INTERNET DIFFUSION AMONG ITALIAN FIRMS: THE DIGITAL DIVIDE EXISTS

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Abstract: The digital divide can occur either as a "local" (within a given country) or "global" (between developing and industrialized countries) phenomenon. Our study intends to offer an important contribution by analyzing the digital divide in Italy and the factors contributing to this situation at the territorial level (i.e., macroareas: North, Center, South and at the regional level). To do this, we used the registration of Internet domains under the ".it" ccTLD as proxy. In particular, we analyzed domain names registered by firms. The analysis produced interesting results: the distribution of domains registered by firms in Italian regions is more concentrated than the distribution according to income and population, suggesting a diffusive effect. Furthermore, when analyzing the factors that contribute to the presence of a digital divide at the regional level, regression analysis was performed using social, economic and infrastructure indicators. Results show that Italian provinces that have good productive efficiency, a high cultural level, and greater spending for investment in telephony and telematics are the best candidates for utilization of the Internet.

1 INTRODUCTION

The analysis of the Internet presence in various social activities and economic and political areas indicatess a serious problem: the existence of a "digital divide" between those who possess the material and cultural conditions to exploit the new technologies, and those who do not, or who lack the crucial ability to adapt to the rapid continual change that characterizes the Internet today (Warschauer, 2001; OECD, 2001).

The term "digital divide" first appeared in the 1990s during the privatization phase of the Internet, to indicate a condition of relative disadvantage experienced by certain user categories in terms of accesssibility and cost - for example, by residents of inland areas compared to those on the East and West coasts (NTIA, 1995, 1998, 1999, 2000, 2001). Many studies have been conducted at the national and international levels concerning Internet diffusion, and reveal the presence of a digital divide between developing and industrialized countries ("global digital divide") as well as within a given country ("local digital divide").

Furthermore, the presence of the digital divide has stimulated researchers and governments worldwide to identify contributing factors and propose methods for reducing this gap.

There are two schools of thought regarding this subject. Some authors, for example Dasgupta et al. (2001), maintain that the digital divide is a problem which exists and will continue to persist because "development researchers" do not see the potential benefits of Internet use in poor countries. Duncombe (2000) insists that Internet access is not justified among the African poor because lack of information will prevent them from using technology. Others believe that in the future, the benefits of the web will also spread among those who are disadvantaged in terms of accessibility and cost; it is only a question of time, whereas those who are currently more apt to use the new technology will reach a saturation level (Norris, 2001; Roger, 1995). Other studies (Lal, 1996; Anand, 2000; IDC, 2000), in agreement with this theory, confirm that where Internet services are available, poor families do not appear to hesitate or be incapable of using the new technology. Bayes (1999) noted the rapid adoption of e-mail by families in Bangladesh as a cost-effective alternative to telephone calls. In a recent study involving more than 100 companies in developing countries, Rajkumar (2000) discovered that Internet use was accompanied by increased exports and sales, and encouraged greater customer loyalty. Kenny et al. (2005) showed that since the mid-1990s the increase in Internet users in the developing world has been

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more rapid than the growth rate in wealthy countries. South Asia, the Middle East, and Africa are far behind in terms of hosting web sites. "The situation of computers in education is similarly mixed "

According to the economics literature, factors determining the presence of the digital divide in the world do not derive exclusively from the impact of income level (Chinn and Fairlie, 2004; Norris, 2001).

Some studies show that low-income countries that have undergone considerable reform towards competition saw a growth of 80% in fixed and mobile teledensity compared with non-reformed countries (Kenny at al., 2003). In a study based on the experiences of 86 countries from 1985 to 1999 Fink et al. (2001) show that sector reforms have a higher percentage of "mainline provisions" and a higher percentage of labor productivity compared with non-reformed countries. Studies show that competitive provision reduces the cost of infrastructures for Internet access (Rassotto et al. 2004; Qiang and Pitt, 2003; Reynolds et. al. 2004; Wallsten, 1999). Other factors having some impact on Internet use are schooling and illiteracy, urbanization and electricity consumption (Kenny at al. 2005; Dasgupta, Lall and Wheeler, 2001). Regarding the extent of e-commerce, studies once again suggest the critical role of the underlying infrastructure but also point out the importance of strong institutional structures in the form of the "rule of law" and the availability of reliable methods of payment such us credit cards (Kenny at al., 2005; Oxley and Yeung, 2001).

2 METHODS

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" (Diaz-Picazo, 1999). These metrics have the undeniable advantage of accuracy; according to the literature the most frequently used are Internet hosts based on hostcount procedures (see studies published by Internet Software Consortium or da RIPE-NCC) and second-level domain names (Naldi, 1997; Zook, 1999; Bauer, Berneand and Maitland, 2002).

To measure the analysis of Internet diffusion in Italy, 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.

Despite the advantages offered by endogenous measures, there are also a few disadvantages, since in some cases they tend to underestimate and in others to overestimate the phenomenon being studied (Zook, 1999, 2000, 2001). Overestimation can occur when the number of hosts is used, often associated with 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, and in many countries the regulations allow foreign citizens to register under their own 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.

The Institute for Informatics and Telematics (IIT-CNR), which manages the ".it" ccTLD Registry, is conducting a study analyzing the diffusion of Internet use in Italy. Data were extracted from the databases of registrations managed by the IIT-CNR, using automatic and semi-automatic procedures [This means that we have created a new database useful for analyzing Internet diffusion by initially consulting the WHOIS[1] database using an automatic procedure, for example in order to determine the category of the applicant, the automatic procedure verified whether a ORG field existed and if there was, classified it as a firms. If the field was erroneous, the LAR[2] database (semi-automatic procedure) was consulted]. Approximately 550,000 domain names have been analyzed and grouped into several categories (individuals, firms, universities, associations, public groups, foundations,

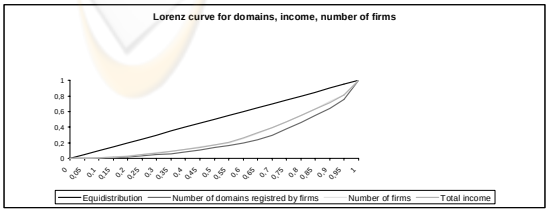
[1] The WHOIS database contains information regarding the domain names registered under the ".it" ccTLD, applicants who have signed a contract with IIT-CNR and technical and administrative contacts.

[2] The LAR is a letter requesting the registration of a domain name, with which the applicant assumes full civil and penal responsibility for the use of the domain name requested. To be able to register a domain name under the "it." ccTLD, firms must send the IIT-CNR (Pisa) a LAR , containing the applicant's identifying data, declaration of the knowledge of basic principles for use of resources and the Internet, and examination of the laws established by the Rules Commission, concerning the technical registration procedures.

committees, and other organizations) in order to identify the determinants of adoption and then of diffusion, for each category. A careful data cleaning procedure was followed. As of September 7, 2001, the database WHOIS contained 265,437 domains registered by companies, of which 3,503 were domains registered by companies with their legal headquarters in the various EU countries. The remaining 3,331 domains were not classified, since it was impossible to ascertain the area where these companies operate. A total of 258,603 domains registered by businesses were analyzed.
thermore, in this paper we will only consider one domain name for each business: in other words, if a company registered multiple domain names, we considered only the first one registered.

3 RESULTS

As the literature suggests, analysis shows that a technological divide exists among companies operating in specific geographic areas in Italy. As shown in the following Figure, the North is more likely than other areas to use the new technology. Since Italy is divided into 20 administrative units called regions, in this article we have found it advisable to analyze internet diffusion by region. Lombardy, Alto Adige and Lazio (in that order) are the regions showing the highest penetration rates (penetration rate is calculated by dividing the number of domains registered by companies by the number of companies in Italy, and multiplying the ratio by 100. At the macro-area level, the relative penetration rate recorded in North and Central Italy are higher compared to the South (7.23 and 7.07 respectively for every 100 companies, compared to 4.04 in the South.). The calculation of the Gini index and the construction of the Lorenz curve show that the concentration of domains is higher compared to the number of firms and total income. The Gini index, calculated according to the number of domains registered, was 0.557 compared to 0.468 computed according to the number of companies and 0.466 calculated according to total income.



3.1 Determinants of adoption

According the OECD (1999), the digital divide is the distinction between "Who has and who does not have access to information (OECD)". Several aspects of this phenomenon exist. It is possible to observe a digital divide among countries (international digital divide), among individuals or organizations and within a country at the local level (domestic digital divide). In order to analyze whether there is a domestic digital divide in Italy, we ran exploratory stepwise regressions using economic and social indicators at the regional level.
This allowed us to examine the determinants of Internet diffusion, by singling out the factors leading to registration of domains by company. The dependent variable of our regression models is the penetration rate calculated as
Penetration Rate = (Number of domains registered by companies/number of companies)*100;
We constructed three model. The first two (M1, M2) analyzed the influence on Internet diffusion of two key economic factors: per-capita income and added value per employee and model 3 using social, economic and infrastructure indicators.
As expected, these two variables positively correlated with penetration rates per capita income and value added per employee (0.701 and 0.827 respectively).

Table 1: Stepwise regressions with per capita income as independent variable

$R^2 = 0.49$

Coefficients

Model		Non-standardized coefficients		Standardized coefficients	t	Sig.
		B	Standard Error	Beta		
1	(Costant)		1,604		-,688	,500
	per capita income	,000	,000	,701	4,173	,001

Table 2: Stepwise regressions with per added value employee as independent variable

$R^2 = 0.68$

Coefficients

Model		Non-standardized coefficients		Standardized coefficients	t	Sig.
		B	Standard Error.	Beta		
2	(Costant)	-10,836	2,619		-4,138	,001
	added value employee	,000	,000	,827	6,253	,000

The economic literature, in fact, underlines that differences in income distribution play a crucial role in explaining differences in ITC access and

utilization (Norris, 2000; Pohjola, 2002, Hansons, 2000 Warschauer, 2001). We included these crucial indicators in distinct models in order to address multicollinearity problems. Per capita income and added value per employee are very likely to be correlated with other social and economic indicators at a local level, generating distortions in the estimated coefficients. Although it includes only a independent variable, the model is quite powerful, and explains about 49% per cent of the variability in registrations among Italian regions. The coefficient of per capita income is highly significant and has the expected sign, showing a positive influence of per capita income on Internet diffusion at a local level. Quite similar results are obtained in M2 including the added value per employees as independent variable. The R2 is even higher, stating that the efficiency of the productivity structure account for 68.5 % of the variability in the Internet diffusion. As previously stated, and in agreement with the economics literature, the variation in Internet diffusion between regions may derive from other factors as well. In the model 3 (Table 3) we analyzed the stepwise regression, taking into consideration as dependent variable an economic factor (employees in the service sector); one related to education (number of college graduates); a socio-cultural variable (spending for theatrical and musical performances); one related to infrastructure (founds for telephony and telematics) and one relative to public spending (hydraulic works and electrical systems).

Table 3: Stepwise regressions taking as dependent variable

Coefficients

Independent variables	Non-standardized coefficients		Standardized coefficients		
	B	Standard Error	Beta	t	Sig.
Service sector employees	1,719E-06	,000	,545	2,761	,013
Number college graduates	,000	,000	,548	2,703	,015
Spending theater and music	2,834E-05	,000	,657	3,697	,002
Founds for telephony and telematics	,033	,008	,708	4,254	,000
Hydraulic works and electrical systems	1,255E-05	,000	,543	2,743	,013

the penetration rate of the companies

The Table shows that regions that spend considerable funds on musical and cultural activity are more likely to use the new technology (spending for theater has the second-highest Beta value compared to the other variables). As might be expected, the index of spending for telephony and telematics also plays an important role (the Beta is equivalent to 0.708). In fact as the literature proposes (Warschauer, 2001) one of the determining factors in Internet diffusion is the presence of adequate network infrastructures.

In brief, it is possible to conclude that regions with an efficient and service-oriented structure, a lively cultural scene, and a good educational level (greater number of college graduates) are more inclined to use the new technology and are the best candidates for a more active and interactive use of the Internet.

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