

eAdoption: Italian Case Study

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Abstract: The digital divide can occur either as a “local” (within a given country) or a “global” (between developing and industrialized countries) phenomenon. Our study intends to analyze the digital divide in Italy and the factors contributing to this situation at territorial level (i.e., macro areas: North, Center, South) and at the provincial level. To do this, we used the registration of Internet domains under the “.it” country code Top Level Domain (ccTLD) as a proxy. In particular, we analyzed domain names registered by firms. The analysis produced interesting results: the distribution of domains registered by firms in Italian provinces is more concentrated than the distribution related to income and to the number of firms, suggesting a diffusive effect. Furthermore, in order to analyze the factors that contribute to the presence of a digital divide at the regional level, a regression analysis was performed using demographic, social, economic and infrastructure indicators. The results show that Italian regions with good productive efficiency measured by the added value per employee and a high educational level measured by the number of firms specialized in the ICT service sale (Internet Service Provider) and by the number of employees devoted to research and development are the best candidates for the utilization of Internet. Our preliminary conclusion is that, far from being an “equalizer”, Internet technology follows and possibly sharpens existing differences in economic opportunities within industrialized countries like Italy.

Keywords: Internet diffusion, Digital Divide, Domain names.

1. Introduction

Internet growth has captured the imagination of users, policymakers, entrepreneurs, corporate managers, military strategists, social commentators, scholars and journalists (Guillèn & Suarèz, 2004). The Internet is seen by some researchers as a new technological means that will lead to a “smaller, more open world” (Tapscott & Caston, 1993). According to some researchers the Internet symbolizes “the triumph over time and space” the rise of the “netizen”, and the crowing of the “customer as sovereign” (Gilder, 2000).

According to Coffman, Odlyzko (2001) the Internet is a means of communication that is expanding very rapidly. Studies carried out by the Network User Association (NUA Ltd) estimating the worldwide on-line population in 1999 and in 2002, showed that in Europe the number of individuals on-line came to 190.91 million in 2002, compared to 47.15 million in 1999.

Companies as well as individuals also turn to the Internet to exploit its communication potential. Today, information infrastructures are available to the individual consumer, and telematics networks reduce the cost of communications. This statement agrees with economic literature (Hoffman & Novak, 1996), which confirms that the Web is becoming a dynamic and personal means of communication.

According to other authors (Bassi, 2002) the spread of the Internet and the functions of electronic commerce will permit individual clients to choose from a wide array of products and

reduce costs, selecting and buying goods directly from the source and allowing companies to sell by passing traditional channels. Scandinavia, at 8.6%, leads the countries with the highest percentage of on-line sales, usually computers and related products, travel, video and music, and books.

This situation could prove to be quite worrisome for traditional businesses, as emerges from a survey carried out by the Syndicate Agents Union and representatives of the Italian Commerce in November 2000. However, companies must adopt entirely new forms of commercial activity so that online sales will be successful. The advantages for businesses provided by Internet are not only linked to the sale of products and services (direct advantages) but can also be indirect (Hansons, 2000). For example, among the most important of these are reduced costs, image consolidation, greater customer loyalty, and a wider diffusion of products offered by the company. They are referred to as “indirect” since they do not lead directly to sales and do not generate immediate profits; however, they are important since they will probably be the greatest benefits offered to businesses by Internet. The gradual confirmation of Internet as a means of communication also permits companies to access data and a variety of other information. For example, it is possible to rapidly obtain information about the market in which one operates by visiting websites specialized in economic information or areas that furnish updates on laws, price changes, the appearance of new operators in the field, fairs, competitive bidding, and other news of interest to operators. One can also identify the competition and analyze them by means of information published on company websites, etc.

Our study analyses the spread of the Internet among Italian firms utilizing the number of domain names registered under the country code Top Level Domain (ccTLD) “.it” as a metric. We took into consideration domain names (names that are associated to IP addresses in the net) because, today it is very important for a firm to have a domain name, as through this name it can exploit the above mentioned direct and/or indirect advantages. Moreover, it is helpful for a firm to register a domain name not only to have its own web site, but also to benefit from the advantages related to on-line means of communications (for example e-mails, FTP and so on). As a matter of fact, on-line means of communications unlike traditional ones (for example call-center services or telemarketing) are more effective as they allow firms to reach, for example, several customers at the same time, and more flexible, as some of them allow customers to solve problems on their own (for example through the FAQs). In this way, a twenty-four hours a day access to resources is granted. On the contrary, traditional customer care methods require intensive work and a considerable engagement of resources to ensure prompt and accessible assistance.

Besides, the analysis of the Internet presence in various social activities and economic and political areas indicates a critical issue: the existence of a “digital divide” between those who possess the material and the cultural conditions to exploit new technologies, and those who do not, or those who lack the crucial ability to adapt to the rapid continual change that characterizes the Internet today (Warschauer, 2001; OECD, 2001, Kirkman et al. 2002; Norris, 2001; Rogers, 2001). Therefore, it is not surprising that the announcement of the Internet potential as “a liberty, productivity and communication instrument, goes hand in hand with the digital divide exposure” caused by the uneven Internet diffusion (Castells, 2001). The 1999 World Human Development Report written by the United Nations organization considers the number of Internet users as one of the most widely used indicators to show the divide between rich and poor countries. Statistics carried out by the International Telecommunication Union indicate that by the end of 2002 Internet users in continents such as Africa, Central America and South America were represented only by 1% of the population while this percentage went up to 50-60% in countries such as Iceland, United States, Scandinavia, Singapore or South Korea (ITU, 2003).

In this paper we analyse the factors contributing to the existence of a digital divide in Italy, taking into consideration not only economic variables, but also educational, cultural, demographic and technological variables.

2. Methodology

Several metrics are available for measuring Internet diffusion. The most convenient are the so-called endogenous metrics, which can be “obtained in an automatic or semiautomatic way from the Internet itself” (Diez-Picazo, 1999). These metrics have the undeniable advantage of the accuracy, being based on automatic data collection and retrieval; in addition they allow a good geographical characterization of the phenomenon being based on data that allow differentiation of users on a national, regional and provincial level. Among the endogenous metrics, according to literature, the most frequently used ones to evaluate Internet diffusion analysis are Internet hosts based on host count procedures (see studies published by Internet Software Consortium or by RIPE-Network Coordination Centre) and second-level domain names (Naldi, 1997; Zook, 1999; Bauer, Berne and Maitland, 2002). Despite the advantages offered by endogenous measures, there are also a few disadvantages, since in some cases they tend to underestimate and in others overestimate the phenomenon being studied (Zook, 1999, 2000, 2001). Overestimation can occur if the number of hosts is used, because they can be associated to multiple IP addresses, while if we consider the number of domains registered, more than one domain may be associated with the same registrant. Underestimation can occur because not all Internet users register a domain name under their own ccTLD (in many countries the regulations allow foreign citizens to register under their own ccTLD for example, Italy allows organizations and citizens of in the European Union countries to register under the “.it” ccTLD).

In the case of hosts, underestimation may be due to the growing presence of firewalls and private networks (Intranet) and the use of dynamic IP addresses, increasingly accompanied by new tools for access to the Net (for example, mobile phones). In spite of these disadvantages, the numbers of hosts and Internet domains are the principal means utilized for analyzing Internet diffusion.

To measure Internet diffusion in Italy among firms, we used the endogenous measure of second-level domain names registered under the “.it” ccTLD, managed by the Institute of Informatics and Telematics of CNR, Pisa, using data extracted from the databases of registrations, using automatic and semi-automatic procedures. We created a new database for analyzing Internet diffusion by initially consulting the WHOIS database (the latter contains information on the domain names registered under the “.it” ccTLD, on applicants who have signed a contract with IIT-CNR and on technical and administrative contacts) using an automatic procedure; for example in order to determine the category of the applicant, the automatic procedure verified whether a ORG field (organization name) and a DESCR field (description of the organization registering the domain name) were present and if there were, depending on the values of these fields, the applicant was classified as a firm. If the ORG or DESCR fields were wrong, the database LAR was consulted (the LAR is the Letter of Assumption of Responsibility through which the applicant assumes full civil and penal responsibility for the use of the domain name requested) (semi-automatic procedure). Finally, where LAR information was not enough accurate the Italian Chamber of Commerce database was consulted.

Approximately 1,000,000 domain names were analyzed and grouped into several categories (individuals, firms, universities, associations, public groups and other registrants). In this paper particular attention, was paid to the registration of domain names by firms.

Moreover, to reduce the aforementioned disadvantages regarding the overestimation of Internet diffusion when using domain names as a yardstick (in other words, if an organisation

has registered multiple domain names) in this paper only the first one registered in the order of data has been taken into account.

From this research performed up to December 31, 2004, it was established that the number of domains registered by firms came to 411,339 of which 407,030 were registered by Italian firms and 4,309 by foreign firms. Furthermore, 1,944 domains registered by Italian firms were not classified since it was impossible to discover the province of origin.

3. Results

To measure the digital divide among Italian regions (Italy is divided into 20 regions) we utilized as metrics the number of domain names registered by firms under the ccTLD “.it”, the penetration rate calculated every 100 firms, an index calculated by Zook and the Gini index (Gini, 1960).

The Zook index “Domain name Specialization Ratio” is “a useful technique for comparing regions which indicates the extent to which a region is specialized in domain names compared to the United States as a whole” (Zook, 1999).

That index has been used by Matthew Zook to define the digital divide in the United States utilising the number of domains registered by the firms under the ccTLD “.com” (Zook, 1999, 2000, 2001) as metrics and it is calculated in the following way:

Domain name Specialization Ratio = (Number of .it domains in a region / Number of firms in that region) divided by (Number of .it domains in a country/ Number of firms in a country)

An index value greater than one indicates a higher specialization than the national average and an index value less than one indicates a lack of specialization.

The penetration rate formula is as follows:

Penetration rate = (Number of .it domains in a region* 100)/Number of firms in that region

Our research shows and it is in line with the literature, even if some regions have a high specialization rate compared to the national average (for example Lombardy, Trentino Alto Adige, Tuscany, Latium) the variance among the analyzed regions could be extreme (Zook, 1999).

As mentioned before, an additional measure that was adopted in order to verify the existence of digital divide in Italy is the Gini concentration index. The Gini index assumes values equal to 0 and 1. Value 0 indicates a situation of equidistribution and 1 signifies the maximum concentration. The aim of the “statistical theory of concentration” is to furnish tools and techniques for measuring the concentration in concrete situations and/or for comparing the degree of concentration among heterogeneous situations.

The Gini index calculated on the number of registered domains (that number should not be confused with the penetration rate) confirms the above-mentioned results. Only firms with head offices in some provinces of Italy register a high number of domains while firms with head offices in other provinces (especially in the South of Italy) shows scarcely significant percentages. The first ten Italian firms with head offices in a specific province register nearly half of the domains compared to the national totality (43.74%).

The study also compares the number of domains registered by firms with the total income of the province itself and with the number of firms of that province. This analysis allows us to verify if the distribution of the registered domains is similar to the number of the existing firms and income distribution. In other words we wanted to verify if the Italian areas that are the richest and the most industrialized are also the most inclined to use the Internet.

Table 1 shows that the Gini index, calculated on the number of the registered domains, is higher than the index calculated according to income and number of firms; this to signify that

in Italy the most industrialized and richest provinces not always come first in the registration of domain names.

Table 1: Gini concentration ratio

Gini index	
No. of registered domains	0.543
Number of firms	0.468
Total income provinces	0.466

A first conclusion, that comes from the observation of these results, is that Internet cannot be considered as a spreading phenomenon capable of closing the gap among Italian regions and provinces: domain names distribution proves to be more concentrated than the income level and the number of firms. This to signify that Internet is far from being an equaliser, it rather intensifies the differences among Italian areas.

3.1 Factors that cause the digital divide

To identify the key factors contributing to the existence of the digital divide at a regional level (the survey has been conducted at a regional level and not at a provincial level as many variables were available only at a regional level) we identified five models:

- Model 1: stepwise regression taking as dependent variable the penetration rate calculated every 100 firms and as independent variables economic indicators;
- Model 2: stepwise regression taking as independent variables indicators expressing the cultural liveliness of a given region;
- Model 3: stepwise regression taking as independent variables indicators expressing the educational attainment of a given region;
- Model 4: stepwise regression taking into consideration demographic indicators;
- Model 5: stepwise regression taking into consideration as independent variables indicators connected to the Information and Communication Technologies (ICT)

In the stepwise regression the independent variables are inserted in the equation if the F probability is of ≤ 0.050 while they are removed from the equation if the F probability is of ≥ 0.100 .

Nevertheless all models show the multicollinearity problem: the variables studied in each model could be correlated to the independent variables examined in the other models generating an evaluation distortion. For example the independent variable number of registered patents of model 1 could be correlated in a positive or negative way to the independent variable number of employees devoted to research and development of model 3.

3.1.1 Model 1

Model 1's purpose is to verify if the disadvantaged areas in terms of economic development are also disadvantaged in terms of Internet diffusion.

In this model the only significant variable that expresses the variance for the 64.4% of Internet diffusion among Italian regions is the added value per employee (see table 2). The rest of the variables analyzed in the model (see table 3) prove to be scantily significant as they do not reflect the literature (Chinn and Fairlie, 2004; Hargittai, 1999; Guillèn & Suarèz, 2001, Maitland & Bauer, 2001, Norris, 2001). Besides, although the above mentioned variables prove to be little significant in expressing variance at a regional level, the economic indicators such as total income, per capita income, number of registered patents every 100 firms and the percentage of big firms are positively correlated to the penetration rate. Table 3 indicates the above described trend.

Table 2: Coefficients (a) $F = 32.62$ $SIG. = 0.000$ $R^2 = 0.644$

Model		Non standardized coefficients		Standardized coefficients	t	Sig.
		B	Standard Error	Beta		
1	(Constant)	-13.383	3.909		-3.423	.003
	added value per employee.	.000	.000	.803	5.711	.000

a dependent variable: Penetration rate

Table 3: Pearson's correlation matrix

	Penetration	added value per employee.	Percentage big firms	Total income	Per capita income	Registered patents every 100 firms
Penetration	1.000					
Added value per employee.	0.803**	1.000				
Percentage big firms	0.539*	0.637**	1.000			
Total income	0.480*	0.510*	0.921**	1.000		
Per capita income	0.737**	0.828**	0.314	0.166	1.000	
Registered patents every 100 firms	0.702*	0.717**	0.701**	0.611**	0.478*	1.000

** the correlation is significant at the 0.01 level; * the correlation is significant at the 0.05 level

3.1.2 Model 2

According to economic literature (Florida 2002) there's a strong correlation between technological indicators and indicators that point to cultural activities. The model 2 seems to confirm this combination. In fact, according to Florida, U.S. cities that have experienced the highest rate of growth in the '90s are those that combine strong technological activity, exciting social environment, and tolerance to deviance. These factors are attractive for the so called creative class, i.e. the growing sector of the economy working to creative tasks, from research to design, from consultancy to advertising.

The results are shown in table 4.

Table 4: Coefficients (a) – $R^2 = 0.34$ $F = 9.442$

Model		Non standardized coefficients		Standardized coefficients	t	sig.
		B	Standard Error	Beta		
2	(Constant)	7.464	0.663		11.266	0.000
	spending in theatres and music	3.557E-05	0.000	0.587	3.073	0.007

a dependent variable: Penetration rate

Although the model is rather plain, it expresses only the 34% of the ICT diffusion variance among Italian regions, the independent variable have a statistically significant positive effect in the ICT diffusion, In fact there is a positive correlation between “spending theatres and music” variable and registered penetration rate (Beta is equal to 0.587).

3.1.3 Model 3

Table 5 shows that the educational attainment plays an important role in the ICT diffusion among firms, the model expresses the 93.4% of the Internet variance diffusion among Italian regions: regions with a number of employees devoted to research and development and with a

higher number of Providers/Maintainers (the Providers/Maintainers are the companies registering a .it domain name for somebody else, offering connection to the Internet services, managing electronic mail and so on - in practice they are the companies specialized in the ICT services) are more inclined to utilize the new technology.

Table 5: Coefficients (a) - $R^2=0.938$ $F=56.58$ $Sig.=0.000$

Model		Non standardized coefficients		Standardized coefficients	t	Sig.
		B	Standard Error	Beta		
3	(Constant)	8.422	1.015		8.294	0.000
	Providers/Maintainers every 1000 firms	29.844	3.663	0.702	8.148	0.000
	graduates in technical scientific subjects	-0.086	0.015	-0.430	-5.849	0.000
	number of graduates every 1000 inhabitants	-0.033	0.011	-0.232	-2.884	0.011
	number of employees devoted to research and development	0.442	0.175	0.195	2.518	0.024

a dependent variable: Penetration rate

Besides, a worth mentioning result according to us, is that the number of graduate people, unlike the other variables expressing the educational attainment level at a regional level, cannot be considered as a factor that affects Internet diffusion among firms, the beta tanking into consideration the number of graduates every 1000 inhabitants proves to be negative and significantly different from zero (the beta is equal to -0.232 at a significance level 0.01) (see table 5). This means that regions with a high level of educational attainment calculated in terms of graduates, register a lower penetration rate. This trend is explained by the fact that in less industrialized areas and where job opportunities are scanty, 19 years old youngsters continue their studies and tend to graduate with the hope of finding a job more easily (usually they find jobs in the North or in the Centre of Italy anyway) while in the northern and central regions that are more industrialized and where there are wider job opportunities young individuals tend to discontinue their studies and start working usually soon after secondary-school diploma.

3.1.4 Model 4

Model 4 shows that there is a linear relation between the demographic indicator and the registered penetration rate (that model expresses the variance of the 68% of the Internet diffusion). Regions with a high unemployment are less inclined to utilize the new technology, the correlation between the penetration rate and the unemployment proves to be negative and significantly different from zero, the beta is equal to -0.754 (see table 6).

Table 6: Coefficients (a) - $R^2 = 0.680$ $F = 18.079$ $Sig. 0.000$

Model		Non standardized coefficients		Standardized coefficients	t	Sig.
		B	Standard Error.	Beta		
4	(Constant)	10.239	0.719		14.231	0.000
	Unemployment	-0.263	0.048	-0.754	-5.488	0.000
	Residing population	4.154E-07	0.000	0.375	2.731	0.014

a dependent variable: Penetration rate

3.1.5 Model 5

As it could be expected even the model 5 is confirmed: the infrastructure supply is a good indicator to measure the existence of the digital divide: the technological indicator has also a statistically significant positive effect on the ICT diffusion (see table 7), in addition the correlation between the penetration rate and the indicator that expresses infrastructures in ICT proves to be positive and significant to a 0.001 level, (the beta is equal to 0.673) this means that some regions with a high investment in IT register also a high penetration rate.

Besides, even the above-mentioned model expresses a variance of only 45% of ICT diffusion among Italian regions.

A first conclusion is that even if in Italy, as literature suggest (Guillén and Suárez, 2001; Kiiski and Pohjola, 2002; Chinn and Fairlie, 2004), infrastructures play an important role in determining the digital divide; economic indicators and indicators related to the educational attainment are also important to explain the differences about Internet use among Italian regions.

Table 7: Coefficients (a) - R2=0.45 F=14.878 Sig. = 0.001

Model	Non standardized coefficients		Standardized coefficients	t	Sig.	
	B	Standard Error.	Beta			
5	4.705	1.162		4.047	0.001	
	Ratio of IT expenditure in each region and number of firm in that region	1.077	0.279	0.673	3.857	0.001

a dependent variable: Penetration rate

4. Conclusions

Our paper aimed to analyse the factors causing the existence of the digital divide in Italy. The econometric analysis shows that the indicators related to education, in particular the number of firms specialized in the ICT services sale, substantially contributes to the existence of the digital divide among firms that have their head offices in a given region and, as economic literature suggests (De Arcangelis et al., 2002), also the number of employees devoted to research and development becomes a crucial element.

Another key factor causing the existence of a digital divide in Italy, according to the results obtained by other researchers (Kiiski and Pohjola, 2002) is determined by economic indicators. Especially in Italy the added value per employee is a variable that significantly expresses the variance of the Internet diffusion among Italian firms. Although the technological indicator, calculated according to investments in IT among Italian regions, is an important factor contributing to the existence of the digital divide in Italy, it does not express significantly the variance of Internet diffusion at a regional level. This result disagree with some researchers.: Chen, Boase e Wellman 2002, and UCLA, 2000, 2003, for example, finds that, in addition to income, access costs are strong predictors of Internet use.

Finally, according to the results obtained we want to highlight that in Italy in disagreement with other researchers (U.S. Department of Commerce, 1999 and Chinn and Fairlie, 2004), even if the variable showing the educational attainment at a regional level (e.g. the number of graduates calculated every 1000 individuals) has also a statistically significant effect in the ICT diffusion, the correlation between this variable and the penetration rate registered by firms in a given region prove to be highly negative. This means that the regions with a high number of graduates, in proportion to the residing population, are the less inclined regions to utilize the new technology.

However, the results obtained in this paper illustrate the factors contributing to the existence of a digital divide at a regional level, utilizing the number of domains registered by firms as metrics. It is obvious that dealing with firms, instead of the number of graduates, economic and educational indicators, such as the number of employees devoted to research and development or the number of providers/maintainers are the best elements contributing to the existence of the digital divide among firms. On this point, in a future research, it would be desirable to analyze Internet diffusion in Italy among individuals and to compare the results obtained with the analysis carried out in this paper. In conclusion, the digital divide in Italy depends on the educational attainment level on regions that are productively efficient (that efficiency is calculated in terms of added value per employee) and with a low unemployment.

Besides, we not only identified the factors contributing to the existence of a digital divide in this paper, but also, analyzing data, we observed the presence of a serious issue: Italian regions with a low economic development and regions with a wide unemployment appear to be underdeveloped even from a technological point of view. The difference between those who use the Internet and those who do not is another factor that contributes to the widening of the gap that makes geographical areas uneven (Northern and Central areas of Italy not only are more industrialized, richer, and with a high productive efficiency compared to Southern ones, but are also the areas that have higher penetration rates). In the first instance the Internet could be a pervasive phenomenon justified by the decentralized, non-hierarchical, immaterial nature of the Internet technology (Negroponte, 1995), which in principle should not have strong barriers to entry as it happens in manufacturing (for example if a new manufacturing company decides to enter a highly competitive sector of the market, barriers could be represented by big companies with strong contractual powers or by high investments costs required to enter the market). This means that everyone in Italy could use the Internet to exploit its potentials seeing due to its low access costs. Besides Internet is a resource that if used by an individual, this does not reduce the possibilities of being used by someone else (immaterial nature), but on the contrary it brings benefit not only to that individual but also to all the users (net externality, Metcalfe law) (Hansons, 2000). Data show that this effect does not take place at all at a provincial level. Domains are even more concentrated than the number of firms and income. A ranking of provinces by penetration rate, shows that the distribution of Internet follows large differences in the level of income: even if some provinces have a high number of firms and high income, not always they are also the first in terms of registered penetration rate. Before drawing conclusions, these data should be compared to those on the use of domains by other categories (e.g. individuals, associations, public bodies and so on), and this comparison is currently in progress. Our preliminary conclusion is that the research indicates that the Internet sharpens the digital divide, rather than being an equalizer. Future research will be dedicated to verifying if those who are more inclined to use the new technology today, in the future will reach a first level of saturation, and the network will also spread among those who are disadvantaged in terms of accessibility and costs.

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