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Conservation Policies and Labor Markets

Unraveling the Effects of National Parks on Local Wages in Costa Rica

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Juan Robalino and Laura Villalobos-Fiatt

Abstract

Despite the global environmental benefits of increasing the amount of protected areas, how these conservation policies affect the well-being of nearby individuals is still under debate. Using household surveys with highly disaggregated geographic references, we explored how national parks affect local wages in Costa Rica and how these effects vary within different areas of a park and among different social groups. We found that a park's effects on wages vary according to economic activity and proximity to the entrance of the park. Wages close to parks are higher only for people living near tourist entrances. Workers close to entrances are not only employed in higher-paid activities (non-agricultural activities) but also receive higher wages for these activities. Agricultural workers, however, are never better off close to parks (neither close to or far from the entrances). Also, workers close to parks but far away from tourist entrances earn similar or lower wages than comparable workers far away from parks. Our results are robust to different econometric approaches (OLS and matching techniques). The location of national park entrances and the possibility that agricultural workers can switch to higher-paid service activities near tourist entrances may be important tools for helping local workers take advantage of the economic benefits of protected areas.

Key Words: wages, national parks, matching, labor markets, conservation policies, parks, poverty

JEL Classification: Q56, Q58, Q24, C21, J31

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Juan Robalino and Laura Villalobos-Fiatt*

Introduction

In the last few decades, the number of protected areas around the world has increased significantly. On a global scale, terrestrial protected-area coverage has reached 12.2 percent (Coad et al. 2008) and initiatives to expand the amount of protected land in developing countries are under way (e.g., REDD, the United Nations Collaborative Program on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries). However, the debate over how these efforts affect local communities continues. Sorting through the effects of protected areas on local communities allows us to determine whether compensation mechanisms are needed for people who lose as a result of these conservation efforts or whether promoting policies that contribute to both poverty and conservation is feasible.

On one hand, it has been argued that national parks may have negative effects on nearby communities. Land-use restriction can lead to loss of employment, social differentiation, inequality, and uncertainty over property rights (Fortin and Gagnon 1999; Pfeffer et al. 2001; Mukherjee and Borad 2004; Robalino 2007; and List et al. 2006). On the other hand, higher population growth rates in areas close to parks, found in some Latin American and African countries, can be seen as evidence of a positive effect on local welfare (Wittemyer et al. 2008). Also, explicit evidence exists that parks have, in some cases, actually alleviated poverty (Sims 2009; Andam et al. 2009) and increased household income (Mullan et al. 2009).

However, a considerable amount of research has also shown that welfare effects of parks are neutral or insignificant. There is no evidence that federal land designated for conservation in the western United States had significant effect on population growth or employment (Duffy-

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Deno 1998). Similar results have been found for employment and wage growth in the Northern Forest region in the United States (Lewis, Hunt, and Plantinga 2002; 2003).

Our research contributes to this discussion by demonstrating conditions in which the effects on local welfare can be positive, negative, or insignificant for different areas of a park and for different social groups. We sorted the effects on wages by the level of aggregation and the spatial reference of our data. The analysis at the workers' level allowed us to obtain more precise and detailed conclusions by economic activity and by controlling for important individual characteristics. Using the spatial reference of the observations, we identified workers close to park entrances, close to parks but far from entrances, and far away from the parks. This, in turn, let us look at the effects on wages where most tourism activities take place and compare these effects with areas close to parks without tourism.

One of our empirical challenges was the fact that parks (and park entrances) are endogenously located (Pfaff et al. 2009). This implies that characteristics of people living close to parks and close to entrances can differ significantly. To address this issue, we used a large data set of workers' and geographic characteristics, as well as matching techniques. We compared workers who live near a national park with similar workers living away from parks in similar geographic areas.

We found that a park's effects on wages vary according to economic activity and proximity to the entrance of the park. Average wages were around 6 percent higher close to tourist entrances, when compared to workers in general with similar individual and geographic characteristics, similar jobs, and similar economic activities. There were no significant wage effects for workers close to the parks-far from the entrance.

Moreover, we found that workers close to the entrance were employed in higher-paid activities. In these areas, fewer workers are engaged in natural resource-dependent activities (agricultural, hunting, forestry, and fishing activities) and manufacturing activities, but significantly more worked in commercial activities (wholesale and retail trade, restaurants, and hotels) and other services. However, in adjacent park areas away from the entrances, the percentage of workers in natural resource-dependent activities and service activities was not significantly different from rural areas far away from parks.

We then analyzed park effects by groups. Initially, we differentiated the effects by economic activity in three subsectors: agriculture, restaurant and hotels, and wholesale and retail trade. Workers in higher-paid activities earned higher wages close to park entrances than far away from parks (12 percent more for those workers in restaurants and hotels, and 9 percent

more for those in wholesale and retail trade). Agricultural workers were not better off close to park entrances. The effects "close to the park but far from the entrance" are, however, negative for workers in restaurants and hotels, and insignificant for workers in trade and agriculture.

We then analyzed the difference of the premiums close to the entrances by migrant status, nationality, and gender. We found that workers who arrived in the area within two years of our analysis (migrants) did not receive significantly better wages that those who relocated to other rural areas. We also found that foreigners did not receive higher wages close to park entrances than foreigners who lived in rural areas away from parks. However, we did find that, while both females and males received better wages close to park entrances, the premium for females was significantly larger.

We concluded that parks can have both positive and negative effects on local wages. Workers close to park entrances will significantly benefit, especially those who work in service and tourism-related activities. Workers who live near the park but far from the entrance will not benefit or even be negatively affected. The sign and the magnitude of these effects depend on the economic activities that workers perform and whether they have the skills and resources to switch to higher-paid activities. To better distribute the benefits of the parks, policies should aim at promoting tourism all around the park and creating opportunities for workers to switch to economic activities that benefit from creation of a national park.

This paper is organized as follows. In section 1, we discuss the Costa Rican context in which this study takes place. In section 2, we describe the data and how it was obtained. We present our empirical strategy in section 3. In section 4, we present the results. Conclusions are discussed in section 5.

1. Background

Costa Rica is a relatively small country of 51.100 km^2 and around 4.5 million people, 41 percent of whom live in rural areas. This Latin American country has a long tradition of conserving its natural resources. Nearly 26 percent of its land and 17 percent of its coastal waters are under conservation regimes (SINAC 2007). Half of the land protected area and almost all of the marine protected areas are designated national parks—under one of the most strict protection policies according to IUCN classification (IUCN 1994).

At present, Costa Rica has 28 national parks distributed all around the country. The first national parks were established in 1955, but most were created in the 1970s. The main objective

of the Costa Rican national parks system is to preserve natural resources in situ; as a result, human settlement is not allowed within a park's borders (SINAC 2006).

Agriculture and tourism-related activities are important to Costa Rica's economy. In 2007, agriculture production was 7 percent of GDP (gross domestic product) and employed 13 percent of the labor force; by contrast, hotels and restaurants were 4 percent of GDP and employed 5 percent of the labor force. Ecotourism, specifically related to protected areas, plays a central role within the tourism industry. In the last five years, tourists made more than 1 million visits to the protected areas in Costa Rica, which generated revenues from entrance fees exceeding US$ 5 million in 2005 and employed around 500 people (SINAC 2006).

Almost 70 percent of the visits to protected areas is concentrated in five national parks.[1] Around 54 percent of all foreign tourists in Costa Rica in 2007 visited a protected area and the average expenditure per each foreign tourist was estimated at US$ 1,345 (ICT 2007). Indirect benefits from protected areas, however, are harder to estimate.

Accounting exercises in Costa Rica have quantified how much national parks contribute to socioeconomic development at local, regional, and national levels. Specifically, Fürst et al. (2004) conducted a cluster analysis in Chirripó, Poás Volcano, and Cahuita national parks. They found that the primary impacts at the local level were income generation from tourism activities, benefits due to watershed protection, increase in land price, and appearance of new activities related to tourism (such as guides and sales of handcrafts and local products). However, tourism has also affected rural areas far from the protected parks. Therefore, these types of studies do not measure impacts in terms of how much the establishment of a park adds to socioeconomic development because they do not use a baseline.

Costa Rica is an excellent place to study the effects of national parks on local communities' welfare because it is a developing country where tourism and agriculture activities are central to rural development. Additionally, Costa Rica's vast and well-established conservation efforts offer a unique opportunity to evaluate their effects. Finally, the availability of data at individual levels and small spatial scales is an advantage for quantitative analysis.

[1] The five parks most visited in 2007 were Poás Volcano National Park, Manuel Antonio National Park, Irazú Volcano National Park, Torguero National Park, and Cahuita National Park.

2. Data

Socioeconomic data was obtained from the Encuestas de Hogares de Propósitos Múltiples (EHPM), which are household surveys conducted annually by the Instituto Nacional de Estadística y Censos (INEC, National Institute of Statistics and Census). The period of the analysis is from 2000 to 2007. Workers' households are grouped into census tracts (around 60 households per tract). We obtained the geographic location of each of these census tracts and focused only on rural census tracts, where the national parks are located.

These surveys include information about workers' characteristics and wages. We used the logarithm of hourly real wages as a dependent variable, as in von Wacher and Schmieder (2009). Hourly real wages were obtained by deflating nominal monthly wages using the consumer's price index calculated by the Costa Rica's Central Bank (July 2006 = 100) and dividing by the number of hours worked per month.

We included other socioeconomic variables from the EHPM that affect wages, such as education level, gender, age, marital status, and full-year employment. We also obtained information about whether workers resided in the census tract for two years before the survey, as well as the workers' nationalities. Information about economic activity and occupation was also available.

Protected areas were mapped by the Geographic Information System Laboratory at the Instituto Tecnológico de Costa Rica. Using a map of the protected areas, we identified census tracts close to a national park (treated) and far from a national park (untreated).

We also calculated the distance by road from each tract's center[2] to each park's entrance. This allowed us to split the treatment group into two different groups: 1) individuals within a 5-kilometer buffer around the park that are also within 20 kilometers by road to a park's entrance (2,041 observations), and 2) individuals that are within a 5-kilometer buffer around the park, but more than 20 kilometers from the park entrance by road (983 observations). In the untreated group, we placed individuals located more than 15 kilometers from any national park (23,209 observations). There are other protected areas besides national parks, but we focused on parks for two reasons: parks are some of the most restricted protected areas (IUCN 1994) and they receive visitors.

[2] To estimate distances by road, we used the center designated by the INEC, which corresponds to the most populated area in the tract.

We also used geographic variables at the census-tract level. We calculated average slope, average precipitation, and average elevation per census tract using geographic information systems. We were also able to calculate distances from the census tract to San José (capital of Costa Rica), and to the closest health and education centers. The density of different types of roads was also calculated per census tract.

3. Empirical Approach

Randomly located parks and randomly located entrances of the parks would eliminate many of the possible biases of estimating their effects. If this were the case, we would only need to compare wages of workers close to parks (or close to the entrances) with wages of workers who live far from parks. Worker characteristics would be equal in expectation and the only reason for difference in wages would be the effect of parks on the labor market.

However, policies are rarely applied randomly and national parks and land-conservation policies are no exception (Pfaff and Robalino 2008; Pfaff et al. 2009). Workers can endogenously choose their location according to their own characteristics. These issues create selection bias (Heckman 1979; Rosenbaum and Rubin 1983; Dehejia and Wahba 2001), which is what we found in our data.

In table 1, we compare the three groups of workers: 1) those located far from parks; 2) those located close to a park's entrance; and 3) those located close to a park but far from an entrance. We found significant differences for many of these variables. There is, on average, more female participation in the labor force, higher education levels, lower proportion of male-headed households, higher immigration, fewer married people, and more people with full-time jobs in areas close to the entrance of the parks than in rural areas far away from the parks. Additionally, on average, workers close to the parks but far from the entrances are younger and less educated than workers in rural areas away from parks. There are also fewer foreign workers and more workers employed full time; moreover, these workers tend to belong to larger households.

Table 1. Comparison of Far from Parks and Close to Parks (Close and Far from Entrances) in Selected Characteristics

Variables	Far from national parks (FP)	Close to national parks (CP)			
		Close to entrance (CE)	***T-stat (FP vs. CE)***	***Far from entrance (FE)***	***T-stat (FP vs. FE)***
Number of observations	23,209	2,041		983	
Workers' characteristics					
Male participation (%)	82.6	75.5	-7.7	81.8	-0.6
Age	32.8	32.6	-0.6	31.7	-2.8
People who finished high school (%)	14.8	22.5	9.0	11.4	-2.9
People with more than 2 years college (%)	3.9	10.7	13.9	2.3	-2.6
Male-headed household (%)	49.8	41.4	-7.0	47.9	-1.2
Costa Rican (%)	74.8	73.5	-1.2	70.5	-3.0
People living in the same place for at least 2 yrs (%)	95.3	93.0	-4.6	94.3	-1.5
People married or living with someone (%)	57.6	53.1	-3.8	56.6	-0.6
People employed for a full year (%)	83.9	88.8	5.7	87.8	3.1
Household size	4.7	4.6	-1.1	4.9	3.4
Workers' occupation					
Professional, technical, and related workers	3.3	7.5	9.4	2.5	-1.3
Directors and managers	1.0	2.1	4.85	1.1	0.39
Administrative workers	6.1	8.6	4.43	4.5	-1.93
Sales workers	8.2	9.3	1.67	7.0	-1.22
Farmers, fishermen, hunters, loggers, and related natural resource workers	36.4	26.0	-9.11	44.8	5.26
Workers in transport	3.9	2.5	-3.22	3.6	-0.59
Craftsmen, production-process workers 1*	17.6	14.8	-3.03	11.9	-4.46
Craftsmen, production-process workers 2**	4.8	4.3	-1.01	2.9	-2.91
Packers, labelers, and related workers	7.9	4.5	-5.3	10.4	2.71
Service workers	10.8	20.4	12.56	11.6	0.73
Economic activity					
Agriculture, hunting, forestry, and fishing	41.3	23.2	-6.39	55.8	1.89
Mining and quarrying	0.0	0.0	.	0.1	-2.05
Manufacturing	16.7	12.6	-4.65	8.8	-6.35

Utilities (electricity, gas, and water)	0.5	1.0	3.03	1.1	2.58
Construction	9.3	10.0	0.97	5.7	-3.67
Wholesale and retail trade, and restaurants and hotels	17.2	32.8	22.3	16.1	-0.12
Transport, storage and communication	4.4	3.8	-1.24	3.7	-1.04
Financing, insurance, real estate, and business services	3.9	4.0	0.24	2.6	-1.93
Community, social, and personal services	6.5	12.8	10.41	5.9	-0.64
Geographic characteristics					
Density of primary roads (km/km2)	0.1	0.2	5.2	0.1	-1.8
Density of secondary roads (km/km2)	0.4	0.3	-3.2	0.2	-4.8
Density of local roads (km/km2)	3.1	3.5	3.1	2.5	-4.4
Slope	9.6	12.4	11.5	11.3	4.8
Precipitation (mm)	3120.4	2915.3	-8.3	4419.7	37.6
Distance to the nearest basic school (km)	1122.3	1524.8	19.3	1443.7	10.7
Distance to the nearest high school (km)	3643.3	4996.2	17.4	4728.0	10.5
Distance to nearest health center (km)	4947.9	6572.2	14.6	7119.9	13.8
Distance to San José (km)	72880.5	69335.7	-2.6	67824.3	-2.8
Log wage (CRC*** per hour)	6.4	6.5	10.4	6.3	-3.3

*Craftsmen, production-process workers 1 includes handicraft workers; plant and machine operators, and assemblers; textile, garment, and related workers; building frame and related trades workers; and building finishers and related trades workers.

**Craftsmen, production-process workers 2 includes extraction and building trades workers; metal molders, welders, and sheet-metal workers; structural-metal preparers and related trades workers; potters, glass-makers, and related trades workers; printing and related trades workers; and pelt, leather, and tobacco trades workers.

*** CRC = Costa Rican colones; CRC 557.4 = US$ 1 (Nov 2009)

Economic activities and occupation are also different among these groups. Workers close to park entrances hold positions that demand a higher level of education, namely, professional, technical, and administrative. The fraction of workers in occupations associated with natural resources, such as farming, fishing, hunting, and logging, is high in all three groups. However, this fraction is higher in areas far from parks than in areas close to parks, but is lower when compared to areas close to parks but far from the entrances. Additionally, the fraction of service workers is quite similar between rural areas far from the parks and close to the parks but far from the entrance, but significantly higher in areas close to park entrances. Meanwhile, the fraction of workers in agricultural-related occupations is larger close to the parks but far from the entrances.

Economic activities close to park entrances are mostly concentrated in wholesale and retail trade, and restaurants and hotels (32.8 percent). However, for both the “far from parks” group and the “close to parks but far from entrances” groups, the most important category is

agriculture, hunting, forestry, and fishing activities (41.3 percent and 55.8 percent, respectively). The fraction of workers in community, social, and personal services is larger close to park entrances than in the other groups.

There are also geographic differences. There is a higher density of primary and local roads close to park entrances. Also, it can be seen that people close to parks are located in areas with steeper slopes, greater distances to education and health centers, and shorter distances to San José, compared with average "far from parks" values.

Differences are, of course, also found in wages (see tests results). Workers living close to park entrances receive higher wages than workers living far from parks. Also, workers living close to the park but far from the entrances have lower wages than workers far from parks. However, as discussed, wages of these groups may be different not only due to the effects of parks, but also due to differences in individual and geographic characteristics.

3.1 Addressing the Selection Bias Problem

We addressed the selection bias by using propensity score matching, which is useful for estimating treatment effects in observational studies when the dimensionality of the observable characteristics is high (Rosenbaum and Rubin 1983; Dehejia and Wahba 2001). The goal is to find an adequate untreated control group that is similar to the treated group in all relevant pretreatment characteristics. Similarity is defined in terms of the propensity score, which is the conditional probability of assignment to a particular treatment, given a vector of observed covariates (Rosenbaum and Rubin 1983).

The advantage of using propensity score matching is that it is possible to determine how well the treatment and control groups overlap, and therefore estimations are less sensitive to the choice of functional form in the model (Rosenbaum and Rubin 1983; Dehejia and Wahba 2001). Another advantage is that the variance of the estimate of the average treatment effect will be lower in matched samples, compared with random samples, because the distributions of the covariates in the treated and control groups are more similar in matched than in random samples (Rosenbaum and Rubin 1983). A third advantage is that, unlike standard techniques, matching avoids extrapolation to portions of covariates space where there is no data.

However, as with all approaches, matching requires certain conditions for the identification of the effect. There must not be unobservable factors that affect the outcome and that are simultaneously correlated to the presence of treatment. Also, with matching, there can be a decrease in the number of observations because unmatched observations are dropped. We

argue that the rich set of available data helped us minimize the possibility of unobservable bias and that the sample size (approximately 7.7 controls per treatment) is large enough to permit this loss of observations and degrees of freedom.

To avoid bad matches when using propensity scores to define similarity, we used a combination of caliper matching and nearest neighbor matching; in other words, we imposed a tolerance level on the maximum propensity score distance of 0.001 and allowed for up to four matches inside this radius per treatment.

3.2 Likelihood of Being in Each Treatment Group (Propensity Scores)

We estimated two different probit regressions in order to estimate the conditional probability of being assigned to each treatment group: being close to the park and an entrance; and being close to the park but far from the entrance. First, we included only the worker's characteristics and the geographic variables (I in table 2), and then we included the worker's occupation and the employer's economic activity (II in table 2). In all cases, the models were statistically significant as a whole (p-value = 0.000).

Table 2. Likelihood of Being in the Treatment Group (Probit Regression)[1]

Variables	Close to park entrance		Close to park but far from entrance	
	I	II	I	II
Male population (%)	-0.121***	0.026	-0.113**	-0.081
Age	0.005	0.003	-0.029***	-0.032***
Age	0.000	0.000	0.000***	0.000***
People who finished high school (%)	0.034	-0.034	0.082	0.080
People with more than 2 years college (%)	0.479***	0.454***	-0.061	-0.090
Male-headed household (%)	-0.145***	-0.149***	0.116**	0.119**
Costa Rican (%)	-0.081**	-0.077**	-0.147***	-0.163***
People living in the same place for at least 2 years (%)	-0.193***	-0.174***	-0.200**	-0.196**
People married or living with someone (%)	-0.049	-0.041	-0.039	-0.035
People employed for a full year (%)	0.186***	0.147***	0.211***	0.220***
Household size	-0.011*	-0.009	0.040***	0.040***
Density of primary roads (km/km2)	0.044**	0.033	0.324***	0.312***
Density of secondary roads (km/km2)	-0.056***	-0.075***	0.015	0.009
Density of local roads (km/km2)	0.013***	0.009**	-0.018**	-0.020***
Slope	0.010***	0.010***	0.036***	0.037***

Precipitation (mm)	0.000***	0.000***	0.003***	0.003***
Precipitation (mm)	0.000***	0.000***	0.000***	0.000***
Distance to the nearest basic school (km)	0.156***	0.138***	-0.154***	-0.159***
Distance to the nearest high school (km)	0.082***	0.095***	0.394***	0.403***
Distance to nearest health center (km)	0.193***	0.195***	-0.225***	-0.225***
Distance to San José (km)	-0.206***	-0.228***	-0.166***	-0.163***
Directors and managers		0.092		0.236
Administrative workers		-0.102		-0.019
Sales workers		-0.258***		-0.040
Farmers, fishermen, hunters, loggers, and related natural resource workers		0.223***		-0.101
Workers in transport		-0.342***		0.018
Craftsmen, production-process workers 1*		-0.264***		0.096
Craftsmen, production-process workers 2**		0.007		-0.123
Packers, labelers, and related workers		-0.181**		-0.036
Service workers		0.072		0.196
Mining and quarrying		.		-0.424
Manufacturing		0.476***		-0.077
Utilities (electricity, gas, and water)		0.916***		0.043
Construction		0.753***		0.058
Wholesale and retail trade, and restaurants and hotels		0.896***		0.029
Transport, storage, and communication		0.594***		0.234*
Financing, insurance, real estate, and business services		0.351***		-0.217
Community, social, and personal services		0.808***		0.046
Number of observations	23752	23609	22761	22761
Log likelihood	-6196.52	-5938.43	-2782.81	-2762.08
LR chi2(44)	926.85	1418.910	2171.840	2213.290
Prob > chi2	0.000	0.000	0.000	0.000

[1] Controlled by year dummies

*Craftsmen, production-process workers 1 includes handicraft workers; plant and machine operators and assemblers; textile, garment, and related workers; building frame and related trades workers; and building finishers and related trades workers.

**Craftsmen, production-process workers 2 includes extraction and building trades workers, metal molders, welders, and sheet-metal workers; structural-metal preparers and related trades workers; potters, glass-makers, and related trades workers; printing and related trades workers; and pelt, leather, and tobacco trades workers.

Using the likelihood ratio test, we found that for “close to entrance” models, the second (II) specification is better (probability > chi2 = 0.000) and many of the occupation and activity

variables are significant. For the "far from an entrance" sample, the second specification is also better (probability > chi2 = 0.0008), but almost none of the additional variables is significant.

We also found that average individual's probability of locating close to a national park's entrance is correlated with some college education, a female head of households, immigration to the area, full-time employment, and work in non-agriculture activities. On the other hand, for an average individual, the probability of locating close to a national park but far from the entrance is correlated with younger age, male head of household, immigration to the area, a full-year of employment, and more family members.

Geographic characteristics also played an important role on the assignment of to a treated group. We saw that the probability of being close to a national park is correlated with steeper slopes and more precipitation, and greater distance from high schools and Costa Rica's capital city. Furthermore, land close to entrances is also correlated with fewer secondary roads, more local roads, and greater distance to basic school and health centers. Far from entrances is also related to more main roads and fewer local roads, and less distance to basic school and health centers.

3.3 Evidence of Comparable Groups

We checked that we had comparable groups using two strategies. First, we checked whether there was enough overlap between the treated and the control group before and after matching. Then, we verified whether matching was effective in obtaining similar samples by observing the balance in the confounder variables between the treated and the control groups before and after the matching.

To check for overlap, we plotted the histograms of the propensity scores of the treated and untreated groups before matching, and treated and matched groups after matching. We did this both for the "close to entrances" and "far from parks" analyses.

For the "close to entrances" analysis, it can be seen that the distribution of the treated and untreated groups are significantly different before matching. However, after matching the distributions are more similar (see figure 1). The difference between before and after matching is more striking when looking close to parks but far from entrance (see figure 2). There are even some intervals where there are not enough matches, such that we could not consider the analysis. For these intervals, there is not empirical evidence to properly estimate the treatment effects.

In the balance test, we found that for the "close to entrances" analysis, after the matching for almost all the control variables, there was no significant difference in the mean values

between the treated and the control group. The exceptions were distance to San José and health centers, and slope (table 3). For "far from entrances," we found that the balance improved for some geographic characteristics (density of primary roads, slope, precipitation, and distance to schools and high schools), but the difference was still statistically significant. For all the other variables, we obtained a good balance. This suggests that it is difficult to find a place with equal geographic characteristics as land close to national parks but far from their entrances.

Figure 1. Histogram of Estimated Propensity Matching Score Close to National Park Entrances versus Far from Parks

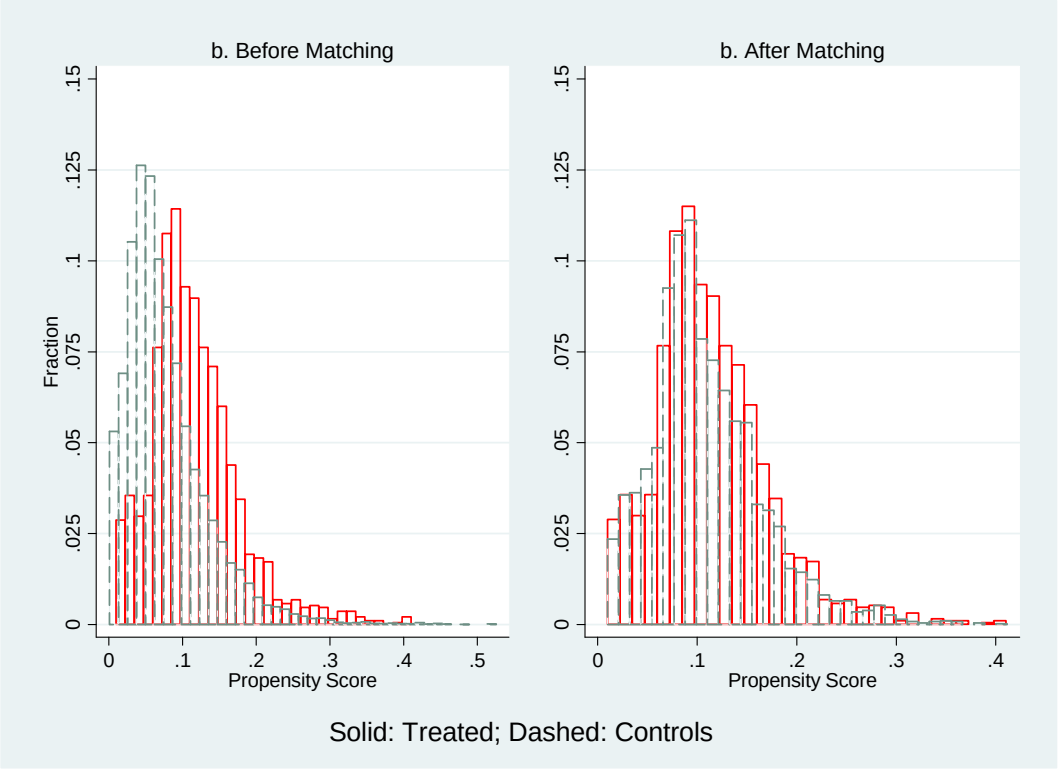

Figure 2. Histogram of Estimated Propensity Matching Score Far to National Park Entrances versus Far from Parks

Table 3. Balances in Characteristics after Matching

Variables	Close to a park's entrance versus far from parks		Far from a park's entrance versus far from parks	
	Difference	***T-stat***	***Difference***	***T-stat***
Workers' characteristics				
Male participation (%)	-0.005	-0.380	0.025	1.510
Age	-0.101	-0.300	0.206	0.400
People who finished high school (%)	0.005	0.390	0.004	0.310
People with more than 2 years college (%)	0.021	2.470	0.001	0.090
Male-headed household (%)	0.001	0.060	0.009	0.430
Costa Rican (%)	-0.002	-0.160	-0.006	-0.290
People living in the same place for at least 2 years (%)	0.000	0.050	-0.001	-0.070
People married or living with someone (%)	0.010	0.700	0.013	0.610

People employed for a full year (%)	0.000	0.000	0.009	0.620
Household size	-0.005	-0.080	-0.018	-0.190
Workers' occupations				
Professional, technical, and related workers				
Directors and managers	0.000	0.100	-0.006	-1.150
Administrative workers	0.012	1.540	-0.004	-0.430
Sales workers	-0.001	-0.080	-0.011	-1.010
Farmers, fishermen, hunters, loggers, and related natural resource workers	-0.005	-0.430	0.028	1.270
Workers in transport	-0.001	-0.200	0.003	0.380
Craftsmen, production-process workers 1*	-0.005	-0.500	-0.011	-0.770
Craftsmen, production-process workers 2**	-0.002	-0.270	0.007	0.960
Packers, labelers, and related workers	-0.002	-0.320	0.001	0.060
Service workers	-0.006	-0.500	-0.010	-0.710
Economic activity				
Agriculture, hunting, forestry, and fishing	0.000	-0.010	0.018	0.830
Mining and quarrying	0.000	.	0.000	0.190
Manufacturing	-0.002	-0.180	0.009	0.710
Utilities (electricity, gas, and water)	-0.002	-0.660	-0.001	-0.420
Construction	0.003	0.320	-0.008	-0.770
Wholesale and retail trade, and restaurants and hotels	0.008	0.600	-0.018	-1.150
Transport, Storage and Communication	-0.005	-0.800	-0.001	-0.110
Financing, insurance, real estate, and business services	0.000	-0.020	0.005	0.730
Community, social, and personal services	-0.002	-0.260	-0.005	-0.470
Geographic characteristics				
Density of primary roads (km/km2)	-0.036	-1.940	-0.025	-1.750
Density of secondary roads (km/km2)	0.037	1.640	0.041	1.700
Density of local roads (km/km2)	-0.138	-1.110	-0.025	-0.170
Slope	-0.970	-3.580	-1.540	-3.130
Precipitation (mm)	-3.882	-0.150	72.742	2.080
Log distance to the nearest basic school (km)	0.010	0.380	-0.150	-4.140
Log distance to the nearest high school (km)	0.030	1.010	-0.221	-7.270
Log distance to nearest health center (km)	0.048	1.810	-0.082	-1.610
Log distance to San José (km)	0.056	1.910	-0.036	-1.620
Log wage (CRC*** per hour)	0.075	4.350	0.043	1.740

* Craftsmen, production-process workers 1 includes handicraft workers, plant and machine operators and assemblers; textile, garment, and related workers; building frame and related trades workers; and building finishers and related trades workers.

** Craftsmen, production-process workers 2 includes extraction and building trades workers; metal molders, welders, and

sheet-metal workers; structural-metal preparers and related trades workers; potters, glass-makers, and related trades workers; printing and related trades workers; and pelt, leather, and tobacco trades workers.

***CRC = Costa Rican colones; CRC 557.4 = US$ 1 (Nov 2009)

4. Results

We used the log of hourly real wages as a dependent variable as in von Wacher and Schmieder (2009). Therefore, the coefficient might be interpreted as the percentage change in the hourly wage caused by the treatment.

In table 4, we compared the effects estimated through different methodologies. First, we estimated the so-called naïve regression (Morgan and Winship 2007), which is basically a mean comparison between treated and controls, controlled by fixed effects on years. The results indicate that wages close to park entrances are 13.5 percent higher than wages far from parks. Also, the wage differential between workers close to parks but far from entrances and far from parks is negative and significant (around 6 percent). As discussed, these differences can be the result of differences in workers' and local market characteristics, and differences due to the effects of the treatment (the presence of parks).

Then, we estimated three different specifications, using OLS and matching methodologies. The first model included workers' socioeconomic characteristics (gender, age, education level, marital status, household size, immigration, and full-time employment). We found that the effect decreased, suggesting that, as expected, part of the wage differences are explained by workers' characteristics. For the "close to park entrances" group, the wage differential was still positive and significant (about 8 percent higher, both with OLS and matching). In "far from the entrances of parks," the wage differential was still negative and significant with OLS, but then became insignificant when using matching.

Table 4. National Parks' Effects on Wages per Hour

Model	Far from park versus: Close to entrance	Far from park versus: Far from entrance
(1) Naïve		
Effect	**0.1349*** **	**-0.0597*** **
Standard error	[0.0130]	[0.0181]
OLS		
(2) Workers' characteristics		
Effect	**0.0765*** **	**-0.0351** **
Standard error	[0.0114]	[0.0160]
(3) (2) + Geographic characteristics		
Effect	**0.0785*** **	**0.0254**
Standard error	[0.0113]	[0.0163]
(4) (3) + Occupation/activity characteristics		
Effect	**0.0558*** **	**0.0196**
Standard error	[0.0110]	[0.0157]
Propensity Score Matching		
(5) Worker's characteristics		
Effect	**0.0789*** **	**-0.0273**
Standard error	[0.0139]	[0.0194]
(6) Geographic characteristics		
Effect	**0.0832*** **	**0.0281**
Standard error	[0.0137]	[0.0224]
(7) Occupation/activity characteristics		
Effect	**0.0615*** **	**0.0140**
Standard error	[0.0129]	[0.0212]

*** p < 0.01, ** p < 0.05, * p < 0.1. No asterisk means no significance.

Note: Workers' characteristics specification includes gender, age, finish high school dummy, college for at least 2 years dummy, male-headed household dummy, Costa Rican dummy, lived in the same place 2 years before dummy, married dummy, full work dummy, and household size.

Geographic specification includes all the workers' characteristics and density of primary, secondary, and tertiary roads; slope; precipitation; and log of distances to schools, high schools, clinics, and San José.

Occupation/activity specification includes workers and geographic characteristics and controls for economic activity and workers' occupation

However, without controlling for geographic characteristics that affect labor markets, it is hard to conclude that the previous results are the effects of the presence of parks. Therefore, we incorporated geographic variables that affect production into the model (density of roads; slope; precipitation; and distance to education, health centers, and Costa Rica's capital city). We found that differences in wages remain about 8 percent higher in the "close to entrances" group, and there is no significant effect for "far from entrances." When using matching, even though geographic characteristics turned out to be significant in explaining the presence of parks and explaining wages, they did not change the impact of parks on wages. We concluded that workers on average receive higher wages close to an entrance, but workers far from an entrance do not.

The difference close to an entrance can be the result of workers changing activities and/or occupation, or workers receiving higher wages for performing the same activity. In order to sort this out, we controlled by economic activity and occupation. In other words, we compared people with similar socioeconomic characteristics, who live in a similar place and work at the same activity and occupation. We found that wages are 6 percent higher close to a park's entrance. This suggests that part of the difference is explained by people changing activities, but also because they receive higher wages for the same activity. For "close to park but far from entrance," there is still no difference in wages compared with "far from parks."

Since wage differences are explained by both activity changes and higher wages within the same activity, we explored whether there are significant different wage premiums in the activities that will be more affected by land restrictions and tourism: agriculture, restaurants and hotels, and wholesale and retail trade. Results are presented in table 5.

Table 5. National Park's Effects on Wages per Hour by Economic Activity, 2001–2007

	Close to park entrances versus far from parks			Far from park entrances versus far from parks		
PSM MODEL	***Agriculture***	***Restaurants and hotels***	***Wholesale and retail trade***	***Agriculture***	***Restaurants and hotels***	***Wholesale and retail trade***
Effect	-0.0015	0.1252***	0.0917**	0.0280	-0.1570***	0.0657
Standard error	[0.0300]	[0.0478]	[0.0439]	[0.0301]	[0.0000]	[0.0757]

*** p<0.01, ** p<0.05, * p<0.1

PSM = propensity score matching

Once we controlled for all characteristics, we did not find differences in wages close to park entrances nor far from them for agriculture activity. So, agricultural workers are not better off close to parks.

In restaurants and hotels, we found significant differences that are positive for workers living close to entrances and negative for people far from entrances. The presence of a national park results in a 12.5-percent higher wage for workers living close to an entrance and working in hotel and restaurants activities, but it is 15.7 percent less if workers live far from a park entrance. This suggests that access to the entrance is crucial in determining the benefits that local communities obtain from the national parks. As tourists visit national parks, the demand for new services (e.g., restaurants, accommodations, guides, souvenirs, etc.) close to the entrance increases.

In the wholesale and retail trade, there is a significant and positive effect for those close to entrances and no effect far away from the entrance. People close to entrances receive a wage that is 9-percent higher than in other rural areas. This suggests that development in communities occurs faster near entrances, so more economic activity takes place; meanwhile, living away from access to tourists results in the same situation as having no park around.

We then analyzed the difference in the premiums for living close to the entrance by migrant status, nationality, and gender (table 6). We found that those workers who arrived in the area within two years of our analysis do not receive significantly better wages than those who relocated to other rural areas. We also found that foreign workers do not receive higher wages close to park entrances than those foreign workers who live in rural areas away from parks.

However, we found that, although both females and males receive better wages close to park entrances, the premium for females is significantly larger.

Table 6. National Parks' Effects on Wages per Hour by Subsamples

Split	Effect	Standard error	P > |t|
Migrants[1]	0.0866	0.0731	0.2380
No migrants	0.0595	0.0133	0.0000
Costa Ricans	0.0763	0.0151	0.0000
Foreigners	-0.0076	0.0257	0.7680
Males	0.0255	0.0144	0.0770
Females	0.1160	0.0293	0.0000

[1] People who relocated near a national park in the last two years

5. Conclusions

We estimated the effect of national parks on local communities' wages by comparing people close to parks with similar people living in similar areas far from parks. We found that there are positive effects of national parks on wages, but these effects are not equally distributed. Workers close to a park's entrance obtain all the benefits from the park's establishment. Protected areas can generate benefits, especially when accompanied with tourism development. These differences in wages are not only explained by shifts in the economic activity close to park entrances, but also by workers in similar activities and occupations who receive higher payments when close to park entrances.

Even within the workers "close to entrances" group, benefits are not distributed evenly. Economic activities with higher benefits are related to tourism, hotels, and restaurants. Close to park entrances, workers in these activities receive higher payments, while close to park but far from entrance the effect is negative. Agricultural workers are not better off close to parks.

When we estimated the effects by groups, we found that women receive a higher premium close to park entrances, and that most beneficiaries are members of the community as opposed to newly arrived workers.

More detailed analysis is required to better understand the effects of national parks on local communities' welfare. For instance, the tourism effect might be looked at more closely by

splitting the data according to the numbers of visits per park. Also, panel data analysis might help to better estimate dynamic effects.

The policy implications of these results are noteworthy, particularly the opportunity to achieve both conservation and development objectives. Moreover, gains are not equally distributed. Policies that encourage people to switch to tourism-related activities might make a big difference in how local communities benefit from parks. Additionally, people working far from park entrances do not benefit from parks. Policies that promote tourism all around the park will also improve local welfare.

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Appendix

Close to Entrance Lineal Regression (Dependent Variable: Log_Wage)

Linear regression Number of observations = 6785

F(45, 6739) = 57.83

Prob > F = 0.0000

R-squared = 0.4270

Root MSE = .45779

		Robust				
log_wage	Coeff.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
Dummy_dis~20	.0615275	.0129093	4.77	0.000	.0362212	.0868339
gender	.1078185	.0188726	5.71	0.000	.0708222	.1448148
age	.0248547	.0032246	7.71	0.000	.0185334	.031176
age2	-.0003189	.0000411	-7.76	0.000	-.0003995	-.0002383
fin_hsch	.2008725	.0236722	8.49	0.000	.1544676	.2472774
college_2y~s	.2763468	.0395276	6.99	0.000	.1988601	.3538334
D_jefe	.0642942	.0186214	3.45	0.001	.0277903	.1007981
D_cr	.035384	.0175747	2.01	0.044	.0009319	.069836
D_mismo_c~2y	-.0653633	.0301632	-2.17	0.030	-.1244927	-.006234
live_with_~1	.1286621	.0174003	7.39	0.000	.094552	.1627722
empl_anual	.0847847	.02102	4.03	0.000	.0435789	.1259905
tamhogar	-.0104708	.0032692	-3.20	0.001	-.0168794	-.0040621
ocup1	.2012966	.0702711	2.86	0.004	.063543	.3390502
ocup2	-.3588545	.0442499	-8.11	0.000	-.4455983	-.2721108
ocup3	-.5409159	.0496716	-10.89	0.000	-.638288	-.4435438

ocup4	-.6012508	.0489008	-12.30	0.000	-.6971118	-.5053898
ocup5	-.5709101	.058544	-9.75	0.000	-.6856749	-.4561452
ocup6	-.5064502	.0449812	-11.26	0.000	-.5946275	-.4182729
ocup7	-.5885412	.0555225	-10.60	0.000	-.6973829	-.4796996
ocup8	-.6161992	.0499439	-12.34	0.000	-.7141049	-.5182934
ocup9	-.5010764	.0469611	-10.67	0.000	-.593135	-.4090179
rama2	(dropped)					
rama3	.2419845	.0319025	7.59	0.000	.1794456	.3045234
rama4	-.0128991	.0852434	-0.15	0.880	-.1800031	.154205
rama5	.1608126	.0362694	4.43	0.000	.0897132	.231912
rama6	.1363688	.0290581	4.69	0.000	.0794058	.1933318
rama7	.1779529	.0432343	4.12	0.000	.0932	.2627058
rama8	.2976031	.0499693	5.96	0.000	.1996475	.3955588
rama9	.081571	.0303224	2.69	0.007	.0221294	.1410125
d_lpr	-.0125858	.0116809	-1.08	0.281	-.035484	.0103125
d_lsr	.0121269	.0075376	1.61	0.108	-.0026492	.0269029
d_luvr	.0039576	.0020281	1.95	0.051	-.0000181	.0079333
pendiente	-.0020314	.0006549	-3.10	0.002	-.0033152	-.0007476
pp_promedi	-.0001345	.0000514	-2.62	0.009	-.0002352	-.0000338
pp_promedi2	1.85e-08	7.79e-09	2.37	0.018	3.22e-09	3.37e-08
log_sch	.0204451	.00976	2.09	0.036	.0013124	.0395778
log_coleg	-.0134537	.0129101	-1.04	0.297	-.0387617	.0118543
log_clinic	.0323074	.0117808	2.74	0.006	.0092134	.0554014
log_saban	-.0646366	.011075	-5.84	0.000	-.0863471	-.0429262
D_01	-.0036548	.0284609	-0.13	0.898	-.0594473	.0521376
D_02	-.055769	.0294786	-1.89	0.059	-.1135562	.0020183

```
        D_03 |  -.0522374   .0310275    -1.68   0.092     -.113061    .0085863
        D_04 |  -.0971243   .0309373    -3.14   0.002    -.1577712   -.0364774
        D_05 |  -.0943242   .0297729    -3.17   0.002    -.1526885   -.0359598
        D_06 |  -.1159268   .0293514    -3.95   0.000    -.1734649   -.0583887
        D_07 |  -.0567828   .0279477    -2.03   0.042    -.1115692   -.0019963
       _cons |   6.816314   .1484073    45.93   0.000     6.525389     7.10724
------------------------------------------------------------------------------
```

Far from Entrance Lineal Regression (Dependent Variable: Log_Wage)

Linear regression Number of observations = 2961

F(46, 2914) = 18.49

Prob > F = 0.0000

R-squared = 0.3189

Root MSE = .46046

log_wage	Coeff.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
Dummy_dis~05	.0140438	.0210408	0.67	0.505	-.0272126	.0553003
gender	.228451	.0339328	6.73	0.000	.1619162	.2949858
age	.0232831	.0064736	3.60	0.000	.0105899	.0359764
age2	-.0002801	.0000841	-3.33	0.001	-.0004451	-.0001151
fin_hsch	.2571006	.0372601	6.90	0.000	.1840418	.3301593
college_2y~s	.3766457	.0874879	4.31	0.000	.2051014	.54819
D_jefe	.0918898	.0312614	2.94	0.003	.0305932	.1531864
D_cr	-.0250675	.0254014	-0.99	0.324	-.074874	.024739
D_mismo_c~2y	-.0529154	.0446266	-1.19	0.236	-.1404182	.0345875
live_with_~1	.0415528	.028089	1.48	0.139	-.0135234	.0966291
empl_anual	.2006693	.0353679	5.67	0.000	.1313207	.2700179
tamhogar	-.005523	.0059303	-0.93	0.352	-.0171509	.0061049
ocup1	.3113634	.1230092	2.53	0.011	.0701696	.5525571
ocup2	-.0647191	.0827416	-0.78	0.434	-.226957	.0975188
ocup3	-.3699998	.0862257	-4.29	0.000	-.5390693	-.2009302
ocup4	-.4352359	.0810164	-5.37	0.000	-.594091	-.2763807

ocup5	-.2055577	.1038098	-1.98	0.048	-.4091057	-.0020096
ocup6	-.1797455	.0779601	-2.31	0.021	-.332608	-.026883
ocup7	-.3202514	.0956303	-3.35	0.001	-.5077613	-.1327415
ocup8	-.2895211	.0810442	-3.57	0.000	-.4484308	-.1306114
ocup9	-.2368022	.0801444	-2.95	0.003	-.3939477	-.0796567
rama2	.2053967	.1185064	1.73	0.083	-.0269681	.4377615
rama3	.0995489	.041221	2.42	0.016	.0187236	.1803741
rama4	-.0195026	.0848748	-0.23	0.818	-.1859234	.1469181
rama5	-.0268832	.0542526	-0.50	0.620	-.1332605	.0794941
rama6	.0541494	.0383333	1.41	0.158	-.0210137	.1293126
rama7	.0522793	.0868001	0.60	0.547	-.1179164	.2224749
rama8	.0870609	.0811718	1.07	0.284	-.0720989	.2462207
rama9	-.0087961	.0556732	-0.16	0.874	-.1179589	.1003666
d_lpr	-.0260418	.0203216	-1.28	0.200	-.065888	.0138044
d_lsr	-.0137966	.0155691	-0.89	0.376	-.044324	.0167309
d_luvr	.0076042	.0043795	1.74	0.083	-.0009831	.0161915
pendiente	-.0061475	.0009454	-6.50	0.000	-.0080012	-.0042939
pp_promedi	-.0000498	.0000998	-0.50	0.618	-.0002455	.0001458
pp_promedi2	4.96e-09	1.30e-08	0.38	0.702	-2.05e-08	3.04e-08
log_sch	-.0179478	.0151602	-1.18	0.237	-.0476737	.0117781
log_coleg	-.0590261	.0196985	-3.00	0.003	-.0976504	-.0204017
log_clinic	.044	.0151654	2.90	0.004	.0142641	.073736
log_saban	-.0519325	.0204679	-2.54	0.011	-.0920655	-.0117995
D_01	-.0925036	.0462537	-2.00	0.046	-.1831969	-.0018104
D_02	-.0546543	.0435374	-1.26	0.209	-.1400216	.0307129
D_03	-.1389677	.0455684	-3.05	0.002	-.2283172	-.0496183

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        D_04 |  -.0742788   .0414837    -1.79   0.073     -.155619    .0070615
        D_05 |  -.0813785   .0416289    -1.95   0.051    -.1630036    .0002466
        D_06 |   .0002546   .0410575     0.01   0.995      -.08025    .0807593
        D_07 |  -.0574461    .040005    -1.44   0.151    -.1358869    .0209948
       _cons |    6.86645   .3265438    21.03   0.000      6.22617     7.50673
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