.436
The Netherlands	2.161.829.687
United Kingdom	8.776.795.290
Total	50.337.828.138

The increase in the financial effort made in the field of ICTs is translated in an increase in physical endowment of ICTs, by estimating to the marginal efficiency of investments.

Regression models between the ICTs factors and capital invested in ICTs have been run in order to estimate such a marginal efficiency; the results of the three regressions are presented in Table 5. Even at a first look, it is evident that the marginal efficiency of investments differs substantially between the different policy actions, witnessing that the impact of ICTs policies on territorial distribution heavily depends also on alternative policy action choices.

Table 5. Marginal Efficiency of Investments

Indicator	Marginal efficiency of investments
Accessibility	0.252 (1.71)
Internet	0.964 (2.36)*
High tech employment	0.222 (2.13)*
<i>Independent variable: per capita invested capital 1990-2000</i>	

In brackets T-Test values.

* = significant with $p < 0.05$

** = significant with $p < 0.01$

4. Territorial Impact of ICTs Policy: Forecasting Results

4.1. Efficiency in the Three Scenarios

The average annual growth rates of per capita GDP differ substantially in the three scenarios¹⁴. In Table 6 the average annual growth rates for the whole sample and for the two sub-samples of lagging and non-lagging regions is presented.

Results at the regional level are plotted on a map (Fig. 1-3). The do-nothing scenario is zero; thus, if no ICTs investments are spent, GDP growth is equal to zero.

Table 6. Per capita GDP annual average growth rate in the three scenarios

Scenarios	Per capita GDP growth rate		
	Lagging regions	Non lagging regions	Total
0 - Do-Nothing	0.00	0.00	0.00
A - Indiscriminate	1.06	0.97	0.99
B - Efficiency	1.02	1.11	1.09
C - Cohesion	1.34	0.00	0.30

In the indiscriminate scenario (A), the average annual growth is around 0.99%, with a slightly higher effect on lagging regions (+1.06%) and a lower on non-lagging ones (+0.97%). Fig. 1 shows that GDP growth is equally distributed in most regions, with some peaks (positive or negative) that in most cases can be explained by statistical effects. Most of the regions show per capita GDP growth rates between 0.5 and 1.2%. Thus, as expected, this scenario affects all regions almost in the same way.

In the efficiency scenario (B), on the contrary, there is a strong discrimination in favour of more efficient regions, towards which the main part of investments is directed. At the average, this scenario presents the highest average per capita GDP growth rate (around 1.10%); advanced regions show a higher growth rate (1.11%) than lagging ones (1.02%). These latter even grow less than in the indiscriminate scenario.

As shown in Fig. 2, this scenario presents higher rates of GDP growth for the advanced regions belonging to the so-called Blue Banana (The Netherlands, Belgium, Luxembourg, and French regions near the Reno River) and to the Sunbelt (southern regions of France and Spain and Northern Italy). A lower increase is shown by the weaker regions of Germany (Eastern regions), Scandinavia and United Kingdom. However, the impact of this scenario is higher than that of scenario A and it is quite different among regions. Per capita GDP values are a bit flattened by some statistical effects, due to a low population density or a low per capita GDP value.

In scenario C, all the financial resources are devoted to lagging regions, which record the highest growth rates than in the other scenarios (Fig. 3).

From the point of view of efficiency, scenario B is obviously the most appropriate, while A and C register large losses in terms of efficiency and growth. The loss in efficiency of a cohesion scenario is rather high; in the case an efficiency policy is chosen, in fact, the increase in per capita GDP reaches 1.09% annual increase, compared to a 0.30% when a cohesion policy is chosen. The indiscriminate scenario also registers a loss in efficiency gains (0.99% increase compared to 1.09% increase of the efficiency scenario), which is, as expected, less drastic compared to the cohesion policy scenario.

The European Union has another important goal, beside efficiency: that of cohesion. In the next section we deal with the costs associated to an efficiency policy scenario in terms of reduced cohesion.

4.2. Cohesion in the Three Scenarios

In this section a comparison between the differences in regional income growth is presented in order to detect the impact of the three different scenarios from the point of view of the cohesion goal. The results in terms of differences between regional growth rate and the EU average growth rate are shown on maps, where different regional behaviours are more easily identifiable.

Scenario A records some peaks, some of which are probably statistical effects due to the low population density. However, in general very few regions present consistent differences from the EU average growth rate (Northern Italy, some regions in France), and the effect in terms of spatial income distribution is very low (Fig. 4).

In scenario B the impact on spatial income distribution is stronger, as expected: a high number of regions shows different growth rates with respect to the European average. The highest rates can be found in France, northern Italy, Belgium and The Netherlands, while the lowest in Scandinavian regions and Spain (Fig. 5).

Scenario C, which by definition concentrates GDP growth in lagging regions, registers a quite distributed positive effect at the territorial level (Fig. 6).

A way of quantifying changes in regional disparities is through the Gini's concentration index and its graphic representation through the Lorenz curve. The Gini coefficients for the different scenarios are presented in Table 7. Concerning GDP distribution, scenario A shows a coefficient very similar to the current situation, as expected, while scenario B measures the decrease in regional disparities by having a Gini coefficient of 0.20 instead of 0.19; by the same token, the improvement which accompanies scenario C is registered by a 0.18 Gini coefficient. Scenarios A and B shows quite similar curves; however, as the zooming area shows, the efficiency scenario shows a more pronounced regional disparity than the indiscriminate scenario.

Table 7. Gini coefficients for different scenarios

Scenarios	Pc GDP	Accessibility	Internet
Current situation	0.1978	0.3992	0.4089
Scenario A	0.1983	0.4383	0.4106
Scenario B	0.2002	0.4382	0.4476
Scenario C	0.1867	0.4382	0.8608
Equal distribution	0.000	0.000	0.000

By looking at Table 7, the costs of an efficiency scenario in terms of reduced cohesion achievement can be quantified in a Gini coefficient equal to 0.20 instead of 0.18; in qualitative terms, Table 7 witness that an efficiency policy choice worsens the present situation in regional disparities, which would, on the contrary, be reduced in a cohesion scenario. Interestingly enough, an indiscriminate policy choice would have no effect on regional disparities. The same results appear in Fig. 7, where the Lorenz curve is shown.

If this is true at the general level, it is interesting to highlight whether the capacity to grasp growth opportunities put forward by ICTs policies is the same in each region. As we will see in the next section, this is not the case.

5. Different Regional Responses to ICTs Policies

From the maps already shown it appears quite evidently that advanced regions react differently in front of ICTs investment policies. Some are more able to grasp the opportunities offered by these exogenous policies, others are more inclined to react only if policies are directly concerned with particular local needs. The same holds for backward regions, in which the capacity of response to ICTs policy opportunities differs substantially among regions, irrespective of the policy choice made (Fig. 4-6).

A way to describe common behaviours in front of ICTs policies is by running a *cluster analysis*, a statistical techniques able to group observations (in our case the regions) according

to their similarities in the values of some selected variables (in our case: GDP growth and Internet connections growth rate).

The cluster analysis has detected four different clusters, mapped in Fig. 8. The subdivision of regions among clusters is rather interesting: two clusters of lagging regions and two clusters of advanced regions. A first cluster contains lagging regions which need specific cohesion policies to achieve a per capita GDP growth. Lagging regions belonging to the second cluster are instead able to grasp economic improvement opportunities even in front of efficiency or indiscriminate policies; the greater capacity of these regions (in comparison to those belonging to the first cluster) to grasp opportunities offered by each ICTs policy choice made is probably explained by the fact that they already use ICTs more than regions belonging to the first cluster (Table 8).

A third cluster contains advanced regions which achieve the lowest advantages in terms of both per capita GDP growth rate and accessibility increase. They represent regions already well endowed in terms of infrastructures and technological skills, which achieve very low marginal advantages when ICTs are increased (Table 8). Finally, the last cluster contains advanced regions that show a strong increase in GDP in scenario B: these regions react in particular to efficiency policies, taking full advantages from the removal of congestion effects in ICTs networks and services.

Table 8. Results of the Cluster Analysis

Indicator	Cluster 1 Lagging regions reacting to cohesion ICTs policies	Cluster 2 Lagging regions reacting to all ICTs policies	Cluster 3 Non lagging regions with low needs of ICTs policies	Cluster 4 Non lagging regions reacting particularly to efficiency policies	Mean
Number of cases	19	22	63	81	185
<u>Cluster indicators</u>					
<i>Scenario A indicators</i>					
Per capita GDP	-0.79	1.35	-0.93	0.54	0.00
Internet connections	-0.77	1.38	-0.91	0.56	0.00
<i>Scenario B indicators</i>					
Per capita GDP	-1.42	0.68	-0.76	0.74	0.00
Internet connections	-1.37	0.73	-0.72	0.79	0.00
<i>Scenario C indicators</i>					
Per capita GDP	1.33	2.22	-0.51	-0.51	0.00
Internet connections	1.19	2.09	-0.56	-0.56	0.00
<u>Descriptive indicators</u>					
Per capita GDP 1999	16.69	12.04	22.95	22.40	20.8
Accessibility 1999	162221	418048	219360	434357	331253
Internet use (e-commerce)	54.1	38.6	56.6	49.9	49.5
Cable or satellite (%)	43.1	29.4	59.6	53.5	51.6
Fixed telephone (%)	87.6	85.8	93.7	92.6	91.7
Internet connections (%)	16.1	3.3	21.1	7.7	12.6
Total employment	357.9	907.4	575.2	1053.7	801.9
High tech employment	21.2	31.8	46.1	92.4	62.1
% of lagging regions	46.3	53.7	0.0	0.0	22.2
% of non lagging regions	0.0	0.0	43.7	56.3	77.8

6. Conclusions

The aims of the paper were twofold. The first was to quantify the costs of alternative ICTs policy strategies in terms of efficiency and cohesion. The second was to highlight different regional capacities to grasp growth opportunities put forward by alternative ICTs policies.

A forecasting methodology has been applied in order to estimate GDP growth and its spatial distribution in alternative policy scenarios. Costs in terms of loss of efficiency and reduced cohesion are calculated; a cohesion scenario has a rather large impact in terms of loss of potential GDP growth rate, decreasing per capita GDP growth rate from 1.09 to 0.30. By the same token, an efficiency scenario registers, on its turns, a worsening of the present level of regional disparities.

In front of this clear trade-off, the tendency could be to choose an indiscriminate policy option; as it is also witnessed by our results, this policy presents limited costs in terms of both reduced efficiency and cohesion. Our impression, however, is that this choice would not be the most appropriate one, since it would limit not only costs but also advantages in terms of both efficiency and cohesion.

A more appropriate way to deal with the trade-off would be to put attention to the different ICTs policy actions, and act on the most appropriate according to the region needs. We recall here the long lasting debate on the fact that ICTs policies should be tailored upon each adopters needs, avoiding indiscriminate policies and reinforcing specific needs and requirements of each local area.

Even regions similar from the economic point of view, like lagging or advanced regions, should not be treated as single homogenous entities, when ICTs policies are concerned; their capacity to grasp economic advantages stemming from ICTs policies is extremely different since it depends on the degree of network endowment and on the capacity to exploit these technologies, unevenly distributed even in local economic systems similar in terms of economic development.

ICTs policies are far from being only a decision on the spatial distribution of financial resources. A call for tailored policy actions is our main concern; policies which should avoid the discrimination between “imitative regions” and “advanced technological regions”, and support instead the development of “adaptive regions”, in which ICTs adoption reflects industrial vocations of the local area.

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¹ On studies concerning the role of infrastructure on regional development, see Hirschman, 1957 and 1958; North, 1955; Biehl, 1986; Perroux, 1955; Keeble et al., 1982; Vickerman, 1991; Aschauer, 1989; Barro, 1990; Bruinsma et al., 1990; Fabiani and Pellegrini, 1997; Ferri and Mattesini, 1997.

² On the role of ICTs on regional development, see, among others, Gillespie and Williams, 1988; Gillespie et al., 1989; Goddard J., 1985, Rosestein-Rodan, 1943.

³ See, among others, Capello, 1994, for the ex-post evaluation of the STAR programme; O Siochru et al. 1995; Nexus Europe et al. 1996, for the ex-post evaluation of other EU Programmes on ICTs.

⁴ In Italian, “stima” means estimate, assessment and esteem. On the concept of a “quasi production function approach” see Biehl, 1986.

⁵ The hypotheses on future EU financial resources is presented in section 3.1.

⁶ The method for estimating the marginal efficiency of investments is presented in section 3.2.

⁷ EOS Gallup (1999).

⁸ European Commission, 1999. The objective 1 regions should meet one of the following requirements: a) GDP < 75% of EU average; b) most remote regions (DOM-TOM, Azores, Madeira, Canaries); c) very low population density (old Objective 6 areas - in particular the Scandinavian regions).

⁹ EOS Gallup (1999).

¹⁰ For more details concerning the spatial dependence problems, see Anselin, 1988 and 1992; Anselin and Hudak, 1992; Anselin et al., 1996.

¹¹ We applied the Moran’s I, the Lagrange Multiplier and the Robust Lagrange Multiplier. These tests assume higher and significant values when there is positive spatial autocorrelation in the dependent variable (lag) or in the errors. For calculating the spatial autocorrelation tests and the spatial lag model, we used STATA 7 with the extensions for spatial analysis (Pisati, 2001). The results are presented in the following Table:

Test	Statistic	Df	p-value
<i>Spatial error</i>			
Moran’s I	7.621	1	0.000
Lagrange multiplier	40.385	1	0.000
Robust Lagrange multiplier	2.695	1	0.101
<i>Spatial lag</i>			
Lagrange multiplier	51.264	1	0.000
Robust Lagrange multiplier	13.574	1	0.000

¹² ITU data on national investments (ITU, 2003).

¹³ It seems quite a reasonable hypothesis, when compared to the results of other studies like Technopolis et al. (2002).

¹⁴ In our model, GDP growth rate is due only to ICTs development; the do-nothing scenario in fact does not envisage any growth.