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

by

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Abstract[1]

This paper takes 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 in small rural towns throughout the national territory. Using a specially designed household survey for a representative sample of rural towns, it is possible to link access to telephone services with household income. It was found that, regardless of the income measurement, most characteristics of public telephone usage are positively linked with income. Remarkably, the benefits occur at both non-farm and farm income levels. Not only do the findings hold when using instrumental variables, but they are also further confirmed when using propensity scores matching methods.

JEL Classification: G32, H10, J45, O1
Key Words: Privatization, Institutions, Rural, Poverty, Telecommunications

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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 López-de-Silanes, 2004).[2] 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 a 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 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 cite falling electricity prices that improved the welfare of all income deciles. They also report welfare gains in Bolivia from increased electricity access for all but the top income deciles. In Nicaragua, the authors 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

[2] 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

privatization. Mookherjee and McKenzie's study (2003) is, however, 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).[3]

This paper studies 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 1990s. In particular, the privatization contract called for the privatized firm to install public telephones in 1,526 small rural towns distributed along the national territory in a random fashion. Using a household survey designed and performed by the authors on a representative sample of towns that received treatment until 2001, it was possible to study household income and welfare implications using both conventional regression analysis and matching methods. The basic premise is that telecommunication services reduce the gap in access to both formal and informal information. This reduction of informational gaps reduces 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.[4] In fact, the existing empirical literature on the impact of rural telecommunications on income is scarce and far more suggestive than formal. Bayes (2001) argues that a village pay phone program in Bangladesh may be an example of how pragmatic policies can turn telephones into production goods. Services originating 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 with 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.

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undergo harsh restructuring processes following privatization and do not simply mark-up prices or lower wages (Chong and López-de-Silanes, 2004).

[3] An exception is Galiani et al. (2002), 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 in 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.

[4] 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).

This 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. Section 4 presents the regression analysis findings to test whether telecommunication variables have an impact on income per capita. Section 5 shows 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 a key ingredient in promoting economic growth (Röller and Waverman, 2001), it has not been a central investment issue in many developing countries. Low-income countries account for only 6 percent of the world's telephone mainlines, which equals about 28 lines per 1,000 inhabitants. In contrast, high-income countries account for 52 percent of the world's telephone mainlines, or 585 lines per 1,000 inhabitants. Furthermore, a comparison with rural areas makes the difference even more dramatic: in developing countries the rural mainline density is lower than one per 1,000 inhabitants (International Telecommunications Union, 2003). It has been claimed that under government control, the potential gains associated with access to telecommunications services are ignored, underestimated or simply unknown.[5] 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 known about the size and distribution of those benefits, particularly in rural areas.

Rural telecommunications services constitute a crucial part of rural infrastructure since they provide the means for transferring information in a context where alternative means of obtaining information are less accessible. Advocates of this kind of infrastructure investment point out that the development of such infrastructure reduces information gaps, decreases the

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

distance between economic agents and therefore reduces transaction costs. As a consequence, it enhances 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 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).[6] Information may be obtained from either formal or informal sources. Where formal or official information is limited or nonexistent, 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 explores 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, when asked to name their primary sources of information on a number of tasks related to cultivation and new technologies, the majority of farmers say they get information from family members (Godtland 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 a six-year investment schedule whereby the privatized firm was required to install and operate public pay telephones in 1,526 towns out of a list of about 40,000 rural municipalities. The basic characteristics of the eligible towns were that they did not have telecommunication services and

[6] 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 and Amacher (1994) find that a lack of information may be a reason the 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.

were limited to a population of between 400 and 3,000 people. The towns were chosen randomly throughout the national territory.[7]

As part of this research, a household survey was designed and implemented in 2002 on a representative sample of towns in rural areas in Southern Peru, a region that is characterized by extremely high levels of poverty.[8] In fact, this particular geographic area was chosen specifically because it is considered among the poorest in the country. The sample includes 1,000 rural households engaged in farm and non-farm activities, distributed proportionally between towns without any telecommunication service and towns with public telephones installed and operated by the privatized company. Ten households were randomly selected from each of 100 towns originally sampled. Thus, half of the towns had at least one public telephone installed by the privatized company in the most accessible part of the town, such as the municipal authority building or the main store in town. The other half, in which the lack of public telephone service was primarily due to a supply constraint instead of a demand constraint, was used as a control group.[9] 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.

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 uses the town's public telephone, 88 percent of the top income group uses it. In terms of the expenditure on public telephone services, Table 2 shows that it varies from US$0.60 for the

[7] Since monitoring was relatively lax, the authors examined 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. They did not find such evidence, since the distributions of the corresponding sub-samples are not statistically different. There are two possible reasons for this. One, the rural pay phone investment requirement was a minuscule part of the total investment requirement of the privatized firm. Second, this type of investment may have been used by the company as a tool to increase goodwill and credibility in the face of necessary price increases.

[8] According to official figures, the poverty rates in 2001 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 consists of about 41 percent of all rural public telephones installed by *Telefónica* after privatization and comprises 25 percent of Peru's total rural population.

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

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 quartile. In addition, 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 since 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 an installed telephone have a higher usage rate than those households from towns without a telephone. This, perhaps, is a consequence of higher transaction costs, since travel time to reach the public phone is dramatically higher. Table 3 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 telephones for both economic and social purposes. The most important reason for the use of a public telephone is to contact relatives (78 percent). The second most important reason is to do business (11 percent). Finally, the third most important reason is for emergencies (10 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 transactions 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 reported in the survey as being made "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 whose main purpose is unknown. 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 of 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, a simple empirical reduced form was estimated, and measures of total household income, farm, and non-farm per-capita

income were linked with several telecommunications characteristics such as availability of telephones, distance to the nearest telephone, frequency of use and motive for using. When variables that may have potential reversal causality problems are included, an instrumental variables approach is also applied 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 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.[10] Finally, all the regressions include fixed-effects, which are applied at the departmental level.[11] The following specification is estimated:

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

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 telephone 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, this paper uses three measures of per capita income as dependent variable. The first measure consists of the total annual household per capita income, regardless of source. The second consists of only farm per capita income. The third consists of only non-farm per capita income. 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 the sample, the income share of non-farm activities is a high 53 percent, which is consistent with other studies on rural income (Escobal, 2002).[12] As such, it is also far more dependent on outside

[10] Given the fact that these instruments may not be ideal, a complementary approach is also used by applying matching methods below.
[11] Non fixed-effects regressions were also tested and the findings are very similar.
[12] Per capita expenditures were used instead of income measures. While very similar findings were obtained when compared with the total household income measure, expenditures do not allow for the separation of farm and non-

linkages with its hinterland, either with neighboring towns, or with nearby urban areas, if any. In a context where towns had lacked access to any telecommunications service prior to the installation of public telephones by *Telefónica*, inhabitants of poor rural villages will benefit the most from mechanisms that help them improve communication with other towns and villages because before the only link to the outside world involved reaching the nearest village, typically on foot. As a result, chances are that demand possibilities will greatly increase.[13]

Figure 1 shows the kernel densities functions of these three income variables. As described above, these measures are regressed against a set of variables that have been classified in two groups. The first group contains a standard set of family characteristics: 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 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 equals 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.

Table 4 presents a basic set of estimates using the logarithm of the total per-capita income as the dependent variable. As expected, a positive and statistically significant link was found between total per capita income and average years of schooling. A negative but statistically insignificant link was also found 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 link with total per-capita income. More important, with respect to the variables of interest, all the relevant variables were found to have the expected sign and are

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farm activities, which as shown above, is particularly relevant in research related to rural areas. Empirical findings using expenditures are available upon request.

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

statistically significant at conventional levels.[14] In particular, the 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, since the sign of the coefficient is positive and statistically significant at 1 percent. This is shown in Column 1. Furthermore, a negative and statistically significant link was found between walking time to the nearest telephone service and total household per capita income, as shown in Column 2 of the same table. The farther the telephone service is, the less likely it will be used, and as a consequence, the less the informational advantages of the service will be obtained. Additionally, the use of a rural public telephone service is associated with 16 percent higher per capita income, or 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.[15] Finally, a positive and statistically significant link was found between expenditures on telephone service and total per capita income. The findings suggest that an additional 10 percent of expenditure on public telephone usage is associated with a 2.4 percent increase in total per-capita income, or 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 services have been conducive to increased household income in rural areas.

Table 5 repeats the above exercise but focuses on per capita non-farm income as the dependent variable. Again, all the variables of interest were found to yield the expected signs and are statistically significant at conventional levels. For instance, the availability of a rural public telephone is associated with 32 percent higher per capita non-farm income, since the sign of the coefficient is positive and statistically significant at 1 percent. This is shown in Column 1. As before, a negative but statistically insignificant link was also found between walking time to the nearest public telephone and per capita non-farm income, as seen in Column 2 of the same Table. Regarding the measure of use, it was found that the use of a rural telecommunications service is associated with 22 percent higher per capita non-farm income, 119 percent when correcting for

[14] Since these variables are highly correlated, they are included separately tas regressors. A principal components approach was also applied, which yields similar statistically significant results. These findings are available upon request.

endogeneity. These figures are shown in Column 3a and Column 3b, respectively. Again, households that self-report business-related use of a telephone service are associated with 25 percent higher per capita non-farm income. Finally, a positive and significant link between expenditure on telephone service and per-capita non-farm income was found. The results suggest that an additional 10 percent of expenditure on public telephone use is associated with a 2.58 percent increase in per capita non-farm income, or 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 service 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 significant link in the case of gender.

Table 6 repeats the same exercise as above but focuses on farm income. The 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, a negative and statistically significant link was found between distance and per capita farm income, a significant link in the case of telephone use was not obtained, as shown in Column 3a and Column 3b. Furthermore, the same occurs with households that self-report business-related use of telephone service. Finally, a positive and statistically significant link was observed 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, or 4.43 when correcting for endogeneity. This is shown in Column 5a and 5b of the same table.

This section has provided evidence that access to telephone services in poor, rural towns in Peru has helped increase per capita household income. While such increases have appeared in both farm and non-farm channels, it is remarkable that the economic impact on non-farm channels is substantially larger than that on purely farm channels.[16] This finding is, in a way, unsurprising when one bears in mind the theoretical literature on the role of telecommunications

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

[16] Statistical tests on the difference of coefficients of farm and non-farm for any given regression always yield statistically significant results at 5 percent or higher.

as a provider of information, particularly in small and isolated rural towns such as those considered in this study.

5. Propensity Scores Matching Methods

The soundness of the regression method approach is based on two assumptions. First, it hinges on the conjecture that the correct functional form of the outcome has been selected. Second, it implicitly assumes that it is possible to adequately control for potential differences between users and non-users of rural public telephone services that may arise from the voluntary nature of participation. Unless these potential differences are properly accounted for, a 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 endogeneity problem since while the instruments considered are the best that could be found, it may not suffice to eliminate endogeneity. In fact, one could always argue that the instruments are not clearly correlated with use and are clearly uncorrelated with outcome (Jalan and Ravallion, 2003). In order to both minimize the potential bias in the impact estimate due to selection of observables, and use a useful alternative method that avoids the need for using instrumental variables, matching methods were used 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 the case of 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. After matching, those numbers became 0.6140 with a standard error of 0.1930, and 0.6019 with a standard error of 0.1871, in the region of common support. Similarly, in the case of use, prior to matching the average estimated propensity scorse for treated and non-treated units were 0.793 with a standard error of 0.1333, and 0.671 with a standard error of 0.1438. After matching, those numbers became 0.787 with a standard error of 0.1307, and 0.793 with a standard error of 0.1320, in 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 of the treated according to the kernel matching estimator. The results confirm a positive and significant link between access to telephone services and the measures of household income. Total per-capita household income among the population who is treated ("existence of public telephone installed by the privatized firm") would appear to be 32 percent lower without it. Furthermore, total per capita non-farm income among the population who is treated would be around 28 percent lower otherwise. Similarly, total per-capita farm income among the population who is treated would be about 41 percent lower otherwise. Likewise, among the population that is treated ("uses rural telephone services installed by the privatized firm"), the total per-capita income would be about 30 percent lower otherwise, while total per-capita non-farm income would be 22 percent lower and total per-capita farm income would be 40 percent lower.

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 López-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 offering public utilities: water, electrical and telephone services (Forero, 2005). This is particularly true in poor and rural areas where, according to the conventional wisdom, the welfare gains of privatization are rather questionable.

This paper takes 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. A specially designed household survey data for a representative sample of rural towns allowed for the establishment of a link between access to telephone services and household income. Regardless of the income measurement, most characteristics related with access to public telephones installed and operated by the privatized firm were found to be positively linked with household income. Remarkably, such benefits occurred at both farm and non-farm income levels, with the latter being particularly crucial in rural areas because 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 also further confirmed when using propensity scores matching methods.

Critics of privatization may point to the fact that while the evidence presented in this paper makes 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, since 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 devised by the privatized company had pure laissez-faire been allowed. A more pragmatic view of the findings is presented here. On the one hand, many governments include investment requirements in their privatization contracts (Chong and López-de-Silanes, 2005). On the other hand, investment requirements allow governments to leverage and direct resources from privatized firms to regions where the private sector would not normally get involved and where the government, because of lack of resources, could not intervene either. Increased government tax collection may be an issue, too. While the relevant question, which is beyond the scope of this study, is whether investment requirements divert firm resources from more productive uses elsewhere, it is also true that privatized firms may have an incentive in participating in such investment deals because they help promote good will on the part of the public and government at a relatively low cost.[17]

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

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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

Notes: All income figures are in dollars. The exchange rate employed is 1US$=3.38S/ (World Bank, 2001). 1/ refers to 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/ refers to average walking travel time to reach to the nearest publicly accessible telephone, in minutes. 4/ refers to average number of calls per month. 5/ includes ratesonly.

Source: Primary survey

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/ refers to 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. The use of telephone services and rural telephone expenditures was instrumented. 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 5.
Access to Public Telephone in Rural Towns and Non-Farm Income

	OLS	OLS	OLS	IV	OLS	OLS	IV
	(1)	(2)	(3a)	(3b)	(4)	(5a)	(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. Use of telephone services and rural telephone expenditures were instrumented. 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. Use of telephone services and rural telephone expenditures were instrumented. 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

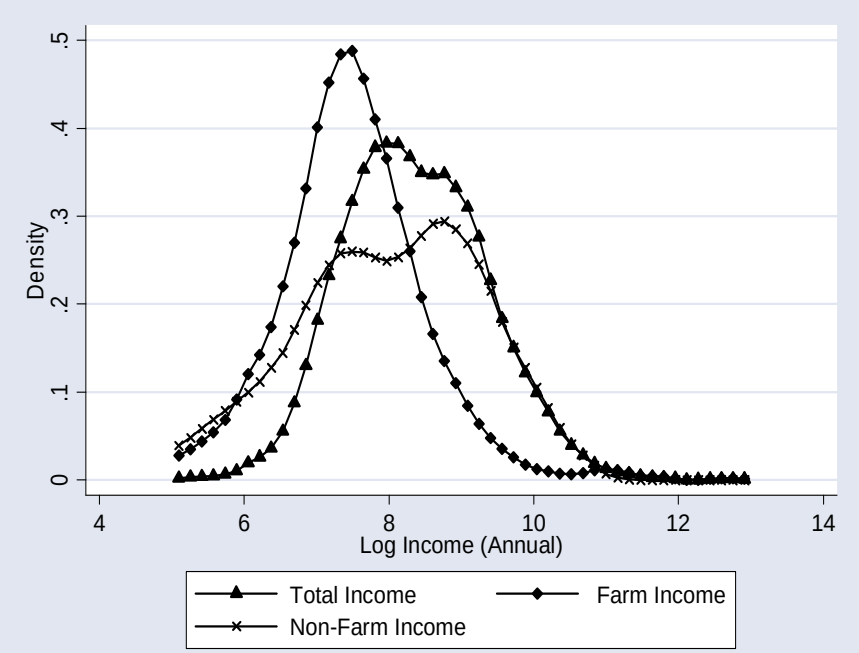
The first dependent variable equals one if the town has a public telephone installed by the privatized firm, but is zero otherwise. The second dependent variable equals one if the head of the household uses the rural telephone service, but is zero otherwise. Standard errors are given in parentheses. 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 Source



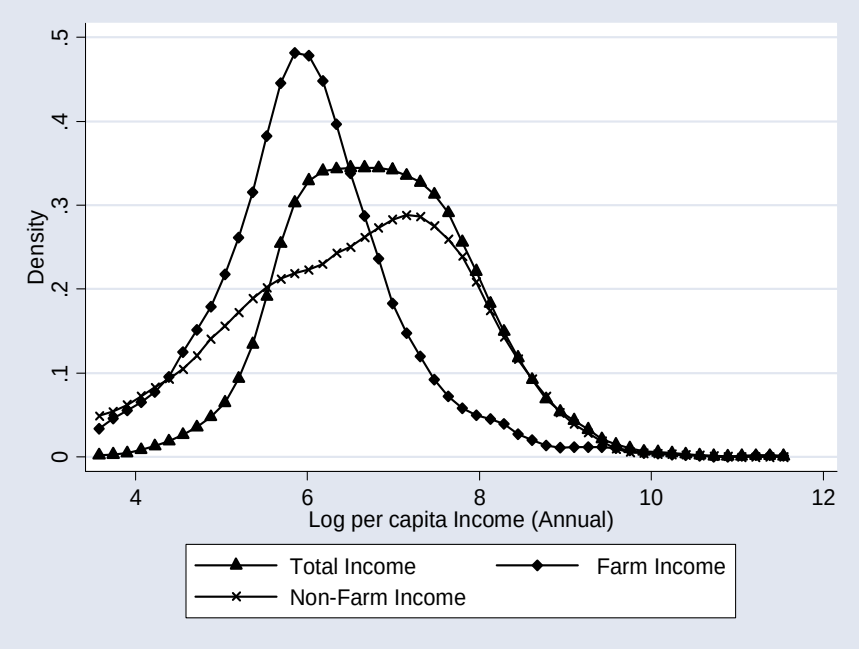


Figure 2.
Before and After Propensity Score Matching (Placement)

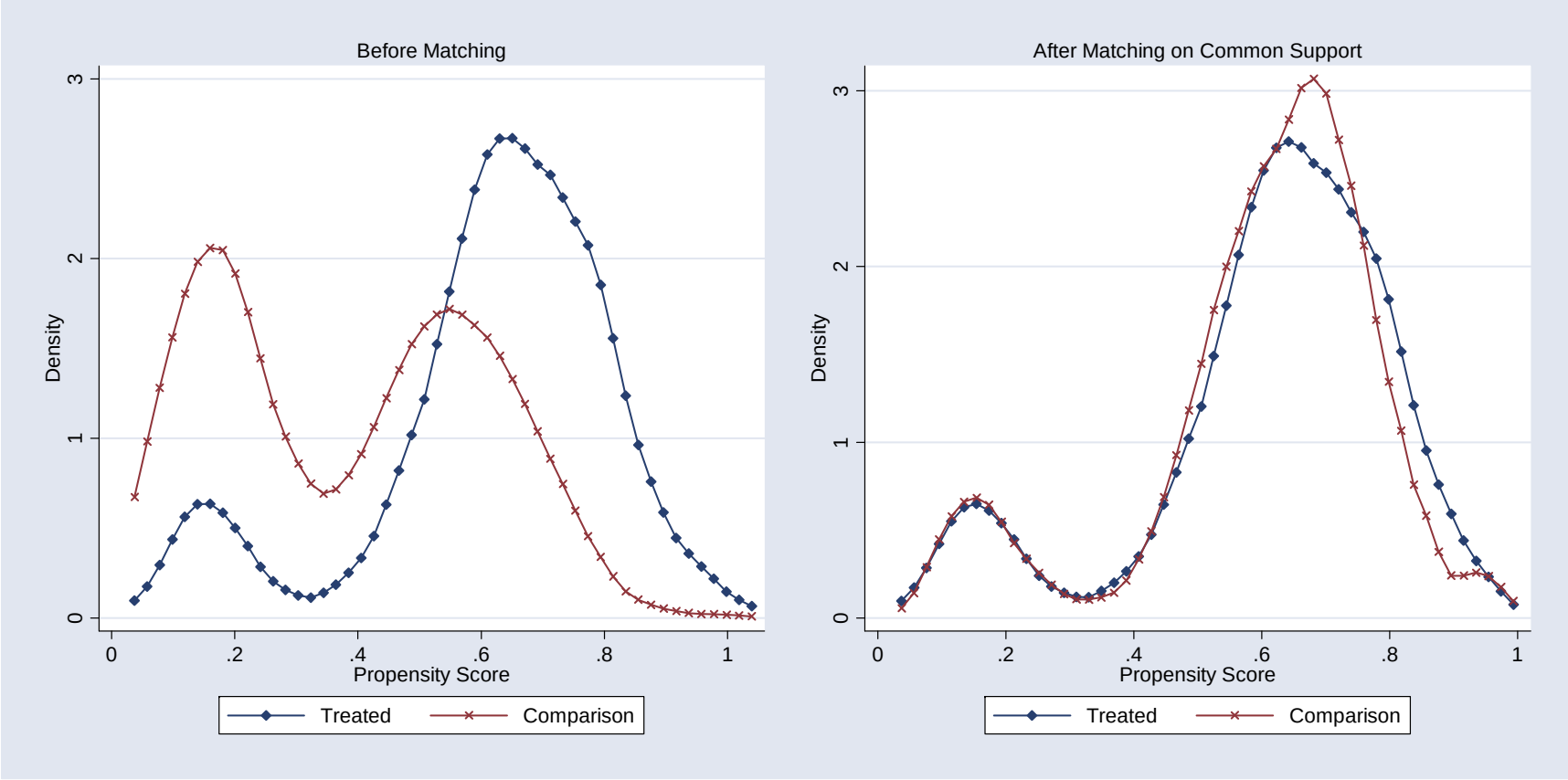


Figure 3.
Before and After Propensity Score Matching (Use)