Does Privatization Deliver?
Access to Telephone Services and Household Income in Poor Rural Areas
Using a Quasi-Natural Experiment for Perú

Alberto Chong
Inter American Development Bank.

Virgilio Galdo
Michigan State University

Maximo Torero*,
International Food Policy Research Institute, Washington, D.C., USA.

Contributed **paper prepared for presentation at the**
International Association of Agricultural Economists Conference, Gold Coast, Australia,
August 12-18, 2006

Does Privatization Deliver?
Access to Telephone Services and Household Income in Poor Rural Areas
Using a Quasi-Natural Experiment for Perú

Alberto Chong
Virgilio Galdo
Maximo Torero

Abstract

We take advantage of a quasi-natural experiment in Peru by which the privatized telecommunications company was required by government to randomly install and operate public pay phones on small rural towns along the national territory. Using a especially designed household survey for a representative sample of rural towns we are able to link access to telephone services with household income. We find, that regardless of the income measurement, most characteristics of public telephone are positively linked with income. Remarkably, the benefits are given at both non-farm and farm income levels. Not only do the findings hold when using instrumental variables but they are further confirmed when using propensity scores matching methods.

JEL Classification: G32, H10, J45, O1
Word Count: 6,891
Key Words: Privatization, Institutions, Rural, Poverty, Telecommunications

Does Privatization Deliver?
Access to Telephone Services and Household Income in Poor Rural Areas
Using a Quasi-Natural Experiment for Perú

1. Introduction

Privatization was supposed to deliver the goods. Some researchers claim that, indeed, it has. Recent evidence shows that firms have dramatically improved performance following privatization and that such positive changes are the result of significant restructuring efforts. The empirical record shows that privatization leads to increased profitability and productivity, firm restructuring, output growth and even quality improvements (Chong and Lopez-de-Silanes, 2004)[1]. However, several critics claim that privatization has impacted consumer income and welfare negatively through decreased access, poorer distribution, and lower quality of goods and services (Bayliss, 2001; Birdsall and Nellis, 2002). These concerns are significant because, for the most part, the poorest segments of society are the main consumers of goods and services previously produced by state-owned enterprises.

Especially in the case of services and public utilities, access and distribution may be a concern as some segments of the population may lack way of entry to networks and thus may be unable to purchase these services independently of their price. The quality of services such as water, electricity, telecommunications, or transportation may be reduced to try to meet price regulation, for example. In all of these circumstances, consumer welfare may suffer as a result of privatization. For instance, Bayliss (2002) points to examples of botched privatizations in Puerto Rico and Trinidad and Tobago where water privatization led to price hikes and no apparent improvement in provision. Similarly, the privatization of the electric sector in the Dominican Republic is claimed to

[1] Most cases of privatization failure may be linked to poor contract design, opaque processes with heavy state involvement, lack of re-regulation and a poor corporate governance framework. In fact, it appears that firms undergo harsh restructuring processes following privatization and do not simply mark-up prices or lower wages (Chong and Lopez-de-Silanes, 2004).

have led to more blackouts and higher utility prices, culminating in civil unrest and the deaths of several demonstrators (Birdsall and Nellis, 2002). On the other hand, some raw studies show some positive links between privatization and welfare. In particular, Mookherjee and McKenzie (2003) argue that the sale of state-owned enterprises brought positive welfare effects and that the poorest segments of the population appear to be relatively better off. In Argentina, they report falling electricity prices that improved the welfare of all income deciles. For Bolivia, they also report welfare gains from increased electricity access for all but the top income deciles. In Nicaragua, they argue that the value of gaining access to electricity was positive and of a larger magnitude for lower income deciles who had relatively less access before privatization. The study by Mookherjee and McKenzie (2003), however, is at most suggestive, as it has been roundly criticized for the weakness of the data used, identification problems, and analytical leaps and extrapolations (Saavedra, 2003) [2].

In this paper we study the link between a privatized utility and household income in a developing country by taking advantage of a quasi-natural experiment that occurred in Peru as a result of the privatization of the state-owned telecommunications enterprise in the early nineties. In particular, the privatization contract called for the privatized firm to install public telephones in 1526 small rural towns distributed along the national territory in a random fashion. By using a household survey designed and performed by the authors to a representative sample of towns that received treatment until 2001, we are able to study household income and welfare implications both using conventional regression analysis and matching methods. Our basic premise is that telecommunication services reduce the gap in access to both formal and informal information.

[2] An exception is Galiani et al. (2003) who design tests that map water delivery to infant mortality in order to address concerns about quality after privatization. They show that Argentinean child mortality fell by 5 to 7 percent more in areas that privatized water services than those that did not. The effect was larger in the poorest municipalities that privatized where child mortality fell 24 percent. Privatization translated into 375 child deaths prevented per year.

This reduction of informational gaps reduce the ability of the better informed to extract rents from the less informed, and thus helps enhance resource allocation, and improve income and welfare among those living in more disadvantaged areas, in particular rural ones[3]. In fact, the existing empirical literature on the impact of rural telecommunications on income is scarce and far more suggestive than formal. Bayes et al., (2001) argue that a village pay phones program in Bangladesh may be an example of how pragmatic policies can turn telephones in production goods. Services originated from telephones in villages may be more likely to deliver more benefits to the poor than to non-poor. Matambalya et al., (2001) analyze the effect of information technologies on the performance of small and medium enterprises and suggest that there may be no effect. Saunders, et al. (1994) try to analyze the savings associated to the use of telecommunications services instead of alternative means of communication. Finally, the International Telecommunications Union (1998) reports a series of anecdotal material on the benefits of rural telecommunications.

The paper is organized as follows. The next section briefly presents the literature on telecommunications and income. Section 3 describes the data collection process and explains some characteristic regarding rural telecom users. In section 4 we present our regression analysis findings to test whether telecommunication variables have an impact on income per capita. In Section 5 we show analogous propensity score matching methods results. Finally, Section 6 presents final comments and the conclusion.

2. Rural Telecommunications, Information, and Economic Outcomes

Even though telecommunications infrastructure has long been recognized as key ingredient to promote economic growth (Röller and Waverman, 2001), it has not been a central investment

[3] Developing countries tend to be more rural than what is typically believed. For instance, when using a multidimensional definition of what rural is, it was found that 42 percent of individuals live in such areas in Latin America (De Ferranti et al., 2005).

issue in many developing countries. The share of low-income countries in the world's telephone mainlines is only 6 percent which equals about 28 lines per 1000 inhabitants. In contrast, high-income countries account for 52 percent of the world's telephone mainlines or 585 lines per 1000 inhabitants. Furthermore, a comparison with rural areas makes the difference even more dramatic. In fact, the rural main line density is lower than one per one-thousand inhabitants in developing countries (International Telecommunications Union, 2003). It has been claimed that under government control, the potential gains associated with the access to telecommunications services are ignored, underestimated or simply unknown[4]. This lack of knowledge may be explained by several factors. First, telecommunication services are often considered a consumer good for the wealthy. Second, network externalities associated with telecommunications infrastructure are typically ignored. Third, while the empirical research has focused on the benefits of roads, transport, electricity and irrigation little attention has been paid to the role of telecommunications. Fourth, the benefits of telecommunication infrastructure are often held to be positive axiomatically and thus, little is know about the size and distribution of those benefits particularly in rural areas.

Rural telecommunications services constitute a crucial rural infrastructure since it provides the means for the transference of information in a context where alternatives means of obtaining information are less accessible. Advocates of this kind of infrastructure investments point out that the development of such infrastructure reduces information gaps, decreases the distance between economic agents, and therefore reduces transaction costs. As a consequence, this will enhance efficiency of resource allocation (Leff, 1984; Tschang et al., 2002; Andrew et al., 2003). Information is a key component in enabling economic agents to make optimal decisions. It has been widely accepted, however, that most of the economic decisions are made under conditions of

[4] There is convincing empirical evidence that shows that under government control, funds are not allocated on the basis of economic criteria (Lopez-de- Silanes, 1997).

imperfect information; thus, decision makers may reduce their uncertainty through acquisition of additional information (Stigler, 1961; Stiglitz, 1985 and 2002). The ability to access and process information is recognized as a significant determinant of economic performance. In particular, productivity reflects not only how efficiently inputs are transformed, but also how well information is applied to resource allocation decisions (Allen, 1990; Babcock, 1990; Hubbard, 2003)[5]. Information may be obtained from either formal or informal sources. Where formal or official information is limited or inexistent, informal channels, such as family and friends, constitute an extremely important pathway of communication. Furthermore, recent research analyzes the role of social networks as a manner of obtaining information about job opportunities and explore its implications for the dynamics of employment (Durlauf, 2002; Calvó-Armengol et al., 2004) In particular, the informal channel seems to be a non-negligible pathway to consider since people employ family networks to facilitate current and future transaction and flows of credits. For instance, the majority of farmers say they get information from family members, when asked to name their primary sources of information on a number of tasks related to cultivation and new technologies (Gotland, et al, 2004).

3. Data

As a result of the privatization of the state-owned telecommunications enterprise in 1994 the Peruvian Government and *Telefónica de España*, the buying firm, agreed upon an investment schedule by which the privatized firm was required to install and operate public pay telephones in 1526 towns out of a list of about 40,000 rural towns during the following six years after privatization. The basic characteristics of the eligible towns were that they did not have

[5] There is a related body of literature on information diffusion and technology adoption in rural areas. Kebede et al., (1990) find that the likelihood of technology adoption increases with the level of education and access to information. Huffman et al., (1991) find that exposure to off-farm work increases the odds of adopting new technologies. Feather el al., (1994) find that lack of information may be a reason why adoption of new practices has not occurred. Isham (2002) finds a positive link between adoption of farm technologies and the cumulative proportion of adopters, the presence of tribally based social affiliations, and the distance to local markets.

telecommunication services and were limited to a population of between 400 and 3000 people, as well. The towns were chosen randomly along the national territory[6].

As part of this research, a household survey was designed and implemented in 2002 to a representative sample of towns in rural areas in Southern Peru, a region that is characterized by having extremely high levels of poverty[7]. In fact, we focus on this particular geographic area for it is considered among the poorest in the country. Our sample includes 1000 rural households engaged in farm and non-farm activities distributed proportionally between towns without any means of telecommunications and towns with public telephones installed and operated by the privatized company. In fact, ten households were randomly selected from each of 100 towns originally sampled. Thus, at the moment of the survey, half of the towns had at least a public telephone installed by the privatized company in the most accessible part of the town, such as the building of the municipal authority or the main store in town. The other half of towns, in which the lack of a public telephone service was primarily due to a supply constraint instead of one of demand, is used as a control group[8]. The survey procedure followed a two stage random sampling procedure and focused on the main demographic and housing characteristics of the household, as well as employment, farming activities, income, expenditures, availability of infrastructure, information and communication technologies, among other characteristics. Table 1 summarizes the characteristics of the variables used.

[6] Since monitoring was relatively lax, we examine whether the privatized company may have used particular criteria to choose the towns, such as the average income of the town, the density of the population, or potential linkages to larger areas, that may result in sample selection bias. We do not find such evidence as the distributions of the corresponding sub-samples are not statistically different. There are two possible reasons for this. For one, rural pay phone investment requirement was a minuscule part of the total investment requirement to the privatized firm. Second, this type of investment may have been used by the company as a tool to increase good will and credibility in the face of necessary price increases.

[7] According to official figures, in 2001 the poverty rates for the four departments included in the survey were 75 percent (Cuzco), 44 percent (Arequipa), 78 percent (Puno), and 79 percent (Apurímac). Overall, the sampled area concentrates about 41 percent of all rural public telephones installed by *Telefónica* after privatization and comprises 25 percent of the total rural population of Peru.

[8] People who live in towns without access to a public telephone travel many kilometres to arrive at a town that has the service. Other means of telecommunications, such as cellular telephones, are non-existent.

Table 2 shows that among surveyed households, more than 76 percent of the heads of household use the public telephone installed and operated by the privatized company. The usage is positively correlated with income. While around 65 percent of the bottom income group use the town public telephone, 88 percent of the top income group use such public telephone. In terms of the expenditure on public telephone services, Table 2 shows that it varies from US$0.6 for the bottom income quartile to US$ 6 for the top income quartile. These expenditures represent 1.7 percent of the total household's income for the bottom quartile and 1.3 percent for the top income quartile. Related to the above, the average number of telephone calls per month varies from 0.5 calls to 6.9 calls depending on income group. Again households with higher incomes make more telephone calls. Furthermore, there appears to be a supply effect as the availability of a public telephone at the town level appears to have some impact on telephone usage. Among surveyed households, those from towns with installed telephone have a higher usage rate than those households from towns without telephone. This, perhaps, as a consequence of higher transaction costs as travel time to reach the public phone is dramatically higher. In fact, Table 3 also shows the one-way travel time to the nearest public telephone as a determinant of the rate of usage of telecommunications services. As expected, the longer the travel time to the nearest public telephone, the lower the usage. This implies that the higher the non-tariff cost to the nearest telephone, the lower the usage.

Regarding the main purpose of telephone calls, the survey reveals that households use telephone for both economic and social purposes. The first most important reason for the use of public telephone is to contact relatives (78 percent). The second most important reason for the use of telephone is to do business (10 percent). Finally, the third most important reason to use telephone is for emergencies (11 percent). It is important to recall that the percentage of business calls may be underestimated because it is common to observe that small rural farmers employ

family networks to facilitate current and future transaction and flows of credits. This is particularly true in the Andean area (Cotlear, 1989; Mayer, 2002). Thus, it is not surprising that many telephone calls made from the household that are reported on the survey as "to contact relatives" are actually calls that have a business-related component (Godtland et al, 2004). On the other hand, there are a significant number of incoming calls which main purpose is unknown. Notice that about 65 percent of the total traffic of rural public telephones is explained by incoming calls (Osiptel, 1999).

4. Regression Analysis

In the context of the discussion above, the aim o this paper is to test whether rural telecommunications services improve the income of the household by helping reduce the gap in access to both formal and informal information. To evaluate this, we estimate a simple empirical reduced form and link measures of total household income, farm, and non-farm per-capita income with several telecommunications characteristics such as, availability of telephones, distance to the nearest telephone, frequency of use, and motive for using. When we include variables that may have potential reversal causality problems, we also apply an instrumental variables approach along with standard ordinary least squares methods. In particular, two variables that may be problematic in this respect are access to telephone, and telephone expenditures. Not only does more access to telephones may help increase household income when, as argued above, the telephone is used as a business and information tool, but also higher income may allow more access to telephone use. Similarly, it is unclear whether telephone expenditures are conducive to higher household income or whether higher income leads to more telephone expenditures. The instruments employed are: (i) whether Spanish is the mother's tongue in the household; (ii) whether the household belongs to a religious organization, and (iii) whether the head of the household works as a dependent[9]. Finally,

[9] Given the fact that these instruments may not be ideal, we also use a complementary approach by applying matching methods below.

all our regressions include fixed-effects which are applied at the departmental level[10]. In particular, we estimate the following specification:

$$y = \alpha + \beta \mathbf{H} + \lambda T + \varepsilon \qquad (1)$$

Where y is a measure of per capita income; α is a constant; $\mathbf{H}$ is a vector of household characteristics; T is a series of variables associated with access to or usage of a public rural telephones installed and operated by the privatized firm, and ε is an error term. In order to better understand the channels by which access to public telephone may impact households, in this paper we use three measures of per capita income as dependent variable. The first measure comprises the total annual household per capita income regardless of source. The second comprises farm per capita income, only. The third comprises non-farm per capita income, only. The logic behind analyzing farm and non-farm income separately is consistent with recent research on the economics of rural households. Non-farm income serves as a consumption smoothing mechanism that helps counterbalance the cyclical nature of farm income. In fact, in our sample the income share of non-farm activities is a high 53 percent, which is consistent with other studies on rural income (Escobal, 2002)[11]. As such, it is also far more dependent on outside linkages with its hinterland, either with neighboring towns, or with nearby urban areas, if any. In a context in which prior to the installation of public telephones by the privatized firms towns had never had access to any telecommunications service, inhabitants in poor rural villages will benefit the most from mechanisms that help them improve communication to other towns and villages as before the only link to the outside world was

[10] We also tested non fixed-effects regressions. Findings are very similar.

[11] We also used per-capita expenditures instead of income measures. While we obtain very similar findings when compared with the total household income measure, expenditures do not allow to separate farm and non-farm activities which as shown above is particularly relevant in research related to rural areas. Empirical findings using expenditures are available upon request.

limited to reaching the nearest village typically reached by foot. As a result, chances are that demand possibilities will greatly increase[12].

Figure 1 shows the kernel densities functions of these three income variables. As described above, these measures are regressed against set of variables that have been classified in two groups. The first group contains a standard set of family characteristics. We include average years of schooling for household members, average years of schooling for household members, family size measured as the number of members in the household, age of household head, gender of household head (male), and walking time to the nearest town of similar size. The second group include includes five variables related to access and usage of rural public telephones. The first is a dummy variable that captures the availability of rural telecommunication services. This dummy variable equals one when a town has a public rural telephone installed and operated by the privatized company. The second variable measures the distance, in hours, to the closest telephonic service. The third is a dummy variable that equals one if the head of household uses the telephone service installed and operated by the privatized firm. The fourth variable is dummy variable that equal one when the head of household reports a business-related use of telephone service. Finally, the fifth variable measures the intensity of use of telephone services as measured by the expenditure on telephone services.

Tables 4 presents our basic set of estimates using the logarithm of the total per capita income as our dependent variable. We find, as expected, a positive and statistically significant link between total per capita income and average years of schooling. We also find a negative but statistically insignificant link between the squared average years of education and income per capita. Family size yields a negative and statistically significant relationship. Similarly, age has a positive and significant link to household income. On the other hand, gender yields no significant

[12] A similar example is provided by the case of rural roads (Jacoby, 2000; Escobal 2002).

link with total per capita income. More important, with respect to our variables of interest, we find that all the relevant variables have the expected sign and are statistically significant at conventional levels.[13] In particular, we find that availability of a rural public telephone installed by the privatized firm in the town or village is associated with 30 percent higher per capita income, as the sign of the coefficient is positive and statistically significant at one percent. This is shown in Column 1. Furthermore, we find a negative and statistically significant link between walking time to the nearest telephone service and total household per capita income, as shown in Column 2 in the same table. The farther the telephone service is, the less likely it will be used and as a consequence, the lesser the informational advantages of the service will be obtained. Furthermore, we find that the use rural public telephone service is associated with 16 percent higher per capita income and about 49 percent when correcting for endogeneity, as shown in Column 3a and Column 3b. Along the same lines, households that self-report business-related use of telephone services are associated with 36 percent higher total per capita income. This is shown in Table 4[14]. Finally, we find a positive and statistically significant link between expenditure on telephone service and total per capita income. The findings suggests that an additional 10 percent of expenditure in public telephone usage is associated with a 2.4 percent increase in total per capita income and 3.3 percent when correcting for endogeneity. This is shown in Column 5a and Column 5b in the same Table. In short, the measures associated with access and use of public telephones installed and operated by the privatized firm point towards the idea that such basic service have been conducive to increased household income in rural areas.

[13] Since these variables are highly correlated, we include them as regressors separately. A principal components approach was also applied which yields similar statistically significant results. These findings are available upon request.

[14] This estimate should be considered as a lower bound since many family calls include business components, as explained above.

Tables 5 repeats the exercise above but focuses on per capita non-farm income as the dependent variable. Again, we find that all the variables of interest yield the expected signs and are statistically significant at conventional levels. For instance, we find that availability of a rural public telephone is associated with 32 percent higher per capita non-farm income, as the sign of the coefficient is positive and statistically significant at one percent. This is shown in Column 1. As before, we also find a negative but statistically insignificant link between walking time to the nearest public telephone and per capita non-farm income, as seen in Column 2, on the same Table. Regarding our measure of use, we find that the use rural telecommunications service is associated with 22 percent higher per capita non-farm income and 119 percent when correcting for endogeneity. These are shown in Column 3a and Column 3b, respectively. Again, households that self-report business-related use of telephone service are associated with 25 percent higher per capita non-farm income. Finally, we find a positive and significant link between expenditure on telephone service and per capita non-farm income. The result suggests that an additional 10 percent of expenditure in public telephone use is associated with a 2.58 percent increase in per capita non-farm income and 5.27 when correcting for endogeneity. These findings are presented in Column 5a and Column 5b. In summary, the findings in this table show that access to telephone services is associated with an increase in non-farm income in poor rural towns. Additionally, notice that the non-farm income regressions yield a positive and statistically significant link with respect to average years of schooling, a negative but statistically insignificant link with years of education, a negative and statistically significant link with family size, a positive and statistically insignificant link with respect to age, and no a significant link in the case of gender.

Tables 6 repeats the same exercise as above but focuses on farm income. We find that availability of a rural public telephone installed by the privatized firm is associated with 13 percent higher per capita farm income. This is shown in Column 1. While, as expected, we find a negative

and statistically significant link between distance and per capita farm income we do not obtain a significant link in the case of telephone use, as shown in Column 3a and Column 3b. Furthermore, the same occurs with households that self-report business-related use of telephone service. Finally, we obtain a positive and statistically significant link between expenditure on telephone service and per capita farm income. An additional 10 percent of expenditure in public telecom is associated with a 1.86 percent increase in total per capita farm income and 4.43 when correcting for endogeneity. This is shown in Column 5a and 5b in the same Table.

In this section we have provided evidence that access to telephone services in poor, rural towns in Peru have helped increase per-capita household income. While such increase has been given through both farm and non-farm channels, it is remarkable that the economic impact of non-farm channels is substantially larger than that of purely farm channels[15]. This finding is, in a way, unsurprising when one bears in mind the theoretical literature on the role of telecommunications as a provider of information in particular in small and isolated rural towns such as the ones studied in this research.

5. Propensity Scores Matching Methods

The soundness of the regression method approach is based on two assumptions. First, it hinges on the conjecture that we have selected the correct functional form of the outcome. Second, it implicitly assumes that we are able to adequately control for potential differences between users and non-users of rural public telephone services as they may arise from the voluntary nature of participation. Unless we properly account for these potential differences, comparison of outcomes would potentially yield biased estimates of the impact of rural public telephone access. As explained above, the use of an instrumental variables approach may not fully solve the potential

[15] Statistical tests on the difference of coefficients of farm and non-farm for any given regression always yield statistically significant results at five percent or higher.

endogeneity problem as the instruments considered, while they are the best possible we were able to come up with, may not suffice to eliminate endogeneity. In fact, one could always argue that the instruments are not clearly correlated with use and clearly uncorrelated with outcome (Jalan and Ravallion, 2003). In order to both minimize the potential bias in the impact estimate due to selection on observables, and use a useful alternative method that avoids the need of using instrumental variables we use matching methods to construct a statistical comparison group.

Table 7 presents the estimates from the logit regression for both placement ("town with telephone") and usage ("head of household use the telephone service"). The regressors comprise a wide range of household characteristics, dwelling characteristics, and geographical variables. In case of our variables placement (towns with telephone) prior to matching, the average estimated propensity score for treated and non-treated units were 0.6178, with standard error of 0.1958 and 0.389 with a corresponding standard error of 0.2159, respectively. After matching, those numbers became 0.6140, with a standard error of 0.1930 and 0.6019, with a standard error of 0.1871, on the region of common support. Similarly, in the case of use, prior to matching, the average estimated propensity score for treated and non-treated units were 0.793 and a standard error of 0.1333, and 0.671 with a standard error of 0.1438, respectively. After matching, those numbers became 0.787 with a standard error of 0.1307 and 0.793, with a standard error of 0.1320, on the region of common support. Figures 2 and 3 show the kernel density of the estimated propensity scores for the two groups.

Table 8 reports the average treatment on the treated according to the kernel matching estimator. The results confirm a positive and significant link between access to telephone services and our measures of household income. Total per capita household income among the population who is treated ("existence of public telephone installed by the privatized firm") appears to be 32 percent lower without it. Furthermore, total per capita non-farm income among the population who

is treated is around 28 percent lower without it. Similarly, total per capita farm income among the population who is treated is about 41 percent lower without it. Likewise, the total per capita income among the population who is treated ("use rural telephone services installed by the privatized firm") is about 30 percent lower without it. Total per capita non-farm income among the population who is treated is 22 percent lower without it and total per capita farm income among the population who is treated is 40 percent lower without it.

6. Conclusions

No doubt, privatization is under attack. Public opinion has turned against privatization and a large political backlash has developed, infused by accusations of corruption, abuse of market power, and neglect of the poor (Chong and Lopez de Silanes, 2005). In a context in which basic services provision remains among the most pressing issues in developing countries, no companies have been more buffeted than those running public utilities offering water, electrical and telephone services (Forero, 2005). This is particularly true in poor and rural areas in which, according to the conventional wisdom, the welfare gains of privatization rather questionable.

In this paper we take advantage of a quasi-natural experiment in Peru in which the privatized telecommunications company, *Telefónica del Perú,* was required by the government to randomly install and operate public pay phones on small and isolated rural towns along the national territory following privatization in 1994. Using a especially designed household survey data for a representative sample of rural towns, we are able to link access to telephone services with household income. We find, that regardless of the income measurement, most characteristics related with access to public telephones installed and operated by the privatized firm are positively linked with household income. Remarkably, such benefits are given at both farm and non-farm income levels, being the latter particularly crucial in rural areas as non-farm income primarily serves as an income-smoothing mechanism on which households tend to rely more and more (Chong, et al,

2004). Not only do the findings hold when using instrumental variables but they are further confirmed when using propensity scores matching methods.

Critics of privatization may point to the fact that while the evidence presented in this paper make a positive case that increased access to telecommunication services in rural areas is conducive to higher household income, it does not provide convincing evidence on the benefits of privatization per-se, as the rural investment studied in this paper was required by the government as part of the original privatization contract and, as a consequence, it is not part of an investment strategy of the privatized company had pure laissez-faire had been allowed. We take a more pragmatic view of our findings. On the one hand, many governments include investment requirements in their privatization contracts (Chong and Lopez-de-Silanes, 2005). On the other hand, investment requirements allow governments to leverage and direct resources from privatized firms to regions that the private sector would not normally get involved and in which the government, because of lack of resources, could not intervene either. Increased government tax collection may be an issue, too. While the relevant question, one that escapes this research, is whether investment requirements diverts firm resources from more productive uses elsewhere, it is also true that privatized firms may have an incentive in participating in such investment deals as it helps promote good will with the public and government, at a relatively low cost[16].

[16] Recent private-public rural investment schemes appear to be good examples of the interest of the private sector in participating, at least in part, for signalling reasons (Wellenius, et al, 2004)

References

Andrew, T. N. and D. Petkov, 2003. "The need for a systems thinking approach to the planning of rural telecommunications infrastructure." *Telecommunications Policy, 27: 75-93*

Allen, Beth, 1990. "Information as an Economic Commodity." *American Economic Review, 80(2):268-273*

Babcock, Bruce A., 1990. "The Value of Weather Information in Market Equilibrium." *American Journal of Agricultural Economics, 72(1): 63-72*

Bayes, Abdul, 2001. "Infrastructure and rural development: insights from a Grameen Bank village phone initiative in Bangladesh." *Agricultural Economics , 25, Issues 2-3: 261-272*

Bayliss, Kate. 2001. "Privatization of Electricity Distribution: Some Economic, Social and Political Perspectives." Public Service International Research Unit Report for Policy Studies Institute, University of Greenwich.

Birdsall, Nancy and John Nellis. 2002. "Winners and Losers: Assessing the Distributional Impact of Privatization." Working Paper No. 6. Washington, DC, United States: Center for Global Development.

Calvó-Armengol, Antoni and Matthew O. Jackson, 2004. "The effects of social networks on Employment." *American Economic Review, 94(3): 426-454*

Chong, Alberto and Florencio Lopez-de-Silanes, eds., (2005) Privatization in Latin America: Myths and Reality, Stanford University Press, Palo Alto: CA.

Chong, Alberto and Florencio Lopez-de-Silanes (2004) "Privatization in Latin America: What Does the Evidence Say? *Economia Journal of the Latin American and Caribbean Association,* Spring.

Chong, Alberto, Jesko Hentschel, and Jaime Saavedra (2004) "Bundling in the Provision of Public Services: The Case of Peru", Working Paper, The World Bank.

Cotlear, Daniel, 1989. Desarrollo Campesino en los Andes. (Peasant Development in the Andes). Lima: Instituto de Estudios Peruanos.

De Ferranti, D., G. Perry, V. Foster, D. Lederman and A. Valdés, 2005. "Beyond the City: The Rural Contribution to Development." World Bank Latin American and Caribbean Studies.

Durlauf, Steven N., 2002. "On The Empirics of Social Capital." *The Economic Journal, 112, Issue 483.*

Escobal, Javier, 2002. "The Determinants of Nonfarm Income Diversification in Rural Peru." World Development, 29(3): 497-508.

Feather, Peter M. and Gregory S. Amacher, 1994. "Role of information in the adoption of best management practices for water quality improvement." *Agricultural Economics, 11, Issues 2-3:159-170*

Forero, Juan (2005) "Latin America Fails to Deliver on Basic Needs", *The New York Times, February 22, A: 1.*

Godtland, E., E. Sadoulet, A. De Janvry, R. Murgai and O. Ortiz, 2004. "The Impact of farmer field schools on Knowledge and Productivity: A study of Potato farmer in the Peruvian Andes." *Economic Development and Cultural Change, 53 (1):63-92*

Hubbard, Thomas N., 2003. "Information, Decisions, and Productivity: On-Board Computers and Capacity Utilization in Trucking." *American Economic Review,. 93(4): 1328-1353.*

Huffman, Wallace and Stephanie Mercier, 1991. "Adoption of Microcomputers Technologies: An analysis of farmers' decisions." *Review of Economic and Statistics, 73 (3): 541-546.*

Isham, J, 2002, "The Effect of Social Capital on Technology Adoption: Evidence from Rural Tanzania." *The Journal of African Economies, 11 (1): 39-60.*

International Telecommunications Union, 1998. World Telecommunication Development Report: Universal Access. Geneva, Switzerland.

_____, 2003. World Telecommunication Development Report: Access Indicators for the Information Society. Geneva, Switzerland.

Jacoby, Hanan (2000) "Access to Markets and the Benefits of Rural Roads", *Economic Journal*, 110, 465: 713-737.

Jalan, J. and M. Ravallion, 2003. "Does piped water reduce diarrhea for children in rural India?" *Journal of Econometrics, 112: 153-173.*

Kebede, Yohannes, Kisan Gunjal and Garth Coffin, 1990. "Adoption of new technologies in Ethiopian agriculture: The case of Tegulet-Bulga district Shoa province." *Agricultural Economics, 4(1):27-43*

Leff, N. H., 1984. "Externalities, Information costs, and Social Benefit-Cost Analysis for Economic Development: An example from Telecomm." *Economic Development and Cultural Change*, 32: 255-276.

Lopez-de-Silanes, 1997. "Determinants of Privatization Prices." *Quarterly Journal of Economics*, 112(4): 965-1025.

Matambalya, Francis and Susanna Wolf, 2001."The Role of ICT for the Performance of SMEs in East Africa. Empirical Evidence from Kenya and Tanzania." ZEF – Discussion Papers on Development Policy, No. 42

Mayer, Enrique, 2002. *The Articulate Peasant: Household Economies in the Andes*. Westview Press.

Mookherjee, Dilip and David McKenzie. 2003. "The Distributive Impact of Privatization in Latin America: Evidence from Four Countries." *Economia, Journal of the Latin American and Caribbean Association.*

OSIPTEL, 2001. Contratos de Concesión con CPT S.A ENTEL PERU S.A Gerencia de comunicación corporativa y Gerencia Legal. Lima.

_____. 1999. El acceso Universal y la Política de Fitel. Serie: Estudios en Telecomunicaciones No. 5. Lima.

Rama, Martin. 1999. "Efficient Public Sector Downsizing." *World Bank Economic Review* 13(1): 1-22.

Ramamurti, Ravi. 1996. *Privatizing Monopolies: Lessons from the Telecommunications and Transport Sectors in Latin America.* Baltimore, United States: Johns Hopkins University Press.

Röller, L-H. and L. Waverman, 2001. "Telecommunications Infrastructure and Economic Growth: A Simultaneous Approach." *American Economic Review, 91(4): 909-923*

Saavedra, Jaime (2003) Comment to: *"The Distributive Impact of Privatization in Latin America: Evidence from Four Countries." Economia*, *Journal of the Latin American and Caribbean Association*.

Saunders, R. , J. Wardford, and B. Wellenius, 1994. Telecommunications and Economic Development. The Johns Hopkins University Press. Baltimore.

Stigler, George, 1961. "The Economics of Information" *Journal of Political Economy, 69(3): 213-225.*

Stiglitz, Joseph 1985. "Information and Economic Analysis." *Economic Journal, 95(supplement): 21-41.*

_____*, 2002. "*Information and the Change in the Paradigm in Economics." *American Economic Review, 92(3): 460-501.*

Tschang, Ted, M. Chuladul and T. Thu Le, 2002. "Scaling-up Information Services for Developmen*." Journal of International Development, 14: 129-141.*

United Nations Development Program , 2001. "Road map towards the implementation of the United Nations Millennium Declaration." Report of the Secretary-General

Wellenius, Bjorn, Vivien Foster, Cristina Malmberg-Calvo (2004) "Private Provision of Rural Infrastructure Services: Competing for Subsidies", Manuscript, The World Bank.

.World Bank (2001) World Development Indicators, CD ROM, World Bank, Washington, DC

Table 1
Summary Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Total per capita Income (log)	1000	6.868	1.031	3.811	11.306
Total per capita non-farm Income (log)	761	6.496	1.352	3.062	10.300
Total per capita farm Income (log)	733	5.979	1.071	2.156	11.306
Family size	1000	4.895	2.026	1.000	14.000
Age of household head	991	44.259	14.052	20.000	90.000
Gender of household head (male)	1000	0.890	0.313	0.000	1.000
Years of education (average household)	1000	5.742	3.103	0.000	16.000
Squared years of education (average household)	1000	42.596	43.931	0.000	256.000
Spanish mother tongue (head)	1000	0.284	0.451	0.000	1.000
Work as Dependent (head)	1000	0.494	0.500	0.000	1.000
Belongs to Religious organization	991	0.269	0.444	0.000	1.000
Access to electricity	999	0.697	0.460	0.000	1.000
Time to the closest important town	1000	2.020	4.318	0.000	78.000
Town with public telephone	1000	0.500	0.500	0.000	1.000
Altitude (/1000 meters)	1000	3.12469	0.7745045	0.163	3.978
Time to the closest public telephone	1000	0.872	1.176	0.000	5.000
Use of Telephone Services (head)	1000	0.766	0.424	0.000	1.000
Purpose of calls : Business	1000	0.101	0.301	0.000	1.000
Rural telephone expenditures (S/.)	1000	8.377	14.893	0.000	100.000
Apurimac	1000	0.281	0.450	0.000	1.000
Arequipa	1000	0.199	0.399	0.000	1.000
Cusco	1000	0.400	0.490	0.000	1.000
Puno	1000	0.120	0.325	0.000	1.000

Table 2
Use of Public Telephone, Travel Time and Direct and Indirect Expenditures

	HH's Income[1/]	Use of Public Telephone[2/]	Avg. Travel Time[3/]	Average Call[4/]	Direct Monthly Exp. on Phone[5/]
Income Group					
I: Bottom 25%	35	65%	80	0.5	0.6
II	74	70%	64	0.9	1.0
III	147	84%	39	2.1	2.1
IV: Top 25%	463	88%	27	6.9	6.2
Type of Village					
With Phone	232	83%	7	3.0	2.8
Without Phone	127	71%	99	2.1	2.2
Total	180	77%	53	2.6	2.5

All income figures are in dollars. The exchange rate employed is 1US$=3.38S/ (World Bank, 2001) 1/ Average monthly income of the household including both farm and non-farm income in US dollars 2/Refers to the head of the household. 3/ Walking average travel time to reach to the nearest publicly accessible telephone in minutes. 4/ Average number of calls per month. 5/ Includes rates, only.

Table 3
One-way Travel Time to the Nearest Public Telephone and Usage Rate

One Way Travel Time	Percentage of Sample in Category	Use of Public Telephone [1/]
Within the village[2/]	22	89%
Within 30 minutes distance	44	78%
Within one hour distance	8	72%
More than one hour distance	27	65%
Total	100	77%

1/ Refers to the head of the household; 2/ Zero or negligible distance.

Table 4
Access to Public Telephone in Rural Towns and Household Income

	OLS	OLS	OLS	IV	OLS	OLS	IV
	(1)	(2)	(3a)	(3b)	(4)	(5a)	(5b)
Family size	-0.1412 ***	-0.1443 ***	-0.1456 ***	-0.1486 ***	-0.1465 ***	-0.1594 ***	-0.1656 ***
	(0.012)	(0.012)	(0.012)	(0.013)	(0.012)	(0.011)	(0.014)
Age of household head	0.0044 ***	0.0051 ***	0.0056 ***	0.0064 ***	0.0056 ***	0.0040 **	0.0034 *
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Gender of household head	0.0744	0.0738	0.0268	-0.0154	0.0214	0.0305	0.0127
	(0.080)	(0.079)	(0.081)	(0.081)	(0.080)	(0.075)	(0.075)
Years of education (average household)	0.2001 ***	0.1886 ***	0.2088 ***	0.1866 ***	0.2104 ***	0.1509 ***	0.1238 ***
	(0.025)	(0.026)	(0.026)	(0.029)	(0.026)	(0.024)	(0.038)
Years of education sqrd. (average household)	-0.0020	-0.0015	-0.0021	-0.0013	-0.0023	-0.0009	-0.0002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Time to the closest important town	-0.0137	-0.0079	-0.0108	-0.0123	-0.0097	-0.0123	-0.0133
	(0.009)	(0.010)	(0.009)	(0.009)	(0.009)	(0.008)	(0.008)
Town with public telephone after privatization	0.3079 ***						
	(0.049)						
Time to the closest public telephone		-0.1531 ***					
		(0.023)					
Use of Telephone Services (head)			0.1606 ***	0.4988 **			
			(0.057)	(0.177)			
Purpose of calls : Business					0.3642 ***		
					(0.081)		
Log. rural telephone expenditures						0.2425 ***	0.3406 ***
						(0.020)	(0.103)
Constant	5.9501 ***	6.3272 ***	5.9257 ***	5.8060 ***	5.9673 ***	6.1407 ***	6.2185 ***
	(0.170)	(0.175)	(0.177)	(0.185)	(0.174)	(0.159)	(0.171)
Obs	991	991	990	986	991	991	986
R-squared	0.491	0.4974	0.475	0.459	0.481	0.543	0.531

All regressions include fixed effects. The dependent variable is log per capita income (farm and non-farm). Standard errors are given in parentheses. We instrumented use of telephone services and rural telephone expenditures. The instruments are whether Spanish is the mother tongue, whether the household belongs to religious organization, and whether the head of household works as dependent. *** Significant at 1 percent; ** significant at 5 percent; * significant at 10 percent.

Table 5
Access to Public Telephone in Rural Towns and Non-Farm Income

	OLS (1)	OLS (2)	OLS (3a)	IV (3b)	OLS (4)	OLS (5a)	IV (5b)
Family size	-0.1700 ***	-0.1722 ***	-0.1758 ***	-0.1831 ***	-0.1785 ***	-0.1952 ***	-0.2173 ***
	(0.021)	(0.021)	(0.021)	(0.023)	(0.021)	(0.020)	(0.024)
Age of household head	0.0021	0.0030	0.0036	0.0072 **	0.0032	0.0018	0.0005
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Gender of household head	0.0504	0.0435	-0.0048	-0.1148	-0.0117	0.0020	-0.0410
	(0.124)	(0.124)	(0.125)	(0.130)	(0.123)	(0.122)	(0.127)
Years of education (average household)	0.2512 ***	0.2492 ***	0.2581 ***	0.2139 ***	0.2542 ***	0.2035 ***	0.1406 **
	(0.041)	(0.042)	(0.041)	(0.046)	(0.042)	(0.039)	(0.057)
Years of education sqrd. (average household)	-0.0036	-0.0035	-0.0038	-0.0026	-0.0037	-0.0028	-0.0017
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Time to the closest important town	-0.0233	-0.0155	-0.0198	-0.0250	-0.0183	-0.0196	-0.0209
	(0.023)	(0.025)	(0.024)	(0.023)	(0.023)	(0.024)	(0.024)
Town with public telephone after privatization	0.3238 ***						
	(0.081)						
Time to the closest public telephone		-0.1241 ***					
		(0.040)					
Use of Telephone Services (head)			0.2235 **	1.1990 ***			
			(0.095)	(0.308)			
Purpose of calls : Business					0.4956 ***		
					(0.116)		
Log. rural telephone expenditures						0.2581 ***	0.5274 ***
						(0.029)	(0.152)
Constant	5.9328 ***	6.2311 ***	5.9441 ***	5.4502 ***	6.0509 ***	6.1979 ***	6.3591 ***
	(0.289)	(0.287)	(0.294)	(0.329)	(0.288)	(0.269)	(0.277)
Obs	754	754	754	752	754	753	752
R-squared	0.424	0.4198	0.415	0.343	0.424	0.463	0.410

All regressions include fixed effects. The dependent variable is log per capita non-farm income. Standard errors are given in parentheses. We instrumented use of telephone services and rural telephone expenditures. The instruments are whether Spanish is the mother tongue, whether the household belongs to a religious organization, and whether the head of household works as dependent. *** Significant at 1 percent; ** significant at 5 percent; * significant at 10 percent.

Table 6
Access to Public Telephone in Rural Towns and Farm Income

	OLS	OLS	OLS	IV[/1]	OLS	OLS	IV[/1]

	(1)	(2)	(3a)	(3b)	(4)	(5a)	(5b)
Family size	-0.1544 ***	-0.1562 ***	-0.1564 ***	-0.1592 ***	-0.1560 ***	-0.1644 ***	-0.1771 ***
	(0.016)	(0.016)	(0.016)	(0.020)	(0.016)	(0.016)	(0.019)
Age of household head	0.0070 ***	0.0072 ***	0.0077 ***	0.0087 **	0.0076 ***	0.0068 ***	0.0059 ***
	(0.002)	(0.002)	(0.002)	(0.004)	(0.002)	(0.002)	(0.003)
Gender of household head	0.0522	0.0548	0.0352	0.0155	0.0377	0.0606	0.0873
	(0.113)	(0.113)	(0.114)	(0.128)	(0.114)	(0.107)	(0.109)
Years of education (average household)	0.1423 ***	0.1334 ***	0.1457 ***	0.1259 *	0.1507 ***	0.0987 ***	0.0250
	(0.032)	(0.032)	(0.033)	(0.070)	(0.033)	(0.032)	(0.062)
Years of education sqrd. (average household)	-0.0053 **	-0.0050 **	-0.0053 **	-0.0045	-0.0057 **	-0.0039 *	-0.0015
	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.003)
Time to the closest important town	-0.0033	0.0000	-0.0020	-0.0030	-0.0012	-0.0038	-0.0068
	(0.006)	(0.006)	(0.006)	(0.007)	(0.006)	(0.006)	(0.006)
Town with public telephone after privatization	0.1336 **						
	(0.061)						
Time to the closest public telephone		-0.0894 ***					
		(0.027)					
Use of Telephone Services (head)			0.0910	0.3641			
			(0.073)	(0.890)			
Purpose of calls : Business					0.1101		
					(0.121)		
Log. rural telephone expenditures						0.1860 ***	0.4433 **
						(0.031)	(0.191)
Constant	5.6661 ***	5.8974 ***	5.6039 ***	5.4747 ***	5.6242 ***	5.6915 ***	5.7537 ***
	(0.214)	(0.227)	(0.217)	(0.463)	(0.215)	(0.208)	(0.233)
Obs	729	729	729	729	729	729	729
R-squared	0.328	0.333	0.326	0.293	0.325	0.3606	0.291

All regressions include fixed effects. The dependent variable is log per capita farm income. Standard errors are given in parentheses. We instrumented use of telephone services and rural telephone expenditures. The instruments are whether Spanish is the mother tongue, whether the household belongs to a religious organization, and whether the head of household works as dependent. *** Significant at 1 percent; ** significant at 5 percent; * significant at 10 percent.

Table 7
Logit Estimations for Placement and Usage

	Placement	Use
Family size	-0.0408	0.0298
	(0.038)	(0.025)
Age of household head	0.0109 **	-0.0098 ***
	(0.005)	(0.003)
Gender of household head	-0.5852 **	0.2516 *
	(0.247)	(0.147)
Years of education (average household)	0.1074	0.1203 **
	(0.088)	(0.058)
Years of education sqrd. (average household)	0.0014	-0.0010
	(0.006)	(0.005)
Time to the closest important town	0.1751 **	0.0360
	(0.053)	(0.028)
Town with public telephone after privatization		0.1365
		(0.104)
Access to Electricity	1.9457	0.3491 ***
	(0.183)	(0.109)
Spanish mother language (head)	0.4837 **	0.5370 ***
	(0.239)	(0.181)
Altitude /1000	0.1881	
	(0.121)	
Constant	-2.9824	-0.7492
	(0.743)	(0.587)
Obs	990	990
LR chi2	249.01	135.39
Prob > chi2	0.000	0.000
Pseudo R2	0.1814	0.125

The first dependent variable equals one if the town has a public telephone installed by the privatized firm, it is zero otherwise. The second dependent variable equals one if the head of the household uses the rural telephone service, it is zero otherwise. Standard errors are given in parentheses. All regressions include fixed effects; *** Significant at 1 percent ** significant at 5 percent, * significant at 10 percent.

Table 8
Rural Public Telephone Usage: Average Treatment on the Treated

	Outcomes					
	Non-Farm per capita Income		Farm per capita Income		Total per capita Income	
	Mean	Std. Err.	Mean	Std. Err.	Mean	Std. Err.
Placement						
A. Unmatched						
Treated	1548	(110.6)	790	(185.5)	2338	(209.9)
Controls	640	(52.2)	509	(42.2)	1148	(64.5)
Treated-Controls	908	(122.3)***	281	(190.2)	1189	(219.6)***
B. Matched[1/]						
Treated	1527	(108.6)	802	(188.8)	2329	(211.8)
Controls	1097	(19.5)	480	(4.6)	1581	(18.0)
Treated-Controls	429	(110.3)***	322	(188.9)*	747	(212.6)***
Use						
A. Unmatched						
Treated	1257	(79.0)	719	(123.6)	1976	(142.8)
Controls	561	(60.0)	421	(39.0)	982	(68.2)
Treated-Controls	696	(146.7)***	298	(224.7)	994	(261.2)***
B. Matched[1/]						
Treated	1064	(75.3)	737	(134.1)	1794	(151.9)
Controls	833	(13.1)	433	(1.3)	1257	(13.4)
Treated-Controls (matched[1/])	231	(76.4)**	304	(134.1)**	537	(152.5)***

1/ Within the region of common support. Kernel Metric = P. Score; Kernel type: epanechnikov (h=0.1).
*** Significant at 1 percent; ** significant at 5 percent; * significant at 10 percent.

Figure 1
Annual Income and Annual per capita Income by Sources

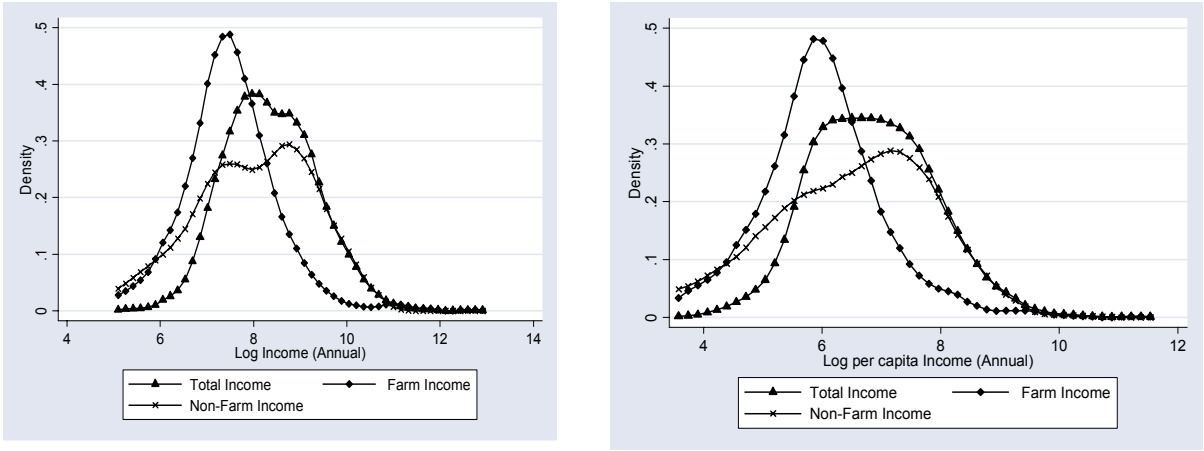

Figure 2
Before and After Propensity Score Matching (Placement)

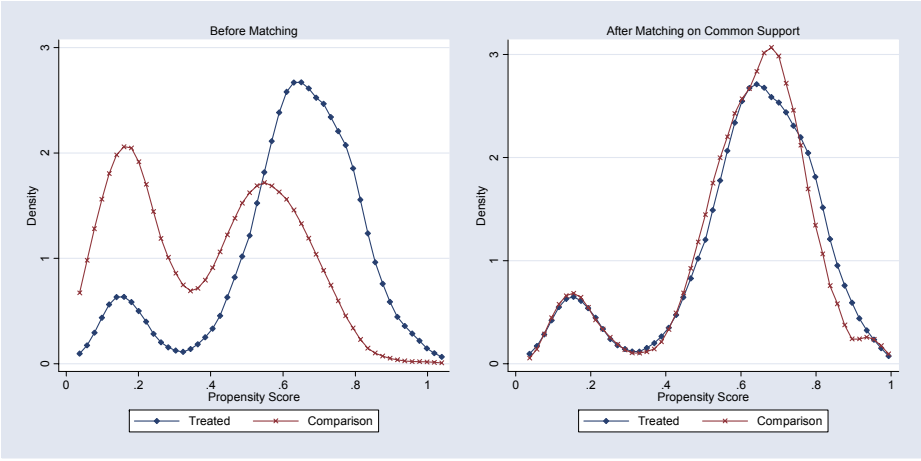

Figure 3
Before and After Propensity Score Matching (Use)