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PUBLIC SERVICES AND RURAL POVERTY MITIGATION IN BRAZIL[1]

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ABSTRACT

The objective of this study was to adjust hedonic regression models capable of explaining rental values of rural households according to their attributes, including the availability of public services. The results showed that the availability of public services increased in the higher income classes. Non-monetary income generated by basic services was estimated at approximately R$ 90 million per month. Simulations performed with these results indicated that extending basic services - electricity, running water and adequate sewage - to all rural households, the additional non-monetary income would be enough to remove between 245 to 280 thousand people from extreme poverty, and bring between 221 and 269 thousand people above poverty line.

Keywords: Public services. Rural poverty. Non-monetary income. Hedonic models.

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Serviços públicos e mitigação da pobreza rural no Brasil

Resumo

O objetivo deste estudo foi ajustar modelos de regressão hedônicos capazes de explicar valores de aluguéis de domicílios rurais em função de seus atributos, inclusive a disponibilidade de serviços públicos. Os resultados mostraram que a disponibilidade de serviços públicos aumentava nas classes de renda mais elevadas. A renda não monetária gerada pelos serviços básicos foi estimada em, aproximadamente, R$ 90 milhões mensais. Simulações efetuadas com esses resultados indicaram que estendendo os serviços básicos – energia elétrica, água canalizada e esgoto adequado – a todos os domicílios rurais, os adicionais de renda não monetária seriam suficientes para que 245 mil a 280 mil pessoas deixassem de ser extremamente pobres, e entre 221 mil e 269 mil pessoas superassem a linha de pobreza.

Palavras-Chave: Serviços públicos. Pobreza rural. Renda não monetária. Modelos hedônicos.

Introduction

Poverty can be measured by its manifestations – through housing, food, health, access to basic services, and infant mortality, among other conditions – or by persons or families income, where poor are considered people with incomes less than or equal to a preset value (HOFFMANN, 1998, p. 393).

According to Kageyama and Hoffmann (2006), in the period from 1994-2002, poverty measured by income insufficiency, which affects one-third of the population of Brazil, showed cyclical variations with no clear trend toward improvement. Other types of poverty, especially extreme poverty – defined by the authors as insufficient income combined with the absence of the three basic amenities (running water, a toilet, and electricity) – were shown to have consistently decreased during the period.

Analyses that make use of income as a quality of life indicator should consider non-monetary income in addition to monetary income; non-monetary income represents 23.3% of income in rural areas of Brazil (IBGE, 2004, p. 89). Comparing living standard for landowners and renters is a significant problem encountered in studies about poverty and inequality. Ignoring this feature can place tenants and landowners at similar income levels when in fact tenants, who have fixed monthly costs, may have lower living standards. Therefore, imputation of rental values is often used in well-designed studies.

In the case of rural areas, there are additional complications involved with valuing public services, *stricto sensu*, apart from difficulty of serving isolated villages or households. For example, even when water distribution networks are available, access to tax-exempt alternative sources may lead some residents to reject the networks; a similar action can also occur with sewage disposal. The installation of landline telephone service in rural areas typically involves delays and high costs, especially for satellite services. Additionally, mobile phones exhibit problems due to lack of coverage in addition to their high costs.

Despite these difficulties, assessing the unavailability of public services effects in rural areas on beneficiaries income in addition to their impact on poverty reduction, it can provide important information to support policymakers and justify policy implementation.

It is possible to correlate rental values with household characteristics, including public services availability, and therefore to value those characteristics based on the following hedonic hypothesis: heterogeneous goods are aggregations of attributes, and economic behavior relates to attributes and not only to goods (Triplett, 2004, p. 137). The deficiencies in Brazilian statistics, especially relating to rural areas, made these efforts practically unfeasible in the past: in a study by Reiff and Barbosa (2005) that used data from the 1999 National Household Sample Survey (IBGE, 1999), only six of the 22 explanatory variables for rents were significant to rural areas, while 17 of variables were significant for urban areas. This result was most likely due to the small amount of rural data (346 observations, versus 12,390 for the urban areas).

This limitation was overcome by the Consumer Expenditure Survey (Pesquisa de Orçamentos Familiares – POF) conducted in 2002-2003, which included rental values for households that were and were not effectively rented (IBGE, 2004, p. 25).

The aim of this study was to fit and test hedonic regression models that can explain rural households rental values in relation to their attributes, using data from the 2002-2003 POF. Based on the results, we attempted to measure the increase in non-monetary income as a result of the availability of public services and its impact on poverty reduction in rural Brazil.

METHODOLOGY

To present data collected in the 2002-2003 POF for households used in models fitting of, the information from the sample was multiplied by the respective weights of households. Household characteristics – rental value, total number of rooms, bedrooms, and bathrooms, and existence of flooring – were sorted according to large geographic regions. The availability of public services was related to levels of *per capita* monthly income based on the four-class aggregation used in the POF (IBGE, 2004): up to R$ 600 (three times minimum wage, according to its value in January 2003, the base date for the study), R$ 600 to R$ 1,200 (three to six times minimum wage), R$ 1,200 to R$ 3,000 (six to 15 times minimum wage), and greater than R$ 3,000 (over 15 times minimum wage). The first class (up to R$ 600) was further subdivided into four groups: up to R$ 50, which characterized the extreme poverty line; R$ 50 to R$ 100, corresponding to the adopted poverty line; R$ 100 to R$ 200, which characterized people above poverty line but with income of up to the minimum wage at the time; and from R$ 200 to R$ 600, which included households with *per capita* monthly income of one to three times minimum wage.

The adopted poverty line (R$ 100 per month *per capita*) corresponded to the administrative poverty line that was adopted by federal government at the time (one-half the minimum wage) for the purpose of establishing eligibility for various social programs. This amount was quite close to the lower threshold poverty line estimated by the World Bank based on data from the 2002-2003 POF and considering the basic necessities cost: R$ 103 *per capita* monthly income at the national level and R$ 94 *per capita* monthly income for rural areas (World Bank, 2007, p.21). The extreme poverty line – corresponding to one-fourth of the minimum wage, which was also used by federal government to define access to social programs – was relatively close to the food poverty line estimated by the World Bank, which was determined as the amount necessary to meet a person's minimum nutritional requirements: R$ 61 per person per month nationally and R$ 58 per person per month in rural areas (WORLD BANK, 2007, p.17).

The evaluated household income was the monetary[3] and non-monetary[4] income, sum including imputation of estimated rental value, minus household expenses for maintenance, repairs, taxes, insurance, and service fees (IBGE, 2004, p.33). The *per capita* monthly income was obtained by dividing a household's income by the household number of inhabitants.

SPECIFICATIONS FOR THE HEDONIC REGRESSION MODEL

The hedonic pricing approach is derived from Griliches study (1961), which analyzed cars prices by comparing a set of attributes. However, the theoretical foundations for its application were developed by Lancaster (1966, 1971, *apud* NEGRI

[3] Income from work, transfers, rent, and other household income (IBGE, 2004, p. 30).
[4] Use and consumption of products that have been acquired through personal production, taken from businesses, exchanges, donations, and payments in kind, among others (IBGE, 2004, p. 32).

NETO, 2003, p.82), who devised a new approach to consumer theory based on goods characteristics.

The issue of hedonic price was set in the labor markets context by Rosen (1974), who formulated his theory as a problem of spatial equilibrium in which a set of implicit prices guides consumers and producers decisions. A system of two equations, representing supply and demand, was proposed and estimated in a two-stage process. Assuming certain restrictions, such as equality of consumer behavior, supply and demand system — collapses into a single, traditional hedonic price equation (Rosen, 1974, p.44).

The specification for the equation used was exponential, semi-logarithmic, or log-linear, which is the approach often used in studies of hedonic models; this form can be linearized by transformation:

$$\ln Y = \ln \alpha + \ln \beta x + e \qquad (1)$$

where Y is the dependent variable, x represents the explanatory variables, α and β are the parameters to be estimated, and e is the aleatory term[5].

Because the data used are from a non-equiprobabilistic sample (IBGE, 2004, p.36), the weight of the households was used in a weighted least squares scheme (JUDGE et al., 1988, p. 359).

DEFINITION OF STUDY VARIABLES (ATTRIBUTES OF RURAL HOUSEHOLDS)

Valuation models of public services for households in rural Brazil were fitted according to the 2002-2003 POF data. The dependent variable in hedonic equations was the imputed rental value (R$/year). Household characteristics and the availability of public services were used as explanatory variables. Selected characteristics of rural households were the total number of rooms, the total number of bedrooms (total of rooms serving as bedrooms), the total number of bathrooms, and the existence of flooring (in fact, dirt floors or others); the latter was defined as a binary variable that assumed a value of 1 in case of a lack of carpet, ceramic/terracotta tile/stone, plywood, cement, or recovered wood flooring.

As discussed previously, characteristics of rural areas hinder the availability of certain public services *stricto sensu* with the exception of electricity, for which there are limited possibilities for alternative sources to distribution network. Isolated localities can hardly rely on water and sewage networks that are connected to general distribution and

[5] To determine the existence of heteroscedasticity, which is common in cross-sectional data, the Harvey (HILL; GRIFFITHS; JUDGE, 1999, p. 258) and Pesaran and Pesaran (MATOS, 2000, p. 52) tests were used.

collection centers. It seems unreasonable to demand that government make such services available, but alternatives can and should be established that are within the reach of rural citizens. Delivery of running water to all households, which would render it unnecessary to reuse water stored in often-inappropriate containers that are potential sources of contamination, as well as septic tank construction s, are measures of public policy that should be present for any socially concerned government.

Assuming that these demands are reasonable, running water and proper sewage (connected to network/rainwater drainage or septic tank) can be considered public services, at least in *lato sensu*.

Under these assumptions, representative variables for public services availability assumed a binary value of one if positive and zero if not. The tested variables were:

a) public service 1 – existence of running water;

b) public service 2 – existence of a flush toilet and sanitary drainage (sewage);

c) public service 3 – existence of electricity connected to the power distribution grid;

d) public service 4 – existence of a landline; and

e) public service 5 – existence of a sidewalk and/or paving throughout the entire street or simply around the household.

For certain households or in isolated localities, the existence of paving can be unfeasible. The same problem occurs with conventional landline telephone service via cables that do not reach many areas and that can only be connected through satellites. In the latter case, the service high prices obstruct the expansion of access. The progress of mobile phones, whose coverage areas are steadily increasing, will likely contribute decisively to substantially increase the proportion of rural population that can benefit from telephone services as long as regulatory agencies can maintain increased productivity and scale that result in falling prices.

Even without information related to household size, there should be no serious problems of specification because variables related to the number of bedrooms and bathrooms, along with other variables that are representative of public services, are among the most frequently used in explanatory studies of housing values reviewed by Sirmans, Macpherson, and Zietz (2005).

RESULTS AND DISCUSSION

In fitting the models with data from the 2002-2003 POF, it was possible to use 10,620 rural households with no missing values: 1,956 located in the North, 4,218 in the Northeast, 1,809 in the Southeast, 1,022 in the South, and 1,615 in the Midwest region.

At national level, the annual declared rental values ranged from R$ 25.25 to R$ 49,248.00, with an average of R$ 1,214.41. Among regions, the lowest average was in the Northeast (R$ 678.08), followed by the North (R$ 1,101.91), the Midwest (R$ 1,634.50), and the South (R$ 1,656.71); the Southeast region had the highest average (R$ 1,839.20). Only 370 households in the sample (3.48%) were effectively rented for annual mean values between R$ 573.44 (in the Northeast region) and R$ 1,274.10 (in the Southeast region).

The average number of rooms in the households was 5.52 (ranging from one to 23), with relatively small discrepancies between regions, whose averages ranged from 4.34 in the North region to 5.87 in the Southeast region. The number of rooms serving as bedrooms was between one and eight, with an overall average of 2.01; the average was 1.90 in the North region and 2.07 in the Northeast. The number of bathrooms in the households in the sample ranged between zero and 13, with an average of less than one per household at the national level (0.78). Lowest averages were in the Northeast (0.56) and North (0.74); the other regions averaged at least one bathroom per household. As for flooring, 12.25% of the households claimed to have dirt floors or others, *i.e.*, no carpet flooring, ceramic/terracotta tile/stone, plywood, cement, or recovered wood; these totals included only 0.66% of the households in the South but 22.36% in the North region.

With regard to public services, electricity was available in 80.9% of households, and energy companies supplied 77.0% of the total[6]. The South region was the most well supplied (95.8% of households had electricity, and 94.1% were supplied by energy companies); it was closely followed by the Southeast region (94.2% and 93.7%, respectively), whereas in the North region, electricity was available in only 53.9% of households, with companies supplying 36.9% of the total. The availability of electricity grew proportionally to income: among households with *per capita* income of up to R$ 50 monthly, 59.8% had electricity, while of those with incomes[7] between R$ 50 and R$ 100 per month, 67.6% had electricity. Additionally, 90% of households with incomes over R$ 600 per month had electricity. This relatively high concentration in households with higher income was observed throughout regions.

Running water connected to a public network was reported in 18.9% of households. Throughout the regions, the percentages ranged from 6.5% in the North to

[6] A table containing all of the data is not shown to conserve space, but it can be requested from the author.
[7] From this point on, income is employed in the sense of *per capita* income.

27.9% in the Southeast. Running water supplied by a public network or obtained through wells, springs, etc. was present in 55.2% of households, ranging from 23.0% in the North to 93.8% in the South region. The proportion of households with running water also increased with income, from 17.0% to 32.7% for extremely poor and poor, respectively, to approximately 90% for those with monthly incomes over R$ 600. The percentage of households with access to a water supply network increased for households up to the income level of R$ 600 to R$ 1,200 and decreased for two upper levels; this result was most likely associated with isolated higher income households.

Sanitary drainage was connected to a main sewage network or a rainwater drainage network in only 5.5% of rural households. The highest sanitary drainage connection rate was in the Southeast region (17.35%), and the worst was in the North (0.58%). Adequate sewage that was connected to a network/rainwater drainage or septic tank was present in 19.4% of households; in the South region, this percentage was 37.0%, but it was only 7.7% in the Northeast region. There was also a positive association between availability of service and income for this variable. Appropriate sewage was reported by only 3.7% of extremely poor households and 10.5% of the poor households. In the three higher income classes, the percentage ranged from 31.8% to 35.8%.

Landlines were present in 7.7% of households, and again this service was most prevalent in the Southeast region (16.6%), while the North and Northeast regions were the least served (2.8% and 2.9%, respectively). As a relatively expensive service, it was expected that there would be a sharp proportional increase in its availability with household income.

Sidewalk and/or paving throughout was reported by 10.4% of households, with extremes in the Southeast (14.5%) and the North (4.8%) regions. Despite the observed growth that is usually associated with increased income, it is important to note that this service was difficult to find in isolated households regardless of the level of income.

Basic services including electricity, public network water, and adequate sewage were found in 17.4% of households. This percentage grew from 1.7% for the extremely poor to 33.9% for those with a monthly income between R$ 1,200 and R$ 3,000. In the highest income class (over R$ 3,000), a lower percentage (25.6%) was observed compared with the two previous levels, which reflects a drop in the number of households with adequate sewage relative to two previous levels. It is possible that households with higher income had access to satisfactory sanitary drainage systems that were not be included based on the POF data.

RESULTS OF FITTED HEDONIC MODELS WITH DATA FROM THE 2002-2003 POF: ESTIMATION OF VALUES FOR PUBLIC SERVICES

The initial goal of this study was to fit a model at the national level with binary variables representing regions followed by regional models with binary variables representing the federative units. However, the models at regional level did not provide good results due to the reduction in sample size. Therefore, a model was fitted at the national level with variables for 119 of the 120 existing rural sectors in the sample[8] with the aim of representing other household characteristics related to location as closely as possible based on the available data.

Because the binary variable related to households that were effectively rented was significant, a model was fitted using only households that were not rented; it is this model upon which simulations presented later in this article were performed. The estimated coefficients for household characteristics and availability of services did not differ between the two models.

In the fitted model with all of the elements from the sample, variables representing characteristics of households, such as number of rooms, bedrooms, and bathrooms, appeared with positive signs for estimated coefficients, while the lack of flooring – carpet, ceramic/terracotta tile/stone, plywood, recovered wood, or cement – exhibited a negative sign. The binary variable related to households that were effectively rented also had a negative coefficient. All coefficients associated with the binary variables that represented public services *lato sensu* – electricity connected to power distribution grid, running water, adequate sewage (network/rainwater drainage or septic tank), landline telephone service, and paving of the household's street – had positive signs, as expected, and all were significant at very low levels of probability. The coefficient for determination (R^2) was 50.93%, and the Harvey and Pesaran and Pesaran tests indicated no problems of heteroscedasticity (Table 1). Among binary variables representing sectors of the sample, 84 were significant at least at the 10% probability level, and 83 had negative signs[9].

From the estimated coefficients, it can be concluded that an extra room increased the rental value by 7.5% (7.3% in the model without rented households) and an additional bedroom increased the rental value by 2.8% (2.9%). An additional bathroom resulted in an increase in rental value of 13.9%, and the lack of any type of flooring reduced the rental value by 26.0% (26.1%). The variable representing households that were effectively rented indicated that equal characteristics resulted in rents that were

[8] To avoid perfect multicollinearity (JUDGE et al., 1988, p. 430), a sector of São Paulo (GSP27) was not represented by a binary variable.

[9] That is, with an intercept lower than that of the São Paulo sector (GSP27), which was not represented by a binary variable.

53.6% lower; it is possible that these households were in worse condition or that the tenants valued other aspects that were not considered in the models, such as proximity to workplace.

With regard to public services, running water increased the rental value by 13.9% (13.0%), adequate sewage increased the rental value by 5.8% (6.4%), and electricity increased the rental value by 4.1% (4.5%). These basic services together added 25.6% to the rental value (25.5% in the model without households effectively rented). Landlines increased the rental value by 43.7% (40.8%); given the relatively high cost of this service, especially in isolated locations that were connected by satellite, it is likely that this increase partly reflected the existence of other services that are typical of urban households or better-equipped and better-maintained households, which are associated with higher income levels. The existence of at least partial paving increased the rental value by 10.8% (10.6%).

Table 1 - Results of the Model Relating Rental Values with Characteristics of Households and Availability of Public Services, Brazil, 2003.

Variable	Coefficient	Standard deviation	t	P Value
Intercept	6.73703	0.03710	181.58	<.0001
Number of rooms	0.07194	0.00418	17.22	<.0001
Number of bedrooms	0.02777	0.00744	3.73	0.0002
Number of bathrooms	0.13027	0.01467	8.88	<.0001
Households with no flooring	-0.30052	0.02187	-13.74	<.0001
Rented households	-0.76828	0.03639	-21.11	<.0001
Running water	0.13041	0.01811	7.20	<.0001
Adequate sewage	0.05674	0.01862	3.05	0.0023
Grid-connected electricity	0.04060	0.01766	2.30	0.0215
Landline	0.36289	0.02544	14.26	<.0001
Paved street	0.10275	0.02281	4.50	<.0001
R^2	0.5093		82.72(1)	<.0001
Harvey test (heteroscedasticity)			0.19(2)	0.9002
Pesaran and Pesaran test (heteroscedasticity)			0.00(1)	1.0000

(1) F test, with 128 and 10.491 degrees of freedom.

(2) F test, with 3 and 10.616 degrees of freedom.

Source: IBGE, 2004.

After estimating models, obtained coefficients were used to estimate the nonmonetary income resulting from the availability of public services. Only non-rented households were considered because tenants paid rent according to the households attributes including public services.

In the first simulation, the value estimated by the model for a household devoid of the measured public services was subtracted from the rental value estimated by the model for the same household. This difference allowed estimation of each public service value – *stricto* and *lato sensu* – for different income levels. By dividing the total value by the number of inhabitants of each household, it was possible to estimate the contribution of each service to *per capita* income.

As is common in regression models with data completely or partly transformed by logarithms, the weighted average of the estimated rents (R$ 1,007.07) was lower than the average rent for the original sample (R$ 1,221.28) in the estimated equation, despite the fact that weighted averages of logarithms of rents coincided. To circumvent this problem of underestimation, a second simulation was performed by calculating the ratio of the rent estimated by the model without each of the services to the rent originally estimated by the model with services. The factor obtained was then multiplied by the rental value reported in the 2002-2003 POF. The difference from the original rent provided the value for each public service, and this total divided by the number of inhabitants provided another estimate for the contribution of the services to *per capita* income.

According to results of these simulations, availability of electricity connected to a main supply network generated non-monetary income between R$ 21.9 million and R$ 26.6 million per month, which represented, on average, 0.42% to 0.51% of the total *per capita* income for households in which this service was available. The welfare provided by electricity was relatively higher for households below the poverty line because the corresponding non-monetary income represented between 0.98% and 1.07% of total income for those households and between 0.71% and 0.72% for the next highest income class.

The existence of running water – here classified as a *lato sensu* public service – was valued by the model between R$ 50.9 million and R$ 61.9 million per month, accounting for 1.14% to 1.39% of total income on average. Among households with lower incomes, this service provided between 3.11% and 3.90% of total income for those below extreme poverty line and 2.26% to 2.52% for those above the lowest class but also below the poverty line. In valuing running water connected to public network according to same parameters, more modest results were obtained (between R$ 16.8 million and R$ 19.1 million/month) due to lower availability of that public service, as previously mentioned. Nevertheless, the benefit provided to residents of households that had running water was quite close to that shown above and was again greater for those at the lower income levels.

Adequate sanitary drainage (sewage) – either from network/rainwater drainage or a septic tank, which is considered a *lato sensu* public service – represented 0.71% to 0.81% of total income in households on average from the R$ 11.2 million to R$ 12.8 million non-monetary income generated monthly. For households with a monthly income of up to R$ 50, the benefit of adequate sanitary drainage accounted for 1.79% to 1.84% of total income, and for households with income between R$ 50 and R$ 100, it represented 1.43% to 1.57% of total income. Considering only non-monetary income associated with *stricto sensu* public services, the relative importance of network/rainwater drainage sewage was greater, especially for lower income households, despite falling to less than one-third of the previous value.

The non-monetary income generated by basic services including electricity, running water, and adequate sewage was between R$ 80.3 million and R$ 96.8 million per month according to the model estimates, which represented an average of 1.44% to 1.73% of the total income of households covered by at least one of the services. The benefit gained from these services accounted for nearly 2% of total income *per capita* for households with incomes below the poverty line and in extreme poverty.

Paving of at least some streets where households were located represented non-monetary income between R$ 7.8 million and R$ 9.3 million per month, which represented, on average, 1.04% to 1.23% of the *per capita* income for households in the sample. As in the other cases, the share of benefit for this service declined with increasing income.

Considered separately, the existence of a landline represented a non-monetary income value below only that estimated for running water (between R$ 30.5 million and R$ 36.7 million per month). It should be noted that this service could be strongly associated with locations that were typically urban and with higher income households, which would lead to higher rental values. Despite these considerations, values obtained should be viewed with caution, especially in the case of households classified as low income. Even if we disregard the possibility of errors in completion of the survey or the withholding of income data, the small number of positive observations in the sample[10] makes it possible to assume that the construction or acquisition of these houses occurred when their inhabitants had a higher income or that they faced economic difficulties that were incompatible with their declared rental value during the POF survey.

[10] Only two households in the income level of up to R$ 50 *per capita* monthly income and 23 households in the income level between R$ 50 and R$ 100 *per capita* monthly income.

The benefit provided by these five *stricto sensu* services – electricity, public running water, sewage, paving, and landline telephone – was valued between R$ 109.2 million and R$ 132.1 million per month. For households with at least one of these services, the non-monetary income accounted for 2.00% to 2.41% of the total *per capita* income, with greater participation for income levels of up to six times the minimum wage.

The obtained coefficients were also used to simulate whether the introduction of basic services – electricity, running water, and adequate sewage – in households without such services would provide them with sufficient non-monetary income to allow mobility into a higher income class. Again, only non-rented households were considered; given the availability of a new basic service, it is reasonable to assume that landowners would add the corresponding valuation to the rental value so that the transferred value would not be appropriated as non-monetary income by tenants. If the landowners were also rural inhabitants, the monetary income corresponding to the rent increase resulting from the new service might be sufficient to allow for a progression in income class; however, this information cannot be extracted from the POF data.

As described above, two simulations were performed. First, the value estimated by the model according to the original conditions of the household without services was subtracted from the new rental value, including the still non-existent public services, as estimated by the model. The difference was added to the original household income, and the total was divided by the number of inhabitants to provide new *per capita* income for the household.

In the second simulation, the rent estimated by the model with the new service was divided by the rent estimated by the model without the service. This factor was then multiplied by the rental value reported in the 2002-2003 POF, and the difference was added to the original household income; finally, this total was then divided by the number of inhabitants to obtain another new estimate of *per capita* income.

According to results of these two simulations, between 37,000 and 54,000 people would move up to a higher income level if grid-connected electricity was available to all of households that lacked electricity in 2003. The additional benefit provided by this public policy measure would almost exclusively impact the poorest: 19,000 to 24,000 people would exit extreme poverty, and between 9,000 and 20,000 would exit poverty.

If running water was available to all of households that lacked it, 301,000 to 342,000 people would move up an income class. Again, almost all of those who would benefit would be in the lower income level: between 126,000 and 144,000 people would exit extreme poverty, and 134,000 to 151,000 would exit poverty.

If all of households with inadequate sanitary drainage conditions were to obtain adequate sewage – either network/rainwater drainage or a septic tank – between 274,000 and 318,000 rural people would move to a higher income class. Again, the low-income populations represent the vast majority of beneficiaries because between 118,000 and 126,000 people would no longer be classified as extremely poor, and the incomes of between 80,000 and 100,000 would go above the poverty line.

As a result of a more objective public policy that was designed to extend basic services to the entire rural population of the country, between 589,000 and 707,000 people would experience increases in non-monetary income large enough for them to move into a higher income class, according to the performed simulations. Of this total, between 245,000 and 280,000 inhabitants would exit extreme poverty, and between 221,000 and 269,000 would exit poverty.

CONCLUSIONS AND FINAL CONSIDERATIONS

In hedonic models that explain rental values, the estimated coefficients were significant and consistent with expectations.

Among the characteristics of households in rural areas, the number of rooms, bedrooms, and bathrooms had positive and significant coefficients. A lack of flooring (carpet, ceramic/terracotta tile/stone, plywood, cement, recovered wood) negatively and significantly influenced rental values.

With regard to public services, existence of landlines and paving on a household's street positively and significantly influenced rental value. Basic services – electricity, running water, and adequate sewage – also positively and significantly impacted rental values.

Coefficients of hedonic models allowed evaluation of the availability of public services in rural households in 2003. Non-monetary monthly income generated was between R$ 3.5 million and R$ 61.9 million for services taken separately, with a higher percentage share of total *per capita* income for the lower income classes. Together, basic services accounted for non-monetary income between R$ 80.3 million and R$ 96.8 million per month, which represented 1.44% to 1.73% of total *per capita* income for the sampled households. The aggregate of the five considered public services accounted for nearly 2.5% of total *per capita* income in households that had at least one of the services, reaching between R$ 109.4 and R$ 132.1 million per month.

From coefficients of hedonic models, the study simulated the increase in non-monetary income that would result from the availability of basic services in households that did not have these services in 2003. Results showed that public policies to alleviate these conditions, in addition to immeasurable benefits such as improved health and a drop in mortality rates, would remove between 245,000 and 280,000 rural people from extreme poverty and move between 221,000 and 269,000 people above the poverty line.

In the case of electricity, alternatives to the power distribution grid are not easily available, and it is up to the government to bring electricity to all households. If certain locations or isolated households make it difficult to connect to power collection and distribution grid, it is still duty of government to facilitate provision of running water and adequate sanitary drainage conditions for all citizens. As an alternative, government could provide good-quality water sources located near households and necessary materials for building water pipes and septic tanks for the poorest rural populations. These actions should be taken by a government with minimal social concern.

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