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SUMMARY FOR DECISION-MAKERS

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Private provision of public goods: applying matching methods to evaluate payments for ecosystem services in Costa Rica

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A new paradigm is emerging in environmental conservation. Conservationists have traditionally spoken of conserving the building blocks of nature−genes, species, and ecosystems, along with the air, water, and land with which these interact. But this approach has not captured the interest of those who influence the activities that degrade these blocks. To fill this gap, conservationists have been seeking language that will make the importance of a healthy environment more obvious and relevant to all stakeholders who make decisions upon which nature's future depends. Such concept is embodied in the idea of *Ecosystem Services* (ES). ES are the benefits that people derive from the biophysical environment. ES are the foundation of life, and they are available without people being conscious of the many and complex processes involved in their production and delivery. However, human actions can irreversibly and substantively impair the provision of ES.

Paying for the provision of ES is a recent policy innovation attracting attention in both developed and developing countries. This policy mechanism, referred to as *Payments for Ecosystem Services* (PES), aims to harness market forces to obtain more efficient environmental outcomes. This policy has emerged as a potential tool for achieving conservation and improving the livelihoods of environmental-service providers and consumers.

PES schemes incorporate different services generated from different ecosystems. Important attention has been focused on services produced by forests. In the tropics, the most prominent PES system has been developed over a decade in Costa Rica. In the *Programa de Pagos por Servicios Ambientales* (PSA) landowners agree to conserve their forests, and establish reforestation, afforestation, or agroforestry areas. In return, they receive a per-hectare annual payment from a State-run national forest fund.

Previous attempts to study the causal impact of PSA have used a more macro-level approach where only immediate causes of deforestation have been used ignoring socio-economic characteristics. This research advances beyond previous analysis, by using census tracts where socio-economic household characteristics aggregated at the census tract level are combined with remote sensing data on land use and

biophysical land characteristics, to estimate the causal impact of the program.

I applied matching methods to evaluate the impact of PSA protection contracts signed between 1998 and 2004. Matching allows selecting tracts non-protected by the program to estimate the counterfactual (e.g. forest gain would have occurred had the census tract not protected by the program). Impacts on forest gain, forest loss and net deforestation were included. These outcomes can explain different and important dynamics of the forest transition in Costa Rica (e.g. loss and regeneration of existing mature natural forests vs. regeneration of new forests). Variations in the implementation of the program have also been incorporated by including estimates of program impact by regions, and explanatory variables of program targeting. Given that I do not observe all the factors that drive local deforestation rates, the expanded data permit the inclusion of other separate effects for each census tract (i.e. underlying causes of deforestation and explanatory variables of PSA targeting) which is a major gain in controlling for the effects of potential unobserved drivers. I found that the program has not a statistically significant effect on existing forest, but have a significant and positive effect on the establishment of new forest areas. As the first attempt in the conservation literature to estimate the impacts of PES using intensity of protection as a continuous explanatory variable of PES impact, results show that intensity matters and expected directions of PSA impact on outcomes can be expected if the protection intensity does not reach a threshold.

Regarding regional variation in the implementation of PSA, impact depends on how intense the protection has been in the region, how well organized has been each conservation area in promoting the program, among other factors (e.g. presence of active NGOs promoting PSA). Some regions follow the expected direction of PSA impact on program outcomes (i.e. positive impact on forest gain and net deforestation, and negative impact on forest loss); however in some regions that impact pattern was not found. A negative impact of PSA on forest gain could indicate that outside areas protected by PSA, there is have been more forest recovery which is not surprising given the current forest transition in Costa Rica. Distribution of PSA forest conservation contracts is explained by the stock of natural forest; however deforestation rate of mature natural forest in Costa Rica is currently very low. The more forest recovery in areas not protected by PSA may also been explained by the existence of other forest incentives designed for the regeneration of new forests (e.g. PSA reforestation contracts). Future evaluations should incorporate regional variations of PSA implementation and different biophysical and socio-economic regional contexts in order to understand the impact of the program across the country.

All these results indicate that PSA is having an impact on the forest transition underway in Costa Rica. It is also important to highlight that this paper presents an analysis of the causal effect of PSA contracts signed for natural forest conservation and the results indicate significant and positive results in the establishment of new forests. In light of these results, PSA should be evaluated beyond its impact on tropical deforestation per se. There is evidence around the world that forest cover is increasing and new forests are being established on former agricultural land. However, there is almost no empirical analysis of the impact of PES and in particular of PSA on forest transition. In that sense, this research constitutes an important contribution to the literature on the evaluation of causal effect of PES using state-of-the art matching methods, and in particular to the impact that PSA has on the ongoing forest transition in Costa Rica.

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