Surveying Impact Analysis of Argentina's Forest Fund on Deforestation in the Chaco, Salta, and Santiago del Estero Provinces

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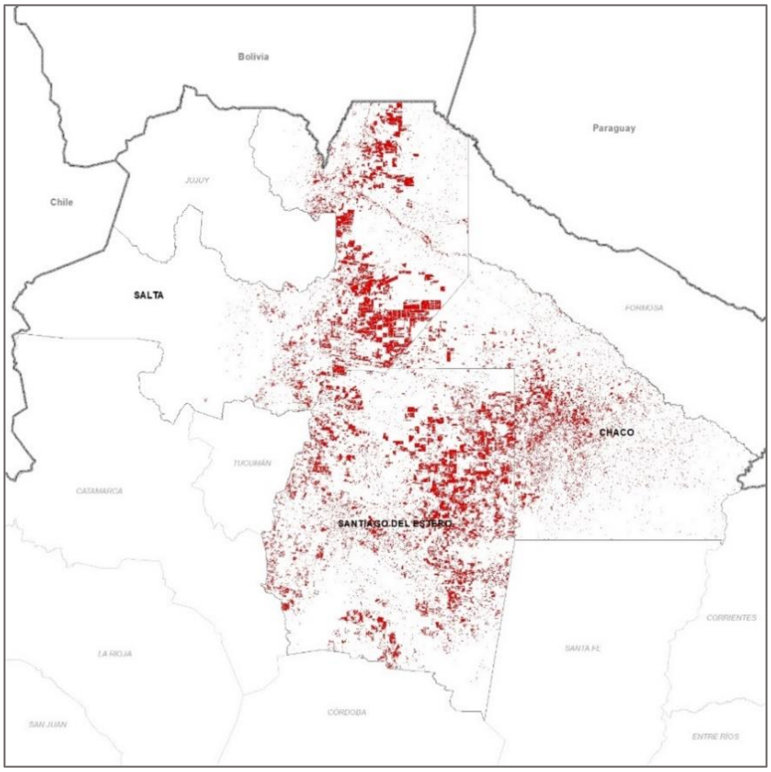
I. Introduction

The United Nations Statistics Division (UNSD) released a report which shows the changes in forest area in each country around the world since 1990. In this report, Argentina ranks 9th among countries that have lost the largest area of woodland during this time period. Previously, Argentina's deforestation had gone largely unnoticed by most of the international public. To give a sample of the deforestation rate in Argentina during this time, in 1990 the country had 37.4 million hectares of natural forests, but by 2015 that amount had fallen to 27.11 million hectares. This represents a 22 percent loss of the country's forests in just a quarter of a century. Most of the deforestation happened in the Chaco ecoregion and occurred at an alarming rate, higher than the tropical forest deforestation rate. (Zak et al. 2008). The Chaco ecoregion is a large, dry forest region, consisting of closed forest, open woodlands, shrublands, and palm savannas that cover an area of approximately 1,080,000 km² with 60 percent located in Argentina. The region is a hotspot for a rich biodiversity, and is home to 145 mammal species (12 endemic to the region), 409 birds (7 endemic), 54 reptiles (17 endemic), 34 amphibians (8 endemic), and more than 80 plant genera with 3,400 species, of which 400 are endemic (Piquer-Rodríguez et al. 2015).

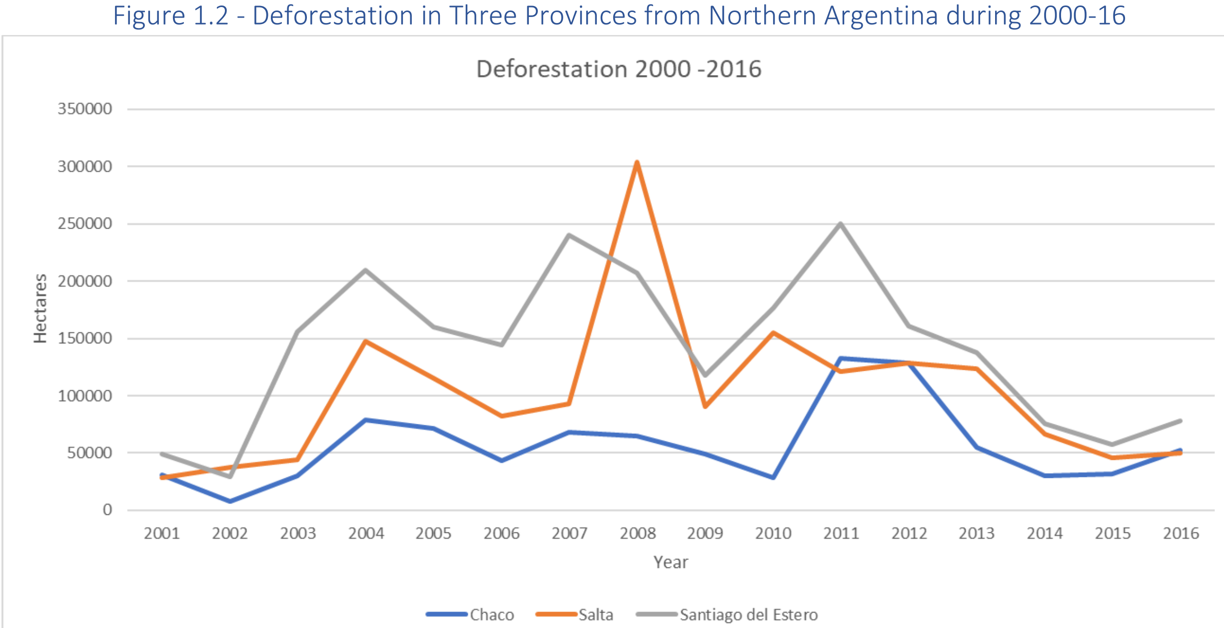
In three provinces, Chaco, Santiago del Estero, and Salta, forest tree cover loss encompasses the majority of the Chaco ecoregion in Argentina (Figure 1.1). Red areas show absolute accumulated forest area loss per pixel (30 meters) during 2000-16. The graph in Figure 1.2 shows deforestation changes per year and by province. Deforestation tends to be correlated across provinces with increasing and decreasing rates. Deforestation in the region is driven by expansion of soy and cattle production expansion, which studies have shown are responsible for a 22.5 percent loss in the Chaco's ecoregional forests (Piquer-Rodríguez et al. 2015, and Zak et al. 2008). Thus, macro level analyses point towards international soy and beef agricultural prices as factors driving deforestation.

Figure 1.1 - Deforestation in Three Provinces from Northern Argentina during 2000-16



Source: Hansen/UMD/Google/USGS/NASA

Figure 1.2 - Deforestation in Three Provinces from Northern Argentina during 2000-16



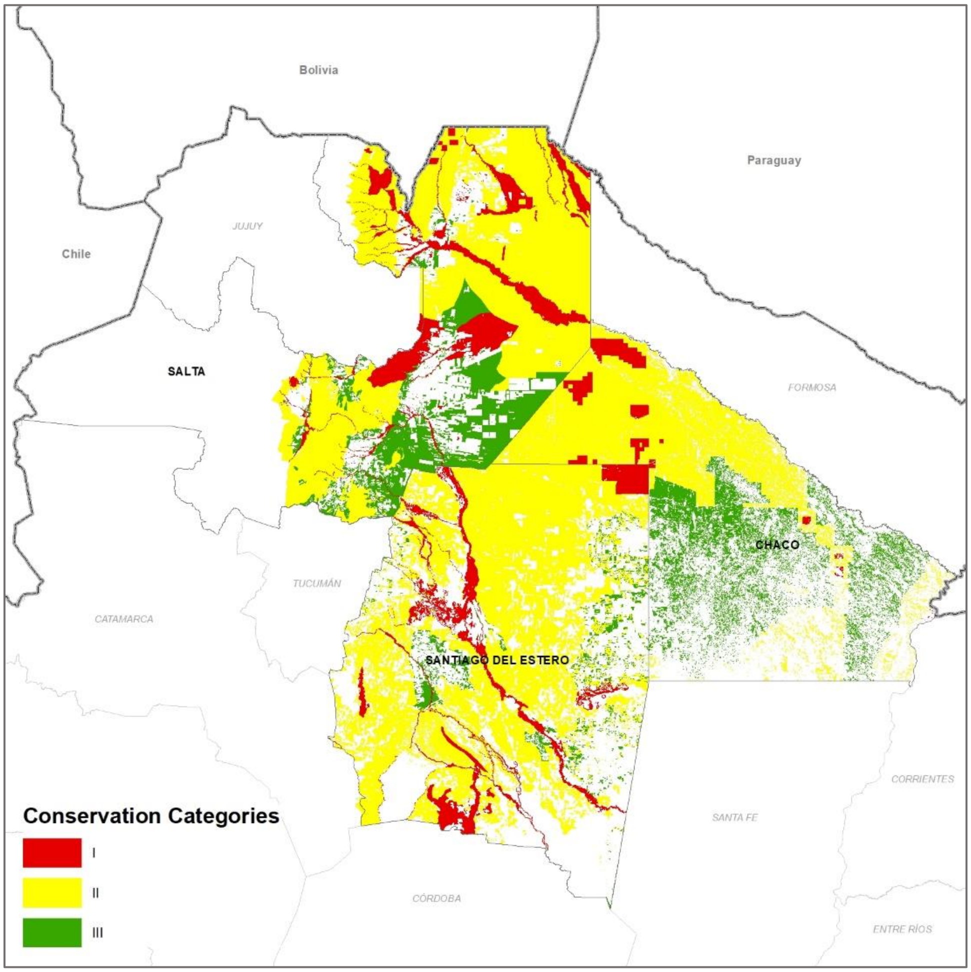
Source: Hansen et al. (2016)

In order to reduce these high levels of deforestation and promote sustainable forest management, the Government of Argentina in December 2007 sanctioned Law 26,331, “Minimum Standards for Environmental Protection of Native Forests,” also known as the "Forest Law.”[1] The objective of this law is to control the decrease of native forests and to promote forest enrichment, conservation, restoration, improvement, and sustainable management. The Forest Law provides different instruments to achieve these goals: 1) the Territorial Organization (Zoning) of Native Forests (OTBN[2]), 2) the National Program for the Protection of Native Forests, and 3) the National Fund for the Enrichment and Conservation of Native Forests (FNECBN[3]). This paper focuses on the effectiveness of the latter in controlling deforestation.

The Forest Law provides “Environmental Sustainability Criteria” through which the OTBN instructs provinces to survey and classify native forests in a participatory process meant to establish different conservation categories (see example in Figure 1.3). Category I forests have high conservation value, and require permanent protection against all uses unless for indigenous communities or research. Category II forests have a medium conservation value, and can be used for tourism, gathering and harvesting, or research, if sustainably managed. Finally, Category III forests have a low conservation value, and can be converted partially or fully. Individual provinces, accredited by the federal government, have determined and legally set-up forest land use zones.

[1] The law was not finally enacted and regulated until February 2009.
[2] Ordenamiento Territorial de los Bosques Nativos
[3] Fondo Nacional para el Enriquecimiento y la Conservación de los Bosques Nativos

Figure 1.3 – Geographic Distribution of Native Forests and Conservation Categories



Source: Provincial OBTN zone maps

Nolte et al. (2017) examined and analyzed the effects of the first of these instruments (OTBN) in the provinces of Chaco, Salta, and Santiago del Estero, and found that it reduced deforestation in all three provinces. However, it also found that the provinces did not randomly allocate the distribution of zones. Instead, land that was considered to have less agricultural value was less likely to be deforested a priori, and more likely to be zoned as Category I. Thus, a selection bias in forest categorization was partially responsible for results that point towards the law successfully achieving its mission.

The FNECBN or "Forest Fund" is a "pay for ecosystem services" (PES) system that compensates jurisdictions that conserve native forests to enable the provision of environmental services.[4] The law stipulates that 30 percent of the funding for the Forest Fund be allocated to institutional strengthening of the Provincial Forest Directorates (local authorities), specifically for the monitoring of native forests and the implementation of technical and financial assistance programs for small producers and for indigenous and/or peasant communities. The remaining 70 percent of funding is distributed directly among forest land holders who submit approved Annual Operation Plans (POAs[5]) for one of three types of initiatives: Conservation Plans (PC)[6]; Sustainable Management Plans (PM)[7]; or financial assistance to formulate those plans (FP). The distribution of funds began in 2010 and is evaluated annually among provinces that have an OTBN approved by a provincial Law and accredited by the Ministry of Environment and Sustainable Development (MAyDS).[8]

Even though the main goal of the Forest Fund was to improve sustainability of Argentina's native forests, the National Forest Directorate (NFD), which is dependent on the MAyDS, requested the technical

[4] The main environmental services are water regulation, conservation of biodiversity, soil and water quality, mitigation of greenhouse gases, contribution to the diversification and embellishment of landscapes, and the defense of cultural identity.

[5] Plan Operativo Annual [Anual Operative Plan]

[6] The Conservation Plan is the document that synthesizes in time and space the organization, means, and resources of specific measures to maintain or increase conservation attributes of a native forest or group of native forests and/or their sustainable use of nontimber resources and services. The latter must include a detailed description of the forest land in its ecological, legal, social, and economic aspects. It must also, in particular, include a forest inventory and/or a detailed listing of nontimber resources that were exploited. These descriptions and listings are meant to facilitate decision-making regarding forestry and to inform related applicable use guidelines that are meant to be applied in each of the native forest units. In cases where herbivory exists, it must be proved that the carrying capacity does not decrease conservation values or it must describe measures to insure that this does not happen.

[7] Sustainable Management Plan for Native Forests: This document synthesizes in time and space the organization, means, and resources of the sustainable use of forest resources, timber, and nontimber, in a native forest or a group of native forests. It should include a detailed description of the forest land and its ecological, legal, social, and economic aspects. In particular, it should include a forestry inventory with enough detail to allow decision-making regarding the type of forestry that can be applied in each of the native forest units, and it should also include enough information to allow estimates of their respective profitability.

[8] Ministerio de Ambiente y Desarrollo Sustentable

assistance of the World Bank to determine the indirect effect of the FNECBN on deforestation. This paper investigates the impact of the Forest Fund on deforestation in Chaco, Santiago del Estero, and Salta provinces between 2010 and 2016.

II. Data and Methodology

The study's unit of analysis is based on the Forest Fund's approved applications, referred to as POAs. The POA data was provided by the NFD which maintains a plan's National Registry with data collected from provincial authorities. The database contains 3,978 observations (Chaco - 2,318, Santiago del Estero – 751, and Salta - 909), and includes some limited attributes about the application, plan status (operational, canceled, completed, and so forth), year of application, and geographic location, which integrates other geospatial data into the study. Errors such as duplications, inconsistencies, and problems with property location were identified and removed through a thorough data cleaning process performed in cooperation with NFD experts. After the data cleaning process, 701 approved POAs for unique properties remained. In addition, precise polygons for approximately 300 POAs were identified in consultation with NFD experts. For the remaining POAs, latitude and longitude were used as a single point. To obtain the spatial extent of these POAs, we used provincial cadasters provided by the NFD, and utilized GIS software that matched cadastral plots with each POA that fell into it.

The fact that Forest Fund beneficiaries are not randomly selected is especially notable, and consequently led to the decision to not use ordinary statistical analysis due to its propensity towards biases.[9] In order to estimate the causal impact of the Forest Fund on deforestation in the three provinces, kernel covariate matching with a difference-in-differences (DID) estimator were combined. Matching is a quasi-experimental technique, frequently used to create a control group that similarly reflects the treated groups' propensity to obtain the outcome in question, based on observable covariates prior to treatment

[9] As with OTBN zoning, each province's forest directorate (local authority) uses different criteria to evaluate applications.

occurring (Ferraro and Hanauer, 2014). This technique has become quite popular in the literature on impact evaluation of land use and "pay for ecosystem services" polices (Alex-Garcia et al. 2010; Nelson and Chomitz 2011; Nolte et al. 2017) since it allows for ex-post evaluation of a policy which was implemented without the usual considerations needed to construct a reasonable counterfactual. While the matching technique can assist in the construction of a counterfactual, based on observable characteristics, it cannot control for unobservable confounders. For this reason, we combine it with a DID estimator, which eliminates any bias caused by unobservable time-invariant confounders.

Prior to treatment, our matching technique is based on finding control group properties which had a similar likelihood of becoming Forest Fund recipients as did our treated group. In order to estimate the *a priori* probability, we followed Nolte's methodology (Nolte et al. 2017). The property characteristics which are likely to determine the interest of property owners in becoming a Forest Fund recipient include: agricultural productivity, accessibility, neighborhood effects, and property size. The indicators and data sources we employed to measure these are:

1. Long-run average annual precipitation (Willmott and Matsuura 2001)
2. Deforestation in a 50km buffer around the property from 2001-08 (Hansen et al. 2013)
3. Forest cover in 2009 (Hansen et al. 2013)
4. Natural log of property size (own calculations from provincial cadasters, hectares)
5. Distance to nearest waterbody (own calculations using water bodies from IGN[10])
6. Distance to nearest urban area (own calculations using urban areas defined by IGN)
7. Province
8. Property's conservation category (OBTN/NFD)

[10] Instituto Geografico Nacional Argentino

Using these covariates, a propensity score is estimated for each property using a logit regression. The logit regression can be shown formally as:

$$Treat_i = \alpha_1 + \alpha_2 Precip_i + \alpha_3 Defor50km_i + \alpha_4 ForestCover09_i + \alpha_5 ln\,(size_i) + \alpha_6 ln\,(DistWater_i) + \alpha_7 ln\,(DistUrban_i) + \alpha_8 Province_i + \alpha_9 OBTN_i + \varepsilon_i\ ; \qquad \text{(Equation 1)}$$

Where: $Treat_i$ is a binary indicator equal to 1 if property *i* is part of the treatment group, and 0 is part of the control group; $Precip_i$ is long run average precipitation for property; *i*, $Defor50km_i$ is the deforestation rate in a 50km buffer around plot *i* between 2001 and 2009; $ForestCover09_i$ is forest cover in plot *i* in 2009, prior to the law taking effect; $ln\,(size)_i$is the natural log of the size of property *i;* $ln\,(DistWater_i)$ is the natural log of the distance from property *i* to the nearest waterbody; $ln\,(DistUrban_i)$ is the natural log of the distance from property *i* to the nearest urban area along roads; $Province_i$ is a set of three binary variables indicating the province that property *i* falls into (Chaco is the omitted province); and $OBTN_i$ is a set of four binary variables indicating the dominant forest classification that property *i* falls into (category I, II, III, or unclassified, with category I as the omitted category).

Treated properties are then matched to control group properties with the most similar propensity scores. Because of the large number of control group properties relative to treated properties (90,000 as opposed to 701), we used a kernel-based match whereby treated properties are matched to a weighted average of multiple control group properties, where the weight declines with differences in the propensity score. This reduces the likelihood that results are driven by several “bad matches” where the propensity score does not accurately characterize the similarities between the treated and control group matched pairs.

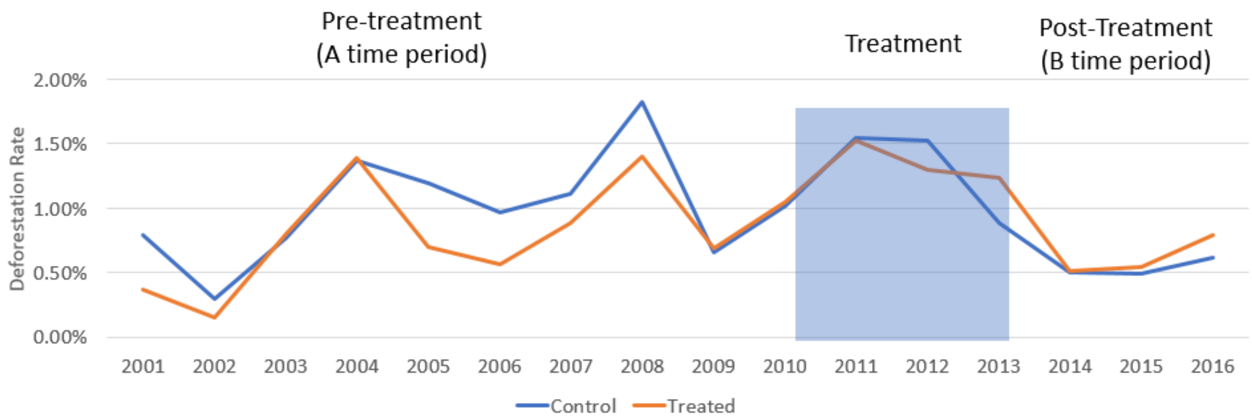
Treated properties are defined as those which received funds from the Forest Fund at any point between 2010 and 2013. Properties which received funds for the first time after 2013 were dropped from the analysis and appear in neither the treatment nor the control groups. Therefore, we are not commenting on the dynamic impacts of the law (that is, how the effectiveness of the law has changed over time). The post-treatment time period is 2013-16 and the pretreatment time period is 2001-09. The DID estimator measures how the difference in deforestation rates between treated and control groups changed between 2001-09 and 2013-16, and is given by the following equation:

$$Deforestation_{it} = \alpha_1 + \alpha_2 Treatment_i + \alpha_3 Post_t + \alpha_4 Treatment_i * Post_t + \varepsilon_{it}; \qquad \text{(Equation 2)}$$

where $Deforestation_{it}$ is the deforestation rate in property *i* in time period *t* (which takes on two values, pretreatment and post-treatment); $Treatment_i$ is a binary variable equal to 1 if property *i* is part of the treatment group, and 0 if it is part of the control group; and $Post_t$ is a binary variable equal to 1 if the time period is post-treatment, and 0 if it is pretreatment.

This is visualized in Figure 2.1 which shows pretreatment and post-treatment trends of both the treated and control groups. It is clear from this graph that in the pre-treatment period, control group, and treated groups trend together, thus satisfying the pretrend assumption of the DID estimator.

Figure 2.1: Deforestation Rates of Treatment and Control Group, Pre- and Post-Treatment



III. Results

We begin by displaying results from estimating Equation (1), shown in Table A.1. Column 1 displays results for the full sample and Columns 2-4 show results for the sample restricted to Chaco, Salta, and Santiago del Estero provinces, respectively.

Regions which have a higher long-run average precipitation were less likely to become treated. The Chaco ecoregion is relatively dry, and it has been shown that wetter areas tend to be more agriculturally productive than drier areas. Thus, it is not surprising that owners of land in less agriculturally productive areas would be more interested in coming up with a plan for sustainable management of the forest than would land owners in wetter areas who might find converting the land for agriculture more profitable. Properties in regions which experienced more deforestation prior to the commencement of the Forest Fund were more likely to become treated, except in Chaco province where that result is reversed. Properties with a larger share of forested land were also more likely to become treated. This may reflect the propensity for officials in the provinces to reject treatment applications from properties with little forest cover.

Larger properties also were more likely to become treated. This trend indicates that wealthier landowners are better able to meet the high application costs for the funds. In addition, a larger amount of marginal agricultural lands tend to be cheaper and in areas with less population density, which may show that owners of less productive lands are being more interested in sustainable forest management. “Distance to water bodies” is statistically insignificant, as is “distance to urban areas”, with the exception of the Chaco province, where the coefficient is negative. The coefficients on Salta and Santiago del Estero provinces are both negative, implying that Chaco properties had a higher likelihood of being treated. Finally, in Chaco properties, Forest Zones II and III had a higher probability of being treated than did those in Zone I. In Salta, Forest Zone III had the lowest probability of treatment. In Santiago del Estero there is no statistical difference between the three categories. The reasoning for this heterogeneity is unclear and may reflect differences in how the law was implemented across the three provinces.

After matching the treated groups to controls using the propensity scores calculated above, using Equation (2) to control for unobservable factors that may influence deforestation, Table A.2 shows the difference in the deforestation rates between treated and control groups in the pretreatment time period and in the post-treatment time period, and then shows the difference-in-differences between the two-time periods. The top three rows show the mean deforestation rate in the pretreatment time period for the control group, for the treated group, and then the difference between these groups. The next three rows show the same three factors in the post-treatment time period. The last row shows the difference in the differences between the two time periods, reflecting α_4 from Equation (2).

The main results for the full sample are shown in Column 1 of Table A.2. Columns 2-4 separate the sample by province, and Columns 5-7 separate the sample by property size. Results for the full sample show that the deforestation rate declined between the pretreatment time period and the post-treatment time period for both the control group and the treated group. However, the deforestation rate declined by 0.1 percent more for the control group, implying that the implementation of the law actually led to an increase in the deforestation rate for treated properties. Similar results are shown when samples are restricted separately to each of the three provinces, where in each province, deforestation in control groups declined more than in treatment groups, (although in Salta, the difference is statistically insignificant).

When the sample is split by property size, there is some heterogeneity. In small- and medium-sized plots deforestation rates declined more in control groups than they did in treatment groups (but in both small- and medium-sized plots, deforestation rates only declined by 0.1 percent in treatment groups), and the point estimate for large properties shows deforestation rates declined more in the treated group, although it is statistically insignificant.

Table C shows the differences in total deforestation between treated and control groups in the pretreatment time period and the post-treatment time period, and then the difference-in-differences between the two time periods. The main results for Table A.3 showcase the full sample in Column 1. Samples divided into each of the three provinces are displayed in Columns 2-4, respectively. Finally, the sample, divided by property size, (small, medium, and large plots) are displayed in Columns 5-7, respectively.

Results for the full sample show that changes in total deforestation (measured by ha) decreased between the pretreatment time period and the post-treatment time period for both the control group and the treated group with a high statistical significance. The full sample shows that 5.375 ha were reduced (change in total deforestation), a high level of significance, as a result of the Forest Fund.

To explain the results in more detail, according to the data in Table A.3 (available at the end of this report), the average treated property deforested 7.3 hectares more than did the average control group property, prior to treatment. After treatment, the average treated property deforested 1.9 hectares of forest more than the average control group property. Thus, the effect of the law resulted in, on average, 5.3 hectares less deforestation per plot, per year.

In Chaco Province, however, the control group showed a decrease in deforestation between the pretreatment time period and the post-treatment time period, while the treated group showed an increase in the change of total deforestation between the pretreatment and post-treatment period. Prior to treatment, the average treated property deforested 3.1 hectares of forest more than the average control group property. However, after treatment, the average treated property deforested 5.19 hectares of forest more than the average control group property. Thus, the effect of the law in the Chaco Province was, on average, 1.9 hectares more deforestation per plot, per year after the treatment took effect.

In both Salta Province and Santiago del Estero Province, the change in total deforestation decreased between the pretreatment time period and the post-treatment time period for both the control group and the treated group.

However, in the case of Salta Province, the statistical significance is not high enough to conclude that there is a statistical impact of the Forest Fund on change in total deforestation. Prior to treatment, the average treated property deforested 4.1 hectares of forest more than the average control group property. After treatment, the average treated property deforested 1.8 hectares of forest more than the average control group property. Thus, the effect of the law was, on average, a 5.9 hectares deforestation change per plot, per years.

In Santiago del Estero, the statistical significance was high enough to conclude there is no statistical impact of the Forest Fund on change in total deforestation.

In relation to plot size, results for the small- and medium-sized plots show that changes in total deforestation (measured by ha) decreased between the pretreatment time period and the post-treatment time period for both the control group and the treated group with a high statistical significance. As shown in Table A.3, prior to treatment, the average small treated property deforested 0.432 hectares of forest more than the average control group property. After treatment, the average small treated property deforested 0.557 hectares of forest more than the average control group property. Thus, the effect of the law was, on average, 0.126 hectares more deforestation per small plot, per year.

This indicates that the Forest Fund has contradictory effects in small and medium plots, and also in the Chaco Province. Where one would expect the Forest Fund to decrease deforestation in these three categories, the data shows the opposite effect. This raises a question to be determined of why in small plots, medium plots, and in Chaco province the funds are creating the adverse effect of its original intention. Meanwhile in large plots, the total change in deforestation also decreased between the pretreatment time period and the post-treatment time period for both the control group and the treated group, but with no statistical significance. There is no statistical impact of the Forest Fund on change in total deforestation in large plots.

IV. Conclusions

Our results show that the Forest Fund was moderately successful at reducing deforestation in participating properties, relative to a plausible control group. Overall, the average deforestation rate in each property actually decreased less in treated groups relative to control groups. However, because larger properties showed the opposite response, with treated properties on average reducing deforestation more quickly than the control group, overall less total deforestation occurred in treated properties than would have occurred without the program. Between 2010 and 2013, there were 701 unique property locations in our sample. Therefore, we can estimate that the law reduced deforestation by 3,715 hectares per year.

There are several reasons why the results on the impact of the Forest Fund in this study are lower than one might have expected. The first is related to several shortcomings in the data used. The Hansen deforestation data represents the current frontier of deforestation data in terms of spatial and temporal coverage, granularity, and accuracy. However, the data itself is calibrated for tropical forests, while the Chaco ecoregion is a dry forest. Therefore, it may not be as accurate in detecting both forest cover and forest loss. While other deforestation datasets do exist, such as NFD's UMSEF[11] and Guyra Paraguay,[12] they either lack a long enough time period to cover a sufficient pretreatment time period, or they are not available at annual intervals. Thus, while Hansen is an imperfect measure, it is the best available option given the methodology chosen for this study.

Furthermore, it is not possible to match POAs to cadasters in an exact manner. For approximately 60 percent of POAs, there is no polygon available with which to measure its respective deforestation rate. To overcome this, each POA was matched in its entirety with its corresponding cadastral plot. However, in many instances, it is likely that there is an overestimation of the land area covered under the Forest Fund

[11] Unidad de Manejo del Sistema de Evaluación Forestal (UMSEF)
[12] http://guyra.org.py/

plan, since a plan does not necessarily cover all of the property owned by the landowner. Finally, the cadaster used in this study is outdated (plots could have been subdivided or merged) and are subject to surveying errors (plots may be shifted).

Unrelated to the analysis itself, there are several reasons why the implementation of the Forest Fund was not as effective as originally intended. For one, the Forest Law's legal and institutional framework, delegates a lot of responsibility to local authorities. While this can be beneficial, it can also lead to implementation that is both flexible and adaptable to the local context, which can create inequities from the beneficiary standpoint. In addition, often different criteria are applied at different local levels.

Moreover, funding of provincial forest directorates is uneven and varies by province, affecting the level of implementation and enforcement of the Forest Law in each province. At the national level, monitoring and enforcement systems are currently also limited. The data currently collected does not enable accurate and rapid monitoring of Forest Fund plans. Thus, Forest Fund recipients seem to have little incentive to follow their approved plan. In the unlikely event that recipients are caught cheating, the punishment is simply that they are removed from the program.

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Appendix A: Tables

Table A.1: Estimates of Logit Models of Forest Fund Allocations, Full Sample, by Province, and by Forest Zone

	(1) Full Sample	(2) Chaco Only	(3) Salta Only	(4) Santiago del Estero Only
Average Precipitation	-0.00064**	-0.0024***	-0.0011*	-0.0010
	(-2.13)	(-4.27)	(-1.78)	(-1.41)
Deforestation 50km buffer 2001-2009	1.236**	-2.309*	2.319**	0.287
	(2.02)	(-1.82)	(2.01)	(0.26)
Forest Cover 2009	1.439***	1.954***	2.218***	0.936***
	(9.00)	(6.67)	(5.43)	(3.96)
ln(Property size)	0.660***	0.733***	0.654***	0.710***
	(24.35)	(14.04)	(12.93)	(15.50)
ln(Distance to waterbodies)	-0.00101	-0.0158	0.00366	0.0146
	(-0.09)	(-1.00)	(0.16)	(0.48)
ln(Distance to urban area)	-0.0584	-0.389***	0.0206	0.0592
	(-1.28)	(-3.54)	(0.27)	(0.73)
Salta Province	-0.331***			
	(-2.64)			
Santiago del Estero Province	-0.284**			
	(-2.13)			
OTBN Category II	-0.160	2.349**	-0.231	-0.274
	(-1.05)	(2.32)	(-1.01)	(-1.23)
OTBN Category III	-0.254	3.075***	-1.941***	-0.124
	(-1.45)	(2.98)	(-5.10)	(-0.40)
OTNB Uncategorized	-0.929***	2.513**	-1.574***	-1.168***
	(-4.19)	(2.39)	(-2.64)	(-3.21)
Constant	-13.82***	-12.83***	-15.03***	-15.44***
	(-18.60)	(-6.99)	(-11.46)	(-13.00)
	90,560	52,000	16,338	22,222

Notes: This table shows coefficient estimates from estimating equation (1) via a logit model. Each column displays coefficients from a different regression. In all columns, the dependent variable is a binary indicator equal to 1 if the property participated in the Forest Fund between 2010 and 2013, and equal to 0 if otherwise. Properties which participated in the Forest Fund only after 2013 are not included in either sample. Standard errors are shown in parenthesis. Statistical significance is given by * p<0.10 ** p<0.05 *** p <0.01.

Table A.2: Difference-in-Difference Estimates of Changes in Deforestation Rate Due to Forest Fund Participation

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Full Sample	Chaco Province	Salta Province	Santiago del Estero Province	Small Plots <500ha	Medium Plots 500-5000ha	Large Plots >5000ha
Pretreatment	Control	0.01	0.008	0.008	0.014	0.011	0.012	0.007
	Treated	0.008	0.006	0.005	0.011	0.007	0.008	0.008
	Difference	-0.002***	-0.002***	-0.003***	-0.002***	-0.004***	-0.004***	0.001
	(T-C)	(0.000)	(0.000)	(0.000)	(0.000)***	(0.000)	(0.000)	(0.001)
Post-treatment	Control	0.005	0.005	0.005	0.007	0.005	0.005	0.004
	Treated	0.006	0.007	0.003	0.007	0.006	0.007	0.004
	Difference	0.001***	0.003***	-0.002***	0.001*	0.001***	0.002***	-0.001
	(T-C)	(0.000)	(0.000)	(0.000)	(0.060)	(0.000)	(0.000)	(0.001)
Diff-in-Diff	Post-treatment Diff	0.003***	0.005***	0.001	0.003***	0.005***	0.005***	-0.001
	- Pretreatment Diff	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)

Table A.3: Difference-in-Difference Estimates of Changes in Total Deforestation due to Forest Fund Participation

		(1)	(2)	(3)	(4)	(5)	(6)	(7)
		Full Sample	Chaco Province	Salta Province	Santiago del Estero Province	Small Plots <500ha	Medium Plots 500-5000ha	Large Plots >5000ha
Pretreatment	Control	14.455	2.959	19.277	20.757	0.693	14.740	83.701
	Treated	21.76	6.142	23.413	39.121	1.125	14.625	97.393
	Difference	7.305***	3.183***	4.136*	18.364***	0.432***	-0.115	13.692
	(T-C)	(0.758)	(0.213)	(2.143)	(1.116)	(0.029)	(0.711)	(15.478)
Post-treatment	Control	12.364	2.202	14.570	14.562	0.473	8.649	58.707
	Treated	14.294	7.349	12.713	23.626	1.031	11.677	55.668
	Difference	1.930**	5.147***	-1.858	-9.064***	0.557***	3.027***	-3.039
	(T-C)	(0.758)	(0.213)	(2.143)	(1.116)	(0.029)	(0.711)	(15.479)
Diff-in-Diff	Post-treatment Diff -	-5.375***	1.964***	-5.994**	-9.301***	0.126***	3.143***	-16.731
	Pretreatment Diff	(0.000)	(0.301)	(3.031)	(1.579)	(0.041)	(1.005)	(21.889)