The Impact of Smart Subsidies on Agricultural Production: Innovative Evidence from Argentina Using Survey and Remote Sensing Data

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Background

- PRODAF was a smart subsidy program in Argentina, focused on family farmers of 4 production chains: livestock, dairy, cotton and citrus.
- Smart subsidies combine financial credit – conditional on the purchase of certain inputs or equipment – with technical assistance to facilitate the adoption of new technologies.
- Implementation was rolled out between 2013 and 2019.
- PRODAF was not randomly distributed, which leads to risks of self-selection. We use 2 different econometric strategies and data sources to address this bias.

Analysis 1: Survey and IPW

DATA: Survey of agricultural households

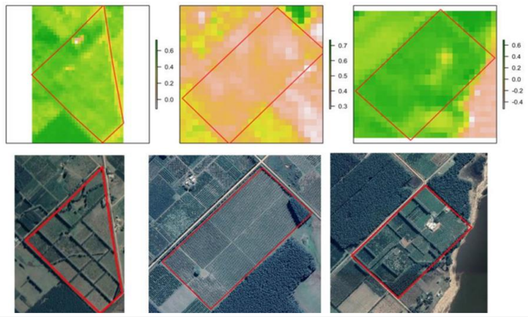
- Sample of 898 farmers (534 treated and 364 control) conducted after the end of the project in 2021

METHODOLOGY: Inverse Probability Weighting (IPW)

- IPW uses the inverse of the estimated propensity scores (PS) to generate regression weights, adjusting the distribution of treatment and control to ensure comparability (Rosenbaum, 1987).
- PS are estimated on the basis of observable characteristics, assuming conditional independence.

Objective

Estimate the impact of PRODAF, a smart subsidies project that benefited the family farming stratum in northeastern Argentina, on productivity.



Example of NDVI for citrus plots

Analysis 2: Longitudinal Analysis

DATA: Remotely sensed agricultural yields

- We use plot georeferencing to measure agricultural yields with satellite data for a subsample of 195 cotton farmers and 126 citrus farmers, over a 10-year period from 2010-2020.
- We construct the average Normalized Difference Vegetation Index (NDVI) to measure greenness and plant health as a proxy of yield.

METHODOLOGY: Event Study

$$\mathrm{NDVI}_{it} = \alpha + \mathrm{Treatment}_i \times \sum_{y=-8, y\neq -1}^{y=6} \beta_y \mathbf{I}(t - t_i^* = y) + \theta_t + \delta_i + \varepsilon_{it}$$

Fixed effects: θ_t (year), δ_i (farm). $\sum \beta_y \boldsymbol{I}(t - t_i^* = y)$: sum of a set of dummy variables indicating years since treatment y=0 ($before$: $y < 0$, after: $y > 0$).

Key findings and Conclusions

- PRODAF increased the likelihood of adopting a new technology and accessing credit, effectively overcoming market failures in terms of information and financial resources.
- In the long term, we find that PRODAF had a positive impact on the economic performance of the production units.
- Using remotely sensed estimates of yield, we observe positive effects for citrus between the second and third year post-treatment.
- We detect only limited impacts in the cotton chain, potentially related to farmers requesting direct production inputs, which highlights the need for long-term strategies for improvements in the production system.
- Results from remote sensing data support results from IPW, confirming that they can be used to accurately estimate yield changes, while allowing differentiation of impacts experienced by early and late adopters.

Effects of PRODAF on various variables, using IPW

	Full sample, excluding dairy	Divided by chain			
		Livestock	Dairy	Cotton	Citrus
Access to credit	**0.47***** (0.04)	**0.50***** (0.07)	**0.32***** (0.09)	**0.42***** (0.11)	**0.31**** (0.13)
Technology adoption	**0.21***** (0.04)	**0.20***** (0.06)	**0.69***** (0.08)	0.13 (0.11)	**0.29***** (0.07)
Net income per hectare (US$)	**372.7*** (201.90)	21.0 (28.69)	**261.9***** (92.42)	**182.2**** (73.70)	**1,504*** (912.70)
Productivity (production per hectare in US$)	95.17 (122.90)	-31.39 (34.64)	-194.6 (127.40)	61.27 (149.00)	**1,161**** (551.40)
Observations	**549**	**296**	**190**	**139**	**107**

Note: Robust std. err. in parentheses. Differences are non-zero if p-value is sign. at conf. levels 99(***), 95 (**) or 90 (*).

Effects of PRODAF on average NDVI