Hidden welfare effects of tree plantations

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ONLINE APPENDIX

Table A1. Data and sources

Variable	Description	Source
Outcome variable		
Poverty	Headcount ratio of individuals below the poverty line.	Poverty Microestimations: 1982, 1992, 2002
Treatment variable		
% subsidized land	Share of district area subsidized with at least 1 component of the program - accumulated	District mapping from the subsidy database (aggregated for years: 1982, 1992, 2002)
Confounders		
Theil Index	Income distribution index	Poverty Microestimations: 1982, 1992, 2002
Income	Log of the income and spatial lag of the log of the income (District average)	
Schooling years of the HH	Mean years of schooling of adults in the HH, district average	Population Census 1982, 1992, 2002
Demographic dependency	Percentage of household members out of labour force over the total household members (District average)	
Family Size	Household size (District average)	
Urban area	Percentage of urban inhabitants (District average)	
% who work in agriculture (district)	District share of household heads employed in agriculture	
Population density	District number of people per hectare	
Distance to pulp mill	Distance from the district centroid to the closest pulp mill (KM)	Own calculation based on National Statistics Institute Cartography: 1982, 1992, 2002
Distance to port	Distance from the district centroid to the closest port (KM)	Own calculation based on National Statistics Institute Cartography: 1982, 1992, 2002

Precipitation	Accumulated annual precipitations interpolated to districts (5 years average centered in 1982, 1992 and 2002)	Own calculation based on historical registers of Ministry of Environment.
District area	District area (ha)	National Statistics Institute : 1982, 1992 y 2002
Road density MOP	District road density (km/km2)	Ministry of Public Works, 2002
High erodibility surface (%)	District high or very high erodibility surface (%)	Ministry of the Environment, National Committee of the Environment, scale 1:250.000. 2002

Table A2. Pre-Matching differences between treated and control

Variable	Treated	Control		t-test		V(T)/	Normalized
	Mean		% bias	t	p>t	V(C)	difference[a]
Poverty 1982	62.13%	60.32%	25.3	3.48	0.001	0.50*	0.6213
Income	9.2937	9.4846	-69.7	-9.35	0.000	0.24*	9.2937
Theil Index	0.7328	0.7610	-39.3	-5.59	0.000	1.03	0.7328
Years of schooling HH	3.7532	4.9343	-73.6	-9.9	0.000	0.27*	3.7532
Household size (district average)	4.9458	4.7806	40.2	5.73	0.000	1.14	4.9458
HH work in agriculture (district average)	0.4983	0.3834	49.0	6.79	0.000	0.60*	0.4983
Demographic dependence (dependent over total)	0.4053	0.3923	43.1	5.99	0.000	0.65*	0.4053
Population density (district)	0.7642	12.2440	-56.0	-7.3	0.000	0.02*	0.7642
% urban area of the district	0.2065	0.4139	-51.8	-7.18	0.000	0.61*	0.2065
Distance to the closest port	73157.0000	93753.0000	-46.3	-6.44	0.000	0.69*	73157.0000
Total district area	2.20E+08	1.80E+08	15.5	2.2	0.028	0.97	2.20E+08
Road density	17524	17500	0.1	0.01	0.992	0.21*	17524
High slope (% district slope >10%)	0.09345	0.10112	-22.9	-3.18	0.002	0.63*	0.09345

* If variance ratio outside [0.81; 1.24].
[a] Imbens and Wooldridge (2009) suggest as a rule of thumb a normalized difference less than one quarter.

Table A3. Post-matching covariate balance (PS matching)

Variable	Treated	Control		t-test		V(T)/	Normalized
	Mean		% bias	t	p>t	V(C)	difference[a]
Poverty 1982	62.2%	62.7%	-7	-0.93	0.351	0.96	0.06
Income	9.307	9.309	-0.7	-0.13	0.894	1.09	0.01
Theil Index	0.739	0.746	-9.6	-1.1	0.271	1	0.07
Years of schooling HH	3.875	3.934	-3.7	-0.62	0.536	0.94	0.04
Household size (district average)	4.923	4.904	4.7	0.55	0.581	0.96	-0.03
HH work in agriculture (district average)	48.5%	48.9%	-1.5	-0.18	0.854	0.92	0.01
Demographic dependence (dependent over total)	0.406	0.405	4.5	0.59	0.556	0.99	-0.04
Population density (district)	0.928	1.295	-1.8	-0.72	0.471	0.52*	0.04
% urban area of the district	23.1%	25.8%	-6.6	-0.81	0.418	0.9	0.05
Distance to the closest port	78934	79,611	-1.5	-0.18	0.855	0.87	0.01
Total district area	16084	16797	-2.2	-0.44	0.664	1.02	0.027
Road density	0.097	0.097	-1.4	-0.19	0.846	1.25	0.012
High slope (% district slope >10%)	0.212	0.226	-6.6	-0.77	0.439	1.06	0.046

* If variance ratio outside [0.81; 1.24].

[a] Imbens and Wooldridge (2009) suggest as a rule of thumb a normalized difference less than one quarter.

Table A4. Post-matching covariate balance (genetic matching)

		Mean		t-test			Normalized
Variable	Treated	control	% bias	t	p>t	V(C)	difference [a]
Poverty 1982	0.62238	0.61899	4.7	0.7	0.485	1.14	-0.029
Income	9.3069	9.3078	-0.3	-0.07	0.947	1.19	0.060
Theil Index	0.73927	0.74055	-1.8	-0.22	0.825	1.08	0.078
Years of schooling HH	3.8745	3.8733	0.1	0.02	0.988	1.18	0.084
HH work in agriculture (district average)	0.4851	0.49915	-6	-0.82	0.411	1	-0.002
Demographic dependence (dependent over total)	0.40587	0.40306	9.4	1.41	0.158	1.32*	-0.064
Population density (district)	0.92847	1.6319	-3.4	-1.51	0.131	0.59*	-0.046
% urban area of the district	0.23131	0.20567	6.4	0.87	0.386	1.03	0.064
Distance to the closest port	78934	76710	5	0.68	0.496	1.13	-0.020
Total district area	16084	15818	0.8	0.14	0.887	0.55*	-0.054
Household size (district average)	4.9231	4.9345	-2.8	-0.36	0.719	1.1	0.003
High slope area (% district slope >10%)	0.212	0.205	3.3	0.41	0.68	1.05	0.115

* If variance ratio outside [0.80; 1.25].

[a] Imbens and Wooldridge (2009) suggest as a rule of thumb a normalized difference less than one quarter.

Table A5. Covariate balance tests

Sample	Ps R2	LR chi2	p>chi2	MeanBias	MedBias	B	R	%Var
Unmatched	0.235	264.69	0	41	43.1	107.2*	0.23*	77
Matched (PSM)	0.011	7.75	0.804	4	3.7	24.5	0.78	8
Matched (Genetic matching)	0.012	10	0.547	3.7	3.4	25.8*	0.92	25

* If B>25%, R outside [0.5; 2].

Table A6. Summary of estimated ATT impact under different matching techniques (treatment defined at 3.2% of district area covered by the subsidy)

Period 1982-2002		**Post-matching regressions**	
Matching technique	DID NP	DID	DID+covars 1982
Baseline	0.0139**		
	(0.031)		
PSM	0.0159**	0.0159***	0.0145***
	(0.036)c	(0.014)c	(0.006)c
GenMatching	0.0148***	0.0222***	0.0226***
	(0.003)b	(0.00)b	(0.00)b
IV treatment effect		0.0419**	0.055***
		(0.00)c	(0.00)c
Period 1982-1992		**Post-matching regressions**	
Matching technique	DID NP	DID	DID+covars 1982
Baseline	0.0098***		
	(0.008)		
PSM	0.0288***	0.0288***	0.0283***
	(0.003)c	(0.009)c	(0.009)c
GenMatching	0.0097	0.0192***	0.0216***
	(0.3195)b	(0.003)b	(0.001)b
IV treatment effect		0.0332***	0.0414***
		(0.003)c	(0.024)c

Notes: p-values in parentheses, ***= 99% confidence, **= 95%, * = 90%.
[a] Non-parametric Difference in Difference
[b] Using matching DiD standard error and post-matching regression standard error.
[c] p-value derived from bootstrapped standard errors, 1000 iterations.
[d] Coefficient and p-value of ATT calculated with genetic matching weighting matrix.

Table A7. Summary of estimated ATT impact under different matching techniques (treatment defined at 8.2% of district area covered by the subsidy)

Period 1982-2002		**Post-matching regressions**	
Matching technique	DID NP	DID	DID+covars 1982
Baseline	0.0137**		
	(0.006)		
PSM	0.0204**	0.0204***	0.0185***
	(0.008)c	(0.008)c	(0.007)c
GenMatching	0.0111**	0.0188***	0.0209***
	(0.034)b	(0.000)b	(0.000)b
IV treatment effect		0.0381***	0.0519***
		(0.00) c	(0.003)c
Period 1982-1992		**Post-matching regressions**	
Matching technique	DID NP	DID	DID+covars 1982
Baseline	0.0078		
	(0.008)b		
PSM	0.0124	0.0124	0.0117
	(0.188)c	(0.108)c	(0.109)c
GenMatching	-0.001	0.0064	0.0077
	(0.929)b	(0.413)b	(0.321)b
		sin covars	con covars 1982
IV treatment effect		0.0424**	0.0557**
		(0.005)c	(0.020)c

Notes: p-values in parentheses, ***= 99% confidence, **= 95%, * = 90%.
[a] Non-parametric Difference in Difference
[b] Using matching DiD standard error and post-matching regression standard error.
[c] p-value derived from bootstrapped standard errors, 1000 iterations.
[d] Coefficient and p-value of ATT calculated with genetic matching weighting matrix.

Table A8. Econometric joint validation of instruments (change on poverty vs covariates)

Test	Stat
Underidentification test (Kleibergen-Paap rk LM statistic):	26.203
Chi-sq(2) P-val =	0
Weak identification test (Kleibergen-Paap rk Wald F-stat)	13.298
ref Stock & Yogo (2005): 10% maximal IV size	19.93
15% maximal IV size	11.59
20% maximal IV size	8.75
25% maximal IV size	7.25
Hansen J statistic (overidentification test of all instruments):	0.904
χ-sq(1) P-val =	0.3416

Table A9. Characteristics of income model estimations used in poverty maps

	Number of vars by year of the income model		
Type of variables	1982	1992	2002
Head of the household characteristics	30	35	42
Household characteristics	10	11	29
Housing characteristics	18	21	34
Conglomerate – Fixed Effects	244	353	575
Total	302	420	680
Number of household (census) observations	2,758,154	3,166,172	3,884,852
R^2 of the OLS income estimation	0.542	0.625	0.67
Number of iterations for random allocation of unobserved error[a]	1000	1000	1000

Note: [a] Estimations of the income model using the household surveys (CASEN) contain an error. When we use the model to predict household income using census data, this error is unobserved. Following the approach suggested by Elbers *et al.* (2003), we estimate household level errors and conglomerate level errors. These errors are then randomly assigned to households many times (1000) to have a household-level estimator of income. These Monte Carlo estimates of income are then used to estimate district level indicators of prevalence of poverty.

References

Elbers C, Lanjouw JO and Lanjouw P (2003) Micro-level estimation of poverty and inequality. *Econometrica* **71**, 355–364.

Imbens GW and Wooldridge JM (2009) Recent developments in the econometrics of program evaluation. *Journal of Economic Literature* **47,** 5–86.