UNIVERSAL SERVICE POLICIES IN EUROPE & LATAM: EVIDENCE ON BRIDGING THE DIVIDE IN RURAL AREAS

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UNIVERSAL SERVICE POLICIES IN EUROPE & LATAM: EVIDENCE ON BRIDGING THE DIVIDE IN RURAL AREAS

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Abstract: Broadband access is a key factor for economic and social development. However, providing broadband to rural areas is not attractive to private telecommunications operators due its low or zero investment return. To deal with broadband provision in rural areas, different governance systems based on private and public cooperation have appeared. This paper not only identifies and defines public and private cooperation models but also assesses their impact on overcoming the digital divide in rural areas. The results show that public ownership infrastructure under private management policy has had positive effects on reducing the broadband digital divide and being applied to areas with higher digital divide; subsides to private operators providers only positive effects on reducing broadband digital divide; but public infrastructure with public management programs did not. The results, obtained using quasi-experimental methods, suggest the importance of incentives and control mechanisms in broadband universal service provision plans.

Keywords: Broadband, Public Plans, Digital Divide, Subsidies, Infrastructures, Universal Service, Europe, Latam, Quasi-experimental methods.

0. INTRODUCTION

The digital divide refers to the gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard to both their opportunities to access information and communication technologies (ICTs) OECD (2001), Jordana (2001) and Wikitel (2011). This gap is not only due to the lack of access but also due to the lack of training and skills to benefit from them Jordana (2001) and Warshauer (2002). The differences in ICT diffusion patterns have been studied in the digital divide literature (Dwivedi, Papazafeiropoulou, Choudrie (2008) and Choudrie, Grey & Tsitsianis (2010). The majority of studies from this literature have used a sociological approach based on individual and social determinants of Internet adoption such as income, age, education and cultural background Hargittai (1999b) and Norris (2001). On one hand, there have been some attempts to explain the ICT adoption differences using political and institutional factors such as political regimes Milner (2006) and political risk Andonova (2004). On the other hand, public policy typologies have been developed to study broadband diffusion from the telecommunications policy literature Umino (2002) Wallsten (2005), Jordana and Sancho (2003); Frieden (2005); Cava-Ferreruela and Alabau-Muñoz (2006), Lattemann, Stieglitz, Kupke and Schneider (2009). However, there is very little existing research that has addressed the impact of public policies designed to analyze the impact of policy on the broadband digital divide gap Gulati and Yates (2012). The majority of cross-country analyses in previous articles do not take into account the internal variability within the countries and regions. At the same time, some case studies about regions seem to be methodological proposals rather than empirical analyses Dwivedi, Papazafeiropoulou and Choudrie (2008). On the other hand, existing empirical analyses about broadband policy impact have not provided conclusive results about the effects of public intervention on broadband diffusion in rural areas Wallsten (2005) and Jeanjean (2010).

The issue addressed in this article is public provision of broadband service in small municipalities in Europe and Latam. Broadband does not have a unique definition based on data transmission speed Cava-Ferreruela and Alabau-Muñoz (2006). Here broadband technology is understood as an Internet connection from 64 Kbit/s to 4 Mbps. Also, broadband implies diverse technologies with similar speed data transmission, such as cable, ADSL, fiber to the home, hybrid fiber, coaxial cable and LMDS - WiMAX wireless access networks 3 G / HSDPA and satellite. All of these technologies will be considered broadband in this article, as all of them allow the transmission of data at an indicated speed. Studying broadband diffusion in small towns is relevant because it provides information about how specific governments are dealing with digital divides in the rural areas. Small areas are unprofitable for private operators due to low density populations, which are predominantly older and lower income in these areas PEBA (2011). In the majority of cases, public intervention is the only way to provide connections to these small municipalities Jeanjean (2010).

In this article, small municipalities are defined as municipalities with a population equal to or less than 10.000 inhabitants. Municipal, regional and national governments have created policies to reduce this digital divide. These policies have consisted of infrastructure creation policies and giving subsidies to private operators. Any implemented public infrastructure may be managed by either a public company or a private company. This article will: 1) create an indicator to measure digital divide based on the gap between the region and the small municipality; 2) revisit the main broadband universal service public and private model categories; 3) work with disaggregated data from small municipalities to examine the policy effects; 4) show robust conclusions using a quasi-experimental method; 5) show new findings for telecommunication policy literature and decision-makers on broadband policy impact improving previous works.

This article is organized in the following manner: section 1 presents the research questions; section 2 addresses the theoretical framework, section 3 introduces the methodological approach. Section 4 shows the results analysis. Final conclusions are presented in the fifth section.

1. RESEARCH QUESTIONS

The aim of this research is to identify, to categorize and to define private cooperation models in rural broadband provision and also assesses their impact on overcoming the digital divide in rural areas.

Digital divide could be defined as the internet access and use gap among individuals, social and cultural groups and territories. In this article, the digital divide problem is analyzed in the gap between people living in small and rural municipalities and those living in the rest of the region. The research questions are the following: What is the effect of the subsidy policy for the private telecommunications operator on the reduction of the broadband digital divide in small municipalities? What has the effect of infrastructure policy on the reduction of the broadband digital divide in small municipalities been?

1.1 Relevance of the Questions

At the theoretical level, the relevance of these research questions consists of the fact that previous studies on the digital divide have not paid enough attention to public policy's impact on digital divide reduction Krueger et al. (2000), Compaine (2001), Norris (2001), Gulati and Yates (2012) or the provision of public private broadband

models either Lattemann, Stieglitz Kupke and Schneider (2009). Even so, when some authors studied this phenomenon, they did not show conclusive evidence in relation to the private telecommunications subsidy policy effects on broadband adoption in rural areas Wallsten (2005), Jeanjean (2010). Other limitations of previous studies have been the scarcity of data on broadband connections at the local level Hargittai (1999 and 2002), Andonova (2004). This article not only analyzes data at the local level but also takes into account the dates of implementation of the policies. Moreover, studying municipalities in the same country allows using the same macro-political and educational factors and lifestyle as control variables.

At the empirical level, taking into account the regions where different broadband policies took place - Catalonia, Andalusia and Asturias, it is possible to observe important differences between the small municipalities and the rest of their own autonomous community. For instance, the Catalonian Government has opted for the policy of public infrastructure projects with private sector management and the digital divide in broadband between small towns and the rest of the autonomous community fell gradually so as to be practically non-existent in 2009 and 2010 (see Figure 1). By contrast, the digital divide between small municipalities and the rest of the autonomous community in Andalusia, where the government has chosen private operator subsidy policies, have decreased slightly but it is still significant at the end of the period (see Figure 2). Finally, the Asturian Government has opted for public infrastructure with public management and medium digital divide policy between small towns and the rest of their own autonomous community. The digital divide in Asturias between the small municipalities and the rest of the region is smaller than in Andalusia but greater than in Catalonia (see Figure 3).

2. THEORETICAL FRAMEWORK

The paper's theoretical framework examines two types of contributions: 1) Systematic typologies to classify and conceptualize broadband policies and 2) Empirical evidence about policy intervention impact on the broadband digital divide gap.

2.1 Public Policies and Digital Divide

Some authors have pointed out that studying the Internet from the social sciences point of view, such as sociology or political science, represents new challenges by testing whether or not institutional, political, economic and cultural factors facilitate Internet adoption DiMaggio et al. (2001), Enter (2007). In the digital divide literature some authors have introduced explanatory political variables, such

as the type of political regime Milner (2006), domestic institutions Milner (2006), and political risk, understood as the discretion of governments to change rules Andonova (2004). However, this research has focused more on macro-institutional or social factors rather than specific public policies Milner (2006). On the other hand, the telecommunications policy literature has developed a variety of taxonomies but has not provided vast empirical and conclusive results Umino (2002), Wallsten (2005), Cava-Ferreruela and Alabau-Muñoz (2006), Lattemann, Stieglitz, Kupke and Schneider (2009). In relation to these typologies, Gillet et al (2004) have based their typology on the role of Government in broadband diffusion. This typology provides sufficiently conceptually comprehensive and inclusive classification to collect the other existing policy taxonomies Gillet, Lehr and Osorio (2004). The typology distinguishes the following roles that can be taken by the government in the broadband promotion: 1) Government as user; 2) Government as regulator; 3) Government as financier and 4) Government as infrastructure owner. In the first case the government indirectly attracts the commercial broadband deployment through demand policies. In other words, the government uses its local leadership role as important telecommunications customer to assess, stimulate, or aggregate demand. In the second case, government as rule-maker, the government adopts reforms or local regulations that have an effect on commercial broadband deployment, such as rights of way, and agreements between operators. In the third case, where the government functions as financier, it provides subsidies for broadband users or providers to buy the necessary equipment, or as a form of a tax reduction. Finally, the government as infrastructure owner adopts policies in which a part of the public administration is responsible for final provision of one or more components of the infrastructure (see Table 1).

To sum up, the policies analyzed in this article are: 1) private telecommunications operator subsidy policy; and 2) public infrastructure ownership policies. In relation to infrastructure policies, some public infrastructures are managed by public companies and the others by private companies (See Table 2). Argentina, Brazil and some regions in Spain have chosen public infrastructures managed by public operator while Chile, Colombia, Mexico and Spain have implemented public infrastructures managed by private operator model (See Table 3).

2.2 Subsidy and Infrastructure Policy Impact on Bridging the Digital Divide

This section discusses the theoretical findings on subsidy policies for telecommunications operators and public infrastructure ownership policies. With regards to subsidy policies in rural telecommunications, there is an unfinished debate about competition and the effect of broadband adoption derived from these policies. The empirical evidence shows that subsidies could cause distortions in market competition Wallsten (2005) and could have short term effects rather than long term ones Garcia-Milà and McGuire (2001). However, other authors have shown that sub-

sidies for telecommunications operators may facilitate the connection in rural and non-profitable areas in the long run while the subsidies for consumers accelerate the broadband penetration in profitable areas in a very short term Jeanjean (2010).

For these reasons the first hypothesis is:

H1: *Policies based on private operator subsidies will tend to reduce the broadband digital divide in treated policy municipalities.*

Infrastructures plans driven by governments could promote broadband adoption because they could stimulate competition among the operators sharing the same infrastructure. In this case, the entry market conditions for those private operators providing the service would be regulated by the government. The government would maintain control of the service provision through regulation. However, this type of public intervention is generally more expensive for taxpayers in comparison to the subsidy policies. In infrastructure policy's favor, it could be argued that public intervention based on infrastructure would promote greater competition between operators than subsidizing a single operator. In relation to this debate, some authors have pointed out that there is no empirical evidence that public or mixed operators can compete better than private in universal service provision for social purposes Bauer (2005).

The second and the third hypotheses are:

H2: *Public ownership infrastructure under private firm management would tend to reduce the broadband digital divide in targeted municipalities.*

H3: *Public ownership infrastructure under public enterprise management would tend to reduce the broadband digital divide in targeted municipalities.*

3. RESEARCH DESIGN

Having discussed the theoretical background to this research, this section presents the research approach of this research. This research applies a quantitative research approach that involves analyzing datasets focused on policies at the regional, municipal and levels. For the analysis, regression analysis was undertaken using Stata software. This section provides more details surrounding this research approach.

3.1 The Variables of the Research

For this study, the dependent variable is the broadband digital divide between small and rural towns and their respective autonomous communities (CCAA). This dimension of the analysis emphasizes the cohesion between rural and urban areas within the country communities. This variable is operationalized as the difference between the broadband penetration average in the autonomous community in a given moment in time (ti) and the broadband penetration average in small towns in a given moment in time (ti). The broadband penetration is understood as the number of broadband subscribers. From a methodological point of view, this indicator allows the comparison of broadband cohesion across regions in Spain using structural factors, like the level of industrialization, or households' income and local economic activity, as control variable. The use of this dependent variable represents a novelty within the digital divide Hargittai (1999), Norris (2001), Compaine (2001) and telecommunications policy literature Wallsten (2005) Katz (2009ab); Jeanjean (2010). The independent variables are public plans for broadband service provision in small municipalities. The analyzed public plans are the telecommunications operators' subsidy policies and public ownership infrastructure policies. Each policy variable will be operationalized as a dichotomous variable, using 1 when at the moment of time the policy begins and 0 for otherwise. In Public policy studies there is always a problem of endogeneity. Endogeneity means that the policy could not only be the cause but could also be the result of a previous situation. For example, in this research the municipalities with more digital divide could have greater public intervention in relation to municipalities with a small or non-existent digital divide. To avoid this endogeneity problem, broadband penetration before the public intervention is included as a control variable Lago (2008); Friederiszick et al (2008). However, these studies focused more on tertiary attainment rather than other educational levels. Since tertiary education is less available in most countries, primary or secondary education can provide the basic skills, knowledge and interest for PC and internet use Kumar and Rego (2009). This research argues that the availability of secondary education would be a key factor for faster and higher broadband diffusion in developed countries, because this resource is more spread across nations than other types of educational levels ENTER (2007); Katz (2009a); Castellano (2010) but this evidence is still not conclusive Kumar and Rego (2009). For this reason educational level is used as a control variable in this analysis. Educational level is calculated using the population percentage by the level of educational achievement INE (2011). Three levels of education have been defined: 1) primary education; 2) secondary education and 3) tertiary education. The primary education level covers the population without education, illiterate, first level of secondary education and first cycle of vocational training (FP). The level of secondary education encompasses people who completed the second cycle of secondary education, vocational training (FP) and high school

diploma. Finally, the higher or tertiary education category corresponds to persons who completed undergraduate, postgraduate and doctoral programs. With regard to technological factors, the impact of network, which refers to the network value based on the number of users, such as computers Aron and Burnstein (2003), previous levels of Internet penetration or fixed lines Hargittai (1999), Ford et al. (2008), and mobile lines Andonova (2004) are viewed as pertinent. It should be noted that mobile lines would not be an important factor because their diffusion has less to do with institutional features of the country Andonova (2004). Despite its significant growth in recent years, mobile broadband will not be taken into account because there is a lack of a standard methodology to account for the users OECD (2011), and there is a lack of data available, which accounts for fixed telephone lines being used as the provided control variable.

3.2 Data

Secondary data was acquired from documents focused upon broadband penetration and telephone line statistical data from the years 2002 to 2009 at the municipal, regional and national levels. The documents were: The La Caixa Spain Economic Yearbook (2001-2010), the Klein Institute at the Universidad Autónoma de Madrid and telecommunications operators. The maximum level of disaggregation that has been achieved for broadband data is at the municipal level, where the policies were often implemented in the towns of municipalities. However, data from broadband penetration at the municipal level may already be sufficient to observe the policy effects. Data related to public policies are obtained from the regional governments documents: the Government de Catalonia, the Principality de Asturias Government, Ministry of Industry, and tourism and trade from the Spanish Government. Educational level data is from the National Institute of statistics (INE), and the average income of the population data is from regional statistical institutes: the Institute of Statistics of Catalonia (IDESCAT), the Institute of Statistics of Asturias (IEA), the Institute of Statistics of Andalusia (IEA) and the National Institute of Statistics (INE). The rate of aging of the population and industry participation rate hail from the social and economic municipal database from Caja España Caja España (2011).

3.3 Analysis Method

The difference in differences (DID) is an econometric non-experimental technique that analyzes a treatment effect given over a period of time. Compared to other approaches, this technique involves an intra-individual comparison, taking into account differences in the results before and after treatment, and also an estimate between individuals who were treated and those who were not. Therefore, the end result is an indicator which gives us information of two dimensions, on the one hand, the effect before and after treatment and on the other hand, the effect of having been treated and not been treated.

Causal inference methods have been applied widely in the economic evaluation of public programs to analyze their effectiveness as they yields interesting results. For this reason, the methods have been widely used in the evaluation of public programs Wooldridge (2007). In the context of public programs, the technique allows establishing of the causal effect between political action and the results by using appropriate controls. As already mentioned, the contrast of this technique can be divided into two analyses; an initial analysis that compares the differences before and then within the group of treatment and in a second analysis in relation to the control group which has not been treated. For example, to determine the effect of making a concrete plan for training and employee productivity in a company, the previous productivity level of individuals attending a training program is compared to their productivity after the training program. However, these results should be compared with the counterfactual situation if the same individuals had not carried out the training program. In other words, other external effects such as a new organizational method or the introduction of a new technology in the company might be the cause of increases in productivity rather than the program. As it is not possible for employees to attend and not to attend the training plan at the same time, the productivity levels are compared to a control group, a group of individuals with similar characteristics who did not take the training program. Furthermore, it is important to take into account that in this contrast, the individuals should be as similar as possible in order to be able to analyze that the variability is due to the treatment itself and not to other factors. Additionally, a regression analysis is used to control the effects of the treatment on outcomes and those political variables which are relevant.

Since the publication of Card and Krueger's seminal work on minimum wage increase and employment creation in fast food restaurants in New York and Pennsylvania Card and Krueger (1994), there has been an increase in studies using this technique Wooldridge (2007), European Commission (2011). One of the major constraints of this technique for this study is the lack of existence of observed characteristics that could affect the results. For example, if we study the effect of Policy A in district 1 (treated) and district 2 (not treated), and conclude that there is no effect, this could be due to that fact there was no effect or that District 2 was treated by another policy, for example, Policy B.

3.4 Unit of Analysis

The units of analysis are small municipalities, in other words, municipalities with less than 10.000 inhabitants. The municipalities chosen are from the autonomous communities (regions) of Andalusia, Asturias and Catalonia. The municipalities from each region will be analyzed separately. The criteria for choosing these autonomous communities were the following: first, the availability of data. Second, the broadband gap between small municipalities and their autonomous communities is different within each community. Catalonia has the smallest broadband gap

between small municipalities as compared to the rest of the autonomous communities, while Andalusia has the biggest broadband gap. Asturias has a smaller broadband gap than Andalusia but larger than that of Catalonia. Finally, the design of the three public plans had to be different: subsidies, public infrastructure under public management and public infrastructure under private management.

3.5 Analysis Organization

Table 4 illustrates the organization of the analysis for each of the hypotheses that was based on the programs, time, number of cases and comments. To analyze hypothesis 1, (H1) 30 municipalities in the province of Granada, Spain are analyzed by comparing those where the PEBA program was applied and those where it was not applied. The period of analysis was from January 1st, 2005 until January 1st, 2009 with the date of treatment being October 31st, 2008. Overall, there are 30 cases and 150 observations. In this analysis, the years before 2005 are not considered due to another subsidy program, the Mercurio project, being implemented in the same autonomous community in 2003; thereby causing confusion and distortion to our results. Thirteen municipalities in the Asturias municipalities of Caudal, Nalón and Narcea are analyzed to test the hypothesis 2 (H2): 7 municipalities where the program was applied and 6 where it was not. Broadband service began in December 2007. Altogether 13 cases were analyzed from 2002 to 2008, which provided a total of 91 observations. To check hypothesis 3 (H3), 18 municipalities from Lleida in Catalonia are analyzed. The BAR program created by the Government of Catalonia was implemented in six municipalities of the 18 observed municipalities. Broadband service started in November 2006. In total there were 18 cases in 6 years, represented by 114 observations.

4. RESULTS ANALYSIS

This section discusses the effects of the three described programs, PEBA, Red Asturcón and BAR project in reducing the digital divide in small municipalities. Each analysis first presents a table that compares the means of broadband digital divide before and after the implementation in those municipalities where the program was applied as opposed to those where the program was not applied. Second, it presents a regression analysis to control the policy effect using social, economic and demographic variables as a control.

4.1 Subsidy Policy effects on Broadband Digital Divide

This section discusses the public policy effects based on private operator subsidies. The PEBA was a plan promoted by the Spanish Ministry of Industry and implemented in the municipalities of Vega de Granada County, in Andalusia.

Table 5 compares digital divide averages from the Vega de Granada municipalities in the previous period of treatment, from 2006 to 2008, with the digital divide average after the treatment, 1st January, 2009. The program began on 31st October, 2008. The results of Table 5 indicate that there are some differences (0.4) between the group of municipalities where the PEBA was applied and those where this program was not implemented. Prior to the PEBA implementation, the municipalities where the program was applied had a lower digital divide average (1.58) than the average of those municipalities which were not treated by the program (2.34). After the PEBA implementation, the municipalities treated by the program experienced a digital divide reduction (-0.09) while non-treated municipalities had a higher digital divide (- 4.41), compared to the regional average. Furthermore, these differences between the groups are statistically significant (0.56). In summary, the PEBA subsidy program had a positive impact on digital divide reduction in those municipalities where the program was applied. At the end of the analysis period, included municipalities had a digital divide 0.1 % lower than the average in Andalusia.

Regression analysis was conducted to control the policy impact using other socio-demographic, economic and social variables that may be relevant in the digital divide explanation. Table 6 shows the estimator having statistical significance for each variable. The table shows that there is a significant relationship between broadband digital divide and the time that program started (0.56). However, the PEBA (2.17) program was not applied in municipalities with higher broadband digital divide within the Vega de Granada county. Therefore, the policy effect might have been lower if the program had been applied to the municipalities with higher broadband digital divide. On a relative level, the variables which most influenced the digital divide were secondary education (0.09), population aging (0.16) and telephone line availability (0.0). The secondary education variable has a negative relationship with the digital divide level - the more secondary education, the less digital divide, while population aging had a positive relationship to the digital divide level. The policy variable cannot be compared at relative terms with the other variables because the measurement units are different.

4.2 Public Infrastructure with Public Management Policy effects on Broadband Digital Divide

This section analyzes the Red Asturcón policy, a public ownership infrastructure with public management's, impact on digital divide reduction in the Asturian municipalities. Table 7 compares the digital divide reduction average before and after the program implementation in some municipalities from the Principality of Asturias. The program started on 1st January 2008. The results in Table 9 indicate differences (-3) between the municipality group where the Red Asturcón Plan was applied and those where it was not applied. However, these differences between the two groups are not statistically significant (0.7). This implies that the Red Asturcón Plan did not have any impact on the digital divide reduction in the municipalities where the program was applied.

The regression analysis results confirm that the Red Asturcón program did not have any effect on the municipalities where the program was applied (0.7). The results also show that the program was implemented in municipalities where the digital divide was lower in relation to the rest of the county (0.35). At a relative level, the most significant variable to explain the digital divide gap is population aging (0.05). Also, this variable has a positive relationship with the dependent variable, the more ageing population a municipality has, the greater the broadband digital divide (see Table 8).

4.3 Public Ownership Infrastructure with Private Management Policy effects on Broadband Digital Divide

This section analyses the BAR program, a public ownership infrastructure program managed by a private firm, and the policy effect on municipalities where it was applied. The municipalities from Segrià County in Catalonia are analyzed to examine this. Table 9 compares broadband digital divide before the treatment from 2002 to 2007, and after treatment, on 1st January, 2008. The results in Table 9 indicate that there are small differences (0.87) between the municipalities treated by the program and those that were not treated. Before the program was implemented, treated municipalities had broadband digital divide average (0.55) similar to non-treated municipalities (0.60). After the BAR project implementation, the municipalities treated by the program presented a slightly lower broadband digital divide (3.24) in relation to non-treated/non-included municipalities (3.52). These differences between the two municipality groups are statistically significant and confirm that the BAR program has had an effect on the municipalities which received this policy (0.0).

The regression analysis results in Table 10 confirm that the BAR project had an effect on the municipalities where it was implemented (0.0). However, the results also show that the program was implemented in municipalities where the broad-

band digital divide average (0.55), is similar to the municipalities where the program was not implemented (0.60). Taking into account these results, the program does have an effect and it was applied to medium broadband digital divide municipalities. According to the regression analysis, the most important variable to explain the broadband digital divide in Catalonia is the aging of the population (0.14). This variable has both a significant and a positive relationship. In other words, the more the population is aging, the more broadband digital divide the municipality has. The other variables have a statistically significant relationship. In conclusion, the results show that the BAR program had significant effects on the municipalities where the program was applied.

5. DISCUSSION & POLICY INSIGHTS

This article analyzes the public plans' impact on the digital divide reduction in small and rural municipalities from Catalonia, Asturias and Andalusia. Small rural areas are unprofitable for private operators due to low density populations, which are predominantly older and lower income in these areas (PEBA (2011). In the majority of cases, public intervention is the only way to provide connections to these small municipalities (Jeanjean (2010).

The first hypothesis establishes that public plans based on private telecommunications operator subsidies could reduce the broadband digital divide in the treated municipalities. On one hand, some authors argue that the subsidies distort the competition but their results are inconclusive in terms of broadband penetration Wallsten (2005). On the other hand, other authors have found that private telecommunications operator subsidies helped connect rural areas while consumer subsidies could accelerate new technology in urban areas Jeanjean (2010).

The empirical evidence of this analysis suggests that subsidy policy for a telecomm private operator, PEBA program, has a positive result on broadband digital divide reduction. However, the results also suggest that the PEBA program was implemented in municipalities with lower broadband digital divide in comparison to the broadband digital divide average in the county. The behavior of the telecommunication company could be explained in terms of deploying the infrastructure in more profitable municipalities, those with less broadband digital divide in the county, in order to obtain more benefits from public subsidies. Other autonomous community governments have chosen other public infrastructure plans rather than subsidize private operators. In particular, the autonomous communities of Catalonia and Asturias have created their own public infrastructure and opened it to telecommunications operators establishing their own price and service conditions. However, these two public plans are different; Asturias's public telecommunications infrastructure is

managed by a public firm while the public infrastructure in Catalonia is managed by a private firm. According to previous research, public telecommunications infrastructure plans could be a stimulus for operator competition. However, this type of public intervention is more expensive than subsidy policies Wallsten (2005).

The analysis results show that the Red Asturcón program, public telecommunication ownership managed by a public company, has not had an effect on treated municipalities. Actually, the policy treated municipalities had a lower broadband digital divide than the county average. The low performance program might be due to internal implementation factors rather than municipal factors. For instance, the private operator renting the network may not have the right incentive system or the right monitoring system to attract new customers. The third hypothesis in this article points out that public infrastructure plans managed by a private company could contribute to a digital divide reduction. The analysis results indicate that the BAR program had a positive impact in the broadband digital divide reduction. The municipalities treated by the plan had a medium broadband digital divide. The improved results of the BAR program in relation to the other program might be due to the ownership and incentives system. In relation to PEBA, the BAR program allows the public administration to keep more control over the deployment in the municipalities with higher digital divide. In relation to the Red Asturcón Program, the BAR program creates more incentives for private managers to attract new customers and better results in terms of broadband diffusion in rural areas.

Finally, it should be noted that some contextual factors such as a low education levels and an aging population are revealed as retaining factors of the digital divide. In particular the variables that seem to play a prominent role are the aging of the population, present in all cases, and relating positively with the digital divide and secondary education which seems to have more effect than other forms of education, especially in the case of Andalusia.

Using a quantitative approach this research aimed to identify and analyze the public-private models impact to overcome the digital divide. For this, we have analyzed three different broadband plans applied to Spanish rural areas. This work has identified and defined public and private cooperation models but also assesses their impact on overcoming the digital divide in rural areas. The concepts and indicators have been built in a rigorous and consistent way. The results show that public ownership infrastructure under private management policy has had positive effects on two dimensions: reducing the broadband digital divide and being applied to areas with higher digital divide; subsides to private operators providers only positive effects on reducing broadband digital divide dimension; but public infrastructure with public management programs did not. It is the first time that different public-private cooperation models impact have been examined in telecommunications policy using a quasi-experimental design. These findings create new avenues to conduct further research in telecommunications policy and useful empirical evidence to use in develop and emerging countries for policy and industry.

REFERENCES

Andonova, V.S. 2004. *Communication technologies: commercial adoption and institutional environment.* Ph D. Universitat Pompeu Fabra.

Aron, D. J. and D.E. Burnstein. 2003. Broadband adoption in the United States: An empirical analysis. In A. Shampine (Ed.) *Down to the wire: Studies in the diffusion and regulation of telecommunications technologies.* Haupaugge, NY: Nova Science Publishers.

Bar, F. and N. Park. 2006. Municipal Wi-Fi networks: The goals, practices, and policy implications of the US case. *Communications & Strategies,* 6: 107-125.

Bauer, J.M. 2005. Regulation and State regional ownership: conflicts and complementarities in EU telecommunications. *Annals of Public and Cooperative Economics,* 76 (2): 151-177.

Bel, G., X. Fageda and M. MUR. 2010. ¿Por qué se privatizan servicios en los municipios (pequeños)? Evidencia empírica sobre residuos sólidos y agua. *Hacienda Pública Española / Revista de Economía Pública,* 192 (1/2010): 33-58.

Beneke, J. H. 2008. South Africa: The Long Walk to Broadband Freedom. In Y.K. Dwivedi, A. Papazafeiropoulou and J. Choudrie (Eds). *Handbook of Research on Global Diffusion of Broadband Data Transmission,* Information Science Reference: New York, NY.

Benkler, Y., R. Faris, U. Gasser, L. Miyakawa, S. Schultze, J. Baudry, L. Baker, E. Bucher, A. Dalal, G. de Muizon. 2010. Next Generation Connectivity: *A review of broadband Internet transitions and policy from around the world.* Berkman Center for Internet & Society, Cambridge, Mass.: Harvard University.

Card, D. and A. Krueger. 1994. Minimum wages and employment: A case study of the fast food industry in New Jersey and Pennsylvania. *The American Economic Review,* 84 (4): 772-793.

Castellano, J.M. 2010. Secondary education and broadband diffusion: a qualitative comparative analysis. Info: *The journal of policy, regulation and strategy for telecommunications, information and media,* 12 (6): 121-138.

Caja España. 2011. Datos económicos y sociales de los municipios de España. [Online] Available at: http://www.cajaespana.es/pubweb/decyle.nsf (Access: 29th January 2014).

Cava-Ferreruela, I. and A. Alabau-Muñoz. 2006. Broadband policy assessment: A cross-national empirical analysis. *Telecommunications Policy,* 30 (8-9): 445-463.

Cava-Ferreruela, I. 2008. Explaining Patterns of Broadband Development in OECD Countries. In Y.K. Dwivedi, A. Papazafeiropoulou, and J. Choudrie (Eds). *Handbook of Research on Global Diffusion of Broadband Data Transmission.* Information Science Reference: New York, NY.

Choudrie, J, S. Grey and N. Tsitsianis. 2010. Evaluating the digital divide: the Silver Surfer's perspective. *Electronic Government, an Int. J.*, 7 (2): 148-167.

Compaine, B. M. 2001. *The digital divide: facing a crisis or creating a myth?* Boston: The MIT Press.

Dimaggio, P., E. Hargittai, R. Neuman and J.P. Robinson. 2001. Social implications of the Internet. *Annual review of sociology,* 27: 307-336.

Dwivedi, Y.K., A. Papazafeiropoulou and J. Choudrie. 2008. *Handbook of research on global diffusion of broadband data transmission.* Hershey: Information Science Reference.

ENTER, 2007. *Inhibidores de uso de las TIC en la sociedad española,* ENTER. Madrid: Instituto de Empresa.

European Commission. 2011. Regional Policy-Inforegio Evalsed: The resource for the evaluation of economic development. Difference-in-Differences [online] Brussels: European Commission. Available at: http://ec.europa.eu/regional_policy/sources/docgener/evaluation/guide/evaluation_sourcebook.pdf (Access: 9th April 2011)

FEDEA. 2011. Fundación de Estudios de Economía Aplicada, Observatorio de Redes de Nueva Generación [online] Available at: www.crisis09.es/redes/ (Access: 9th April 2011).

Ford, G.S., T.M. Koutsky and L. Spywak. 2008. The Broadband Efficiency Index: What Really Drives Broadband Adoption across the OECD?. *Phoenix Center Policy Paper,* 33.

Frieden, R. 2005. Lessons from broadband development in Canada, Japan, Korea and the United States. *Telecommunications Policy,* 29 (8): 595-613.

Friederiszick, H. W., M. Grajek and L.H. Röller. 2007. Analysing the Relationship Between Regulation and Investment in the Telecom Sector . European School of Management and Technology, Berlin. Available at: http://www.esmt.org/fm/312/Analysing_the_Relationship_Between_Regulations_and_Investment_in_the_Telecom_Sector.pdf, (Acceso 15 Julio 2010).

Ganuza, J.J., K. Perca and M.F.V. Trocello. 2010. Las Redes de Nueva Generación en España. Situación actual y retos para el futuro. Working Paper. [online] Available at: http://www.crisis09.es/redes/ (Access: 9th April 2011).

Ganuza, J.J. and M.F. Viecens. 2010. Deployment of High-speed Broadband Infrastructures during the Economic Crisis. The case of Regional Governments in Spain. Working Paper [online] Available at: http://www.crisis09.es/redes/ (Access 9th April 2011).

Garcia-Milà, T. and T. McGuire. 2001. Do interregional transfers improve the economic performance of poor regions? The case of Spain. *International Tax and Public Finance,* 8 (3): 281-296.

GENCAT. 2011. Pla Banda Ampla Rural (BAR) Departament de Governació i Relacions Institucionals, Government de Catalunya. [online]. Available at: http://www20.GENCAT.cat/portal/site/governacio/menuitem.63e92cc14170819e8e629e30b0c0e1a0/?vgnextoid=75026f1f8295c210VgnVCM1000008d0c1e0aRCRD&vgnextchannel=75026f1f8295c210VgnVCM1000008d0c1e0aRCRD&vgnextfmt=default (Access: 9th April 2011).

Gillett, S.E.W. and C. Osorio. 2004. Local government broadband initiatives. *Telecommunications Policy,* 28 (7): 537-558.

GITPA. 2011. Gestión de Infraestructuras Públicas de Telecomunicaciones del Principado de Asturias, Government del Principality de Asturias [online] Available at: http://www.gitpa.es/ (Access: 29th January 2014).

Gulati, G.J. and D. Yates. 2012. Different paths to universal access: The impact of policy and regulation on broadband diffusion in the developed and developing worlds. *Telecommunications Policy,* 36: 749-761.

Hargittai, E. 1999. Weaving the Western Web: Explaining differences in Internet connectivity among OECD countries. *Telecommunications Policy,* 23 (10-11): 701-718.

——. 2002. Second-level digital divide: Differences in people's online skills. *First Monday,* 7 (4): 1-20.

Instituto Asturiano de Estadística. 2011.[online] http://www.sadei.es/es/portal.do;jsessionid=E0EB95C2E3F6D70C4026A3694A3E49F1 (Access: 9th April 2011).

Instituto de Estadística de Andalucia. 2011. [online] Available at: http://www.juntadeandalucia.es/institutodeestadisticaycartografia/ (Access: 9th April 2011)
Institut d'Estadística de Catalunya. 2011. [online] Available at: www.IDESCAT.cat (Access: 9th April 2011).
Instituto Klein. 2011. Instituto de Predicción Económica "Lawrence R. Klein", Universidad Autónoma de Madrid [online] http://www.uam.es/otroscentros/klein/ (Access: 9th April 2011).
Instituto Nacional de Estadística. 2011. [online] http://www.ine.es/inebmenu/mnu_tic.htm [online] (Access: 9th April 2011).
Jordan, V., H. Galperin and W. Peres. 2013. *Banda ancha en América Latina: más allá de la conectividad.* 2013/70 Santiago de Chile: Naciones Unidas.
Jeanjean, F. 2010. Subsidising the next generation infrastructures. Consumer-side or supply-side? *Info,* 12 (6): 95-120.
Jordana, J. 2001. Desigualtats digitals i societat de la informació: un debat pendent. *Papers de la Fundació,* 130. Barcelona: Fundació Rafael Campalans.
Jordana, J. and D. Sancho. 2003. Les polítiques de difusió de la societat de la informació a Catalunya: de quina manera es pot estimular la demanda?. *Nota d'economia,* 69-70: 53-63.
Katz, R.L. (2009a). *El papel de las TIC en el desarrollo: Propuesta de América Latina a los retos económicos actuales.* Colección Fundación Telefónica, Madrid: Ariel.
Katz, R.L. (2009b). La brecha digital: ¿oferta o demanda? *Nota* 135. Madrid: ENTER/ Instituto de Empresa.
Krueger, A.B. 2000. *The digital divide in educating African-American students and workers.* Princeton University, Industrial Relations Section, Joint Center for Political, y Economic Studies (US); Washington, DC.
Kumar, N. and S. Rego. 2009. Level of Educational Attainment and Its Impact on Technology Diffusion in Developing Countries. [online] Disponible en: http://ssrn.com/abstract=1350187 (Acceso: 15 de Julio de 2011).
La Caixa. 2010. Anuario Económico La Caixa 2010. [Online] Disponible en: http://www.anuarieco.lacaixa.comunicacions.com/java/X?cgi=caixa.anuari99.util.ChangeLanguage&lang=esp [Access: 4th June 2010].
Lago Peñas, I. 2008. *La lógica de la explicación en las ciencias sociales.* Madrid: Alianza Editorial.
Lattemann, C., S. Stieglitz, S. Kupke and A.M. Schneider. 2009. Impact of PPPs to broadband diffusion in Europe. *Transforming Government: People, Process and Policy,* 3 (4): 355-374
Levi-Faur, D. 2005. The global diffusion of regulatory capitalism. *The Annals of the American Academy of Political and Social Science,* 598 (1).
Milner, H.V. 2006. The Digital Divide. *Comparative Political Studies,* 39 (2): 176-199.
Norris, P. 2001. *Digital divide: Civic engagement, information poverty, and the Internet worldwide.* Cambridge: Cambridge University Press.
OECD. 2001.*Understanding the digital divide.* Paris: OECD Publications. Available at: http://www.oecd.org/dataoecd/38/57/1888451.pdf (Access: 9th April 2011).
PEBA. 2011. Plan de Extensión de la Banda Ancha [online] Available at: http://www.bandaancha.es/Paginas/Index.aspx (Access: 9th April 2011).
Richefort. L. 2008. La diffusion de technologies d'irrigation économes en eau à l'île de la Réunion. *Revue d'Économie Régionale & Urbaine,* 1: 109-130.
Rogers, E.M. 1995. *Diffusion of innovations.* New York: Free Press.
Umino, A. 2002. Broadband infrastructure deployment: The role of government assistance. *OECD Science, Technology and Industry Working Papers,* Paris: OECD.

Wallsten, S. 2005. Broadband penetration: an empirical analysis of State and federal policies. *AEI Brookings Joint Center for Regulatory Studies Working Paper:* 05-12.

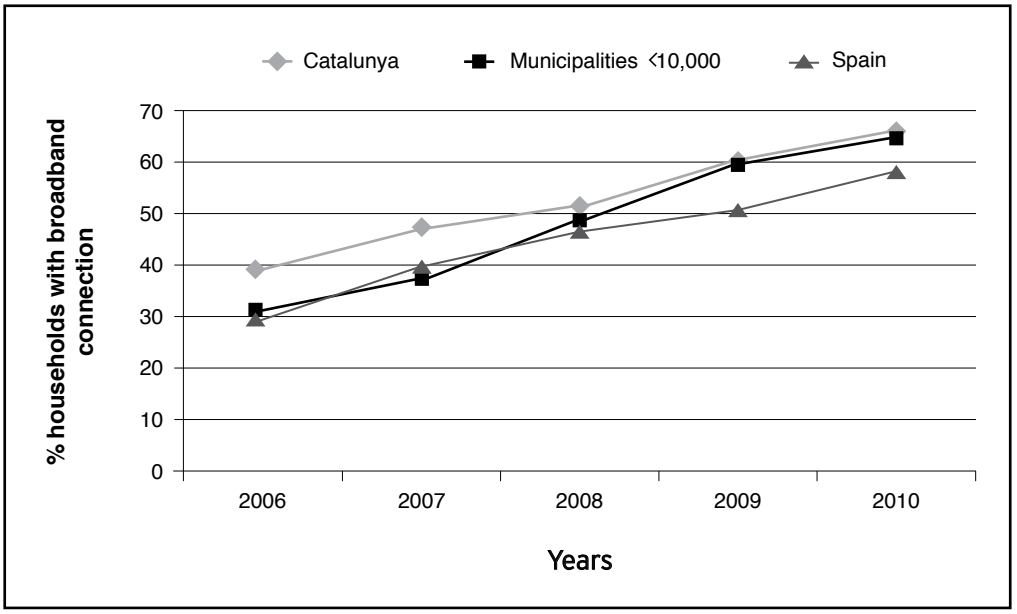
Warschauer, M. 2002. Reconceptualizing the digital divide. *First Monday,* 7 (7).

Wikitel. 2011. Concepto de brecha digital. [online] Available at: http://wikitel.info/wiki/Brecha_Digital (Access: 9th April 2011).

Wooldridge, J.M. 2007. What's new in econometrics? Imbens/Wooldridge lecture notes; summer institute 2007, lecture 10: Difference-in-differences estimation. NBER. Available at: http://www. nber.org/minicourse3. html (Access: 10th March 2011).

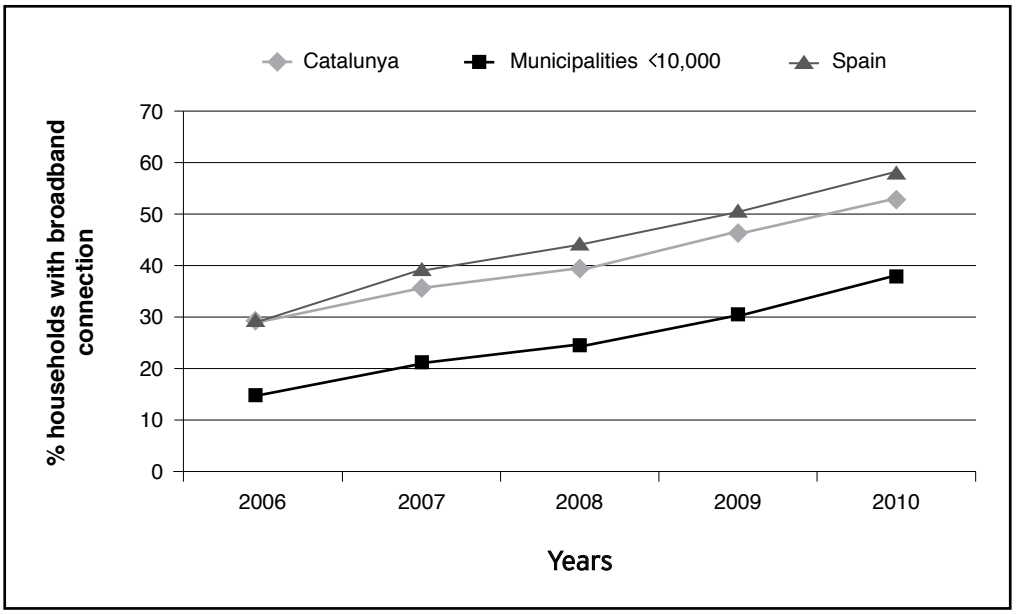
ANNEX

Figure1. Evolution of the digital divide in broadband between small towns in Catalonia and the rest of the Catalonia from 2006 to 2010.



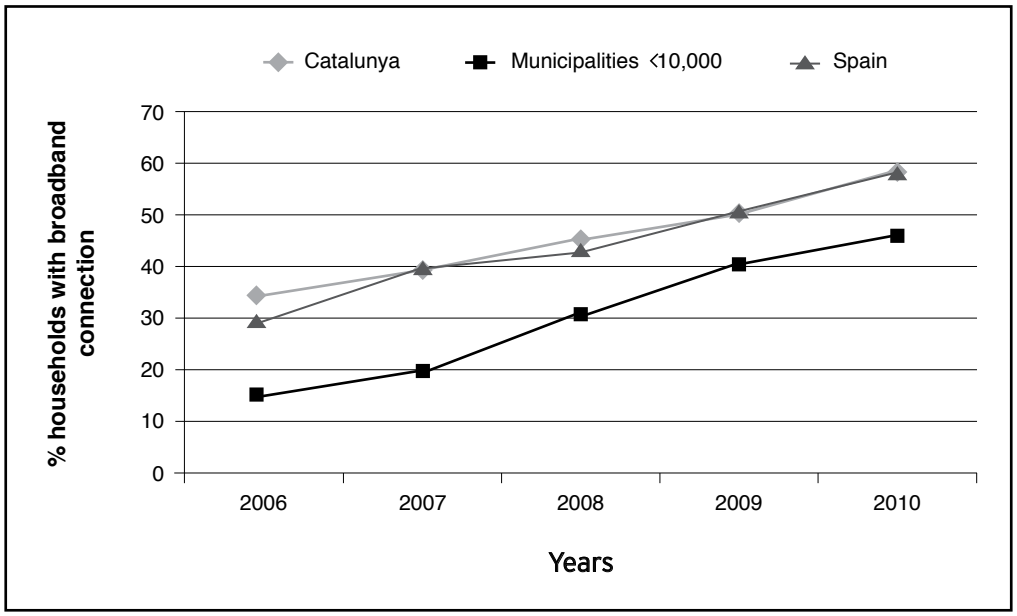
Source: Spanish National Statistics Institute (INE), 2010

Figure 2. Evolution of the digital divide in broadband between small towns in Andalusia and the rest of the Andalusia from 2006 to 2010.



Source: Spanish National Statistics Institute (INE), 2010

Figure 3. Evolution of the digital divide in broadband between small towns in Asturias and the rest of Asturias from 2006 to 2010.



Source: Spanish National Statistic

Table 1. Taxonomy of the role of Government in broadband promotion.

Role of Government	Examples
Government as a user	Buying PCs for the public administration; ITC Training
Government as regulatos	Ensures adequate funding of public service obligations imposed on operators, including universal service provision
Government as a financier	Producer and consumer subsidies for ICT tools
Government as an infrastructure owner	Infrastructure builder and owner

Source: Fuente: Gillet, Lehr and Osorio, 2004

Table 2. Taxonomy of analyzed broadband public policies.

Role of Government	Typology	Examples	Countries
Financier	Telecommunications Operator Subsidies	Broadband Extension Plan (PEBA)	Spain
Public Ownership Infrastructure	Public Infrastructure Management	Red Asturcón Plan (RA)	Spain
		Plan Argentina Conectada	Argentina
		Plano Nacional de Banda Larga (PNBL)	Brazil
	Private Infrastructure Management	Rural Broadband Project (BAR)	Spain
		Plan Todo Chile Comunicado	Chili
		Plan Vive Digital	Colombia
		Acciones para el Fortalecimiento de la Banda Ancha y las TIC	México

Source: Own framework

Table 3. Universal Service programmes features in Europe and Latam.

Programmes	Total Public Investment (USD Million)	Investment per Capita	Investors	Broadband Technology	Mbp/s	Country
Broadband Extension Plan (PEBA)	110	1,79	30% Public fund from National Government; 70% European funds	DSL	4	Spain
Red Asturcón Plan (RA)	55,6	51,4	Regional and National government and European funds	Fiber to the Home (FTTH)	50-100	Asturias, Spain
Plan Argentina Conectada	1800	44,2	Public fund from National Government	Cable	10	Argentina
Plano Nacional de Banda Larga (PNBL)	3250	16,6	Public fund from National Government	Cable	1	Brazil
Banda Ampla Rural, Catalunya (BAR)	72,4	9,6	Public fund from Regional Government	Wimax	1-2	Catalunya, Sapin
Plan Todo Chile Comunicado	45	2,6	50% National Government; 50% Telecommunications Development Fund; private sector	Mobile broadband; 12 optical nodes	1	Chili
Plan Vive Digital	2250	48,6	Public fund from National Government	Cable	1	Colombia
Acciones para el Fortalecimiento de la Banda Ancha y las TIC	N.A.	N.A.	Public fund from National Government, private sector	Cable	N.A.	México

Source: Valeria Jordán, Hernán Galperin y Wilson Peres (2013); Own framework.

Table 4. The Analysis Organization: cases, periods and observations.

Hypothesis	Programs	Number of cases	Treated Municipalities	Non-treated Municipalities	Treatment Dates	Observation Period	Observations
1	PEBA	30	24	6	31-10-2008	01-01-2005 01-01-2009	150
2	Red Asturcón	13	7	6	1-12-2007	01-01-2002 01-01-2008	91
3	BAR	18	6	12	09-11-2006	01-01-2002 01-01-2007	114

Source: Own framework

Table 5. Broadband Digital Divide Reduction Average before and after the PEBA program treatment in the Vega de Granada municipalities, Andalusia.

PEBA PLAN	Before	After	Differences between groups and differences between periods
Treated Municipalities	1.58	-0.09	0.4
Non-Treated Municipalities	-2.34	-4.41	(0.56)

Source: Own framework

Table 6. Regressions with Broadband Digital Divide Reduction as a Dependent Variable in Andalusia.

VARIABLES	(1) MODEL	(2) MODEL	(3) MODEL
PEBA_after	-1.662***	-1.666***	2.492
	(0.558)	(0.561)	(2.410)
PEBA	1.738	1.795	0.735
	(2.174)	(2.166)	(2.128)
Population Density			0.001
			(0.001)
Fixed lines	-0.002***	-0.002***	-0.002***
	(0.001)	(0.001)	(0.001)
Income			0.000
			(0.000)
Primary Education		0.114	0.412***
		(0.104)	(0.095)
Secondary Education	-0.445***	-0.333**	-0.366**
	(0.087)	(0.140)	(0.165)
Tertiary Education			0.830
			(0.492)
Ageing People	0.386**	0.367**	0.356**
	(0.163)	(0.163)	(0.173)
Broadband Growth			-0.001
			(0.019)
Constant	5.795*	-3.227	-24.385***
	(2.946)	(8.990)	(8.801)
Observations	150	150	90
R-squared	0.660	0.660	0.772

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Table 7. Broadband Digital Divide Reduction Average before and after the Red Asturcón program treatment in the municipalities of Asturias.

Red Asturcón Program	Before	After	Differences between groups and differences between periods
Treated Municipalities	-0.76	-0.5	-3
Non-Treated Municipalities	1.64	4.9	(0.7)

Source: Own framework

Table 8. Regressions with Broadband Digital Divide Reduction as a Dependent Variable in Asturias.

	(1) MODEL	(2) MODEL	(3) MODEL
Red Asturcon	-1.807***	-1.713***	-2.007***
	(0.345)	(0.322)	(0.479)
Red Asturcón_after	0.700	7.503	14.160
	(0.898)	(8.573)	(8.383)
Population Density			0.001
			(0.001)
Income			-0.000*
			(0.000)
Primary Education			-0.223*
			(0.111)
Secondary Education			-0.191
			(0.114)
Tertiary Education			-0.067
			(0.096)
Nalón	-1.620***	-1.552***	-1.748**
	(0.397)	(0.375)	(0.681)
Caudal	-3.125***	-2.929***	-3.203***
	(0.320)	(0.294)	(0.627)
Narcea	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Aging	0.157**	0.144**	0.213***
	(0.052)	(0.049)	(0.049)
Industrialization level			0.028*
			(0.013)
Broadband Growth Index		0.004	0.009**
		(0.003)	(0.004)
Constant	-1.342	-1.349	21.194
	(1.613)	(1.560)	(12.476)
Observations	91	65	65

Constant	(1.613)	(1.560)	(12.476)
Observations	91	65	65

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Table 9. Broadband Digital Divide Reduction Average before and after the BAR program treatment in the municipalities of Catalonia.

BAR Program	Before	After	Differences between groups and differences between periods
Treated Municipalities	0.55	3.24	0,87
Non-Treated Municipalities	0.60	3.52	(0.0)

Table 10. Regressions with Broadband Digital Divide Reduction as a Dependent Variable in the municipalities of Catalonia.

VARIABLES	(1) MODEL	(2) MODEL
BAR	-1.135*	1.542
	(0.562)	(1.014)
BAR_after	2.060***	8.493*
	(0.000)	(4.494)
Population Density		-0.003
		(0.007)
Primary Education		-7.827
		(8.648)
Secondary Education		-7.855
		(8.673)
Tertiary Education		-8.335
		(8.860)
Income		0.001
		(0.000)
Fixed lines		-0.001*
		(0.001)
Ageing People	0.675***	0.587***
	(0.135)	(0.151)
Industrial Workers		-0.028
		(0.032)
Broadband Growth per year		-0.005*
		(0.003)
Constant	-10.329***	771.888
	(2.292)	(863.657)
Observations	126	72
R-squared	0.483	0.669

Robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1