

Household fuelwood consumption in western rural China: ethnic minority families versus Han Chinese families

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ONLINE APPENDIX

Appendix A. Estimation models with interaction terms

A1. Off-farm income and quantity of fuelwood consumption: Han Chinese vs. Ethnic minority

Equation (A1) defines the second-stage estimation model (of the Heckit model) to examine the difference in the effect of off-farm income on the quantity of fuelwood consumption between the Han Chinese families and the ethnic minority families.

$$\begin{aligned} \text{Log}(Q_{ij}^{fw}) = & \alpha + \beta_0 \text{Log}(p_j^f) + \beta_1 \text{Log}(p_j^c) + \beta_2 \text{Log}(p_j^e) + \beta_3 \mathbf{I}_{ij} + \beta_4 R_{ij} + \beta_5 A_{ij} + \beta_6 M_{ij} + \\ & \beta_7 R_{ij} * M_{ij} + \boldsymbol{\gamma}_2 \mathbf{H}'_{ij} + \theta * \text{IMR} + \varepsilon_{ij}, \end{aligned} \quad (\text{A1})$$

where R_{ij} is the variable of off-farm income share and M_{ij} is the indicator of ethnic minority status, with all the other variables the same as defined in section 4 of the main text. To interpret estimation result of the parameters, $\widehat{\beta}_4$ represents the partial effect of a 1 per cent change in off-farm income share on fuelwood consumption in the Han Chinese families; and the partial effect for the ethnic minority families is given by $\widehat{\beta}_4 + \widehat{\beta}_7$.

Furthermore, to examine the heterogeneous effect of local and migrant off-farm income on the quantity of fuelwood consumption, we disaggregate off-farm income into local and migrant off-farm income share, as R_{ij}^{local} and $R_{ij}^{migrant}$. The interaction terms between each of the two variables and the minority status are added to the estimation model in a similar way, defined as equation (A2):

$$\begin{aligned} \text{Log}(Q_{ij}^{fw}) = & \alpha + \beta_0 \text{Log}(p_j^f) + \beta_1 \text{Log}(p_j^c) + \beta_2 \text{Log}(p_j^e) + \beta_3 \mathbf{I}_{ij} + \beta_{41} R_{ij}^{local} + \beta_{42} R_{ij}^{migrant} + \\ & \beta_5 A_{ij} + \beta_6 M_{ij} + \beta_{71} R_{ij}^{local} * M_{ij} + \beta_{72} R_{ij}^{migrant} * M_{ij} + \boldsymbol{\gamma}_2 \mathbf{H}'_{ij} + \theta * \text{IMR} + \varepsilon_{ij}. \end{aligned} \quad (\text{A2})$$

Similarly, $\widehat{\beta}_{41}$ ($\widehat{\beta}_{42}$) represents the partial effect of a 1 per cent change in local (migrant) off-farm income share on fuelwood consumption in the Han Chinese families; and the partial effect of local (migrant) off-farm income share for the ethnic minority families is given by

$$\widehat{\beta}_{41} + \widehat{\beta}_{71} (\widehat{\beta}_{42} + \widehat{\beta}_{72}).$$

A2. Forestland ownership and quantity of fuelwood consumption: Han Chinese vs. Ethnic minority

Next, equation (A3) defines the second-stage estimation model (of the Heckit model) to examine the difference in the effect of household-owned forest resources on the quantity of fuelwood consumption between the Han Chinese families and the ethnic minority families.

Thus

$$\begin{aligned} \text{Log}(Q_{ij}^{fw}) = & \alpha + \beta_0 \text{Log}(p_j^f) + \beta_1 \text{Log}(p_j^e) + \beta_2 \text{Log}(p_j^e) + \beta_3 I_{ij} + \beta_4 R_{ij} + \beta_5 A_{ij} + \beta_6 M_{ij} + \\ & \beta_8 A_{ij} * M_{ij} + \gamma_2 H'_{ij} + \theta * IMR + \varepsilon_{ij}, \end{aligned} \quad (\text{A3})$$

where A_{ij} is the area of household-owned forestland and M_{ij} is the indicator of ethnic minority status as before. $\widehat{\beta}_5$ represents the partial effect of a 1 per cent change in the area of owned forestland on fuelwood consumption in the Han Chinese families; and the partial effect for the ethnic minority families is given by $\widehat{\beta}_5 + \widehat{\beta}_8$.

Appendix B. Tables

Table A1. Sample distribution

Province	County	Village	Household
Yunnan	Shuangbai	3	32
	Weishan	3	30
	Ninglang	3	30
	Shangri-La	2	20
	Ning'er	3	30
	Shizong	3	30
	Qiubei	3	30
Gansu	Lintan	6	60
	Zhouqu	3	30
	Diebu	3	30
Total		32	322

Source: Household and village survey in Gansu and Yunnan, conducted by Peking University in August 2013.

Table A2. Household off-farm employment

	Total	The Han Chinese	Ethnic minority group	Difference	Obs.
Total off-farm members (%)	0.364 (0.192)	0.375 (0.197)	0.352 (0.187)	0.023 (0.025)	228
Total off-farm workdays	211.108 (96.429)	216.885 (93.053)	204.690 (100.089)	12.195 (12.793)	228
Local off-farm members (%)	0.327 (0.190)	0.331 (0.208)	0.324 (0.172)	0.008 (0.036)	113
Local off-farm workdays per person	185.791 (103.294)	193.961 (103.364)	178.043 (103.525)	15.918 (19.470)	159
Migrant off-farm members (%)	0.301 (0.138)	0.324 (0.147)	0.272 (0.119)	0.053** (0.022)	113
Migrant off-farm workdays per person	228.790 (96.840)	221.811 (98.975)	237.564 (94.116)	-15.754 (15.012)	158

Notes: Asterisks indicate *t*-test result of differences between the two groups, with standard deviations in parentheses in columns 2-4, and standard errors in parentheses in column 5.

Source: Authors' computation from the household survey data in Gansu and Yunnan, conducted by Peking University in August 2013.

Table A3. Fuelwood consumption and forestland ownership

Dependent variable: log of fuelwood consumption	Heckit approach		
	First-stage	Second-stage	Second-stage
Ln (fuelwood price)	0.255 (0.158)	0.110 (0.219)	0.150 (0.230)
Ln (coal price)	1.600 (1.135)	1.121** (0.489)	1.124** (0.500)
Ln (electricity price)	2.666* (1.381)	-0.134 (0.411)	-0.088 (0.418)
County distance	0.003 (0.004)	0.002 (0.002)	0.002 (0.002)
Male head	-0.216 (0.303)		
Head's age	0.009 (0.008)	0.011** (0.005)	0.011** (0.005)
Head with high school education	0.121 (0.150)	-0.359* (0.194)	-0.338* (0.200)
Ln (household size)	-0.149 (0.242)	0.317** (0.161)	0.283* (0.149)
Labor force ratio	-0.534 (0.339)	-0.272 (0.363)	-0.246 (0.363)
Ln (cropland area per capita)	0.081 (0.142)	0.021 (0.100)	0.029 (0.102)
Ln (Total value of houses)	0.101 (0.075)	0.129** (0.055)	0.109* (0.057)
Ln (forestland area per capita) (b_5)	0.198*** (0.069)	0.075* (0.046)	0.135** (0.067)
Ethnic minority family	0.586** (0.268)	0.143 (0.192)	0.430 (0.372)
Ln (forestland area per capita) * Minority (b_8)			-0.102 (0.091)
Inverse Mills ratio		0.003 (0.157)	0.021 (0.162)
Test: (<i>p</i> -value)			
b_5 + b_8 = 0			0.603
Log pseudolikelihood		-473.303	-472.441
Wald test of indep. eqns. (rho = 0): <i>p</i> -value		0.985	0.898
Observations	322	322	322

Notes: This specification controls for household income level by using the natural log of total value of the house(s) owned by the household instead of per capita income. Constant is not reported, and standard errors in parentheses are clustered at the village level. Significance is denoted by *** for $p < 0.01$, ** for $p < 0.05$, and * for $p < 0.1$.

Table A4. Household perception on forestland tenure rights

	Total	Han	Minority	Difference	Obs.
1. Right to mortgage forest certificate	0.398 (0.491)	0.391 (0.490)	0.406 (0.493)	-0.016 (0.061)	256
2. If no certificate, right to mortgage land or crop	0.152 (0.360)	0.156 (0.365)	0.148 (0.357)	0.008 (0.045)	256
3. Right to change land use	0.441 (0.498)	0.414 (0.494)	0.469 (0.501)	-0.055 (0.062)	256
4. Right to decide tree species	0.684 (0.466)	0.609 (0.490)	0.758 (0.430)	-0.148 (0.058)	256
5. Right to harvest non-forest products	0.875 (0.331)	0.859 (0.349)	0.891 (0.313)	-0.031 (0.041)	256
6. Right to transfer land to other villagers	0.477 (0.500)	0.438 (0.498)	0.516 (0.502)	-0.078 (0.062)	256
7. Right to transfer land to outside villagers	0.348 (0.477)	0.336 (0.474)	0.359 (0.482)	-0.023 (0.060)	256
8. Right to abandon land	0.375 (0.485)	0.359 (0.482)	0.391 (0.490)	-0.031 (0.061)	256
9. Right to inherit	0.902 (0.297)	0.875 (0.332)	0.930 (0.257)	-0.055 (0.037)	256
Sum of the nine rights	4.652 (2.247)	4.438 (2.377)	4.867 (2.098)	-0.430 (0.280)	256

Notes: Each right dummy variable with value 1 if yes, and 0 if otherwise. Standard deviations are in parentheses from columns 2-4, and *t*-test/proportion-test results of differences between the two groups with standard errors in parentheses are reported in column 5.

Source: Authors' computation from the household survey data in Gansu and Yunnan, conducted by Peking University in August 2013.

Table A5. Probit regression results on electricity choice

Dependent variable: Whether or not use electricity	Coefficient
	-0.082
Ln (fuelwood price)	(0.143)
	0.829*
Ln (coal price)	(0.502)
	-0.600
Ln (electricity price)	(0.612)
	-0.003
County distance	(0.003)
	-0.208
Male head	(0.399)
	-0.016
Head's age	(0.012)
	0.303
Head with high school education	(0.225)
	-0.179
Ln (household size)	(0.303)
	-0.098
Labor force ratio	(0.413)
	0.025
Ln (cropland area per capita)	(0.111)
	0.741
Ln (household per capita income)	(1.743)
	-0.025
Ln (household per capita income) squared	(0.082)
	0.178
Off-farm income ratio	(0.359)
	-0.016
Ln (forestland area per capita)	(0.058)
	-0.186
Ethnic minority family	(0.258)
Log pseudolikelihood	-136.436
Pseudo-R ²	0.092
Observations	322

Notes: Constant is not reported, and standard errors in parentheses are clustered at the village level. Significance is denoted by * for $p < 0.1$.

Table A6. Distribution of the main ethnic minority groups

Family of Ethnic Minority Group of:	Mean	Standard Deviation
Tibetan people	0.220	0.415
Yi people	0.137	0.344
Zhuang people	0.093	0.291
Other minority groups	0.059	0.236

Source: Household survey in Gansu and Yunnan, conducted by Peking University in August 2013.

Table A7. Heterogeneity of fuelwood consumption across ethnic groups

Dependent variable: log of fuelwood consumption	Heckit approach			
	First-stage	Second-stage	Second-stage	Second-stage
Ln (fuelwood price)	0.251 (0.170)	0.112 (0.272)	0.139 (0.284)	0.147 (0.293)
Ln (coal price)	1.532 (0.946)	1.118 (0.704)	1.164* (0.707)	1.151 (0.722)
Ln (electricity price)	3.034*** (1.063)	-0.020 (0.440)	-0.137 (0.456)	0.075 (0.450)
County distance	-0.002 (0.003)	-0.000 (0.002)	-0.000 (0.002)	-0.000 (0.002)
Male head	0.026 (0.282)			
Head's age	0.012* (0.007)	0.012** (0.006)	0.011* (0.006)	0.012** (0.005)
Head with high school education	0.236 (0.160)	-0.289* (0.173)	-0.265* (0.153)	-0.285 (0.185)
Ln (household size)	-0.401 (0.247)	0.435* (0.171)	0.407** (0.160)	0.392* (0.169)
Labor force ratio	-0.301 (0.398)	0.180 (0.301)	0.086 (0.285)	0.274 (0.279)
Ln (cropland area per capita)	0.207 (0.140)	0.006 (0.105)	0.018 (0.101)	0.020 (0.104)
Ln (household per capita income)	-0.185 (1.246)	-1.561 (1.027)	-1.460 (0.984)	-1.767* (0.953)
Ln (household per capita income) squared	0.006 (0.061)	0.077 (0.050)	0.073 (0.048)	0.084* (0.046)
Off-farm income ratio (b_4)	-0.063 (0.339)	-0.679*** (0.236)	-0.352 (0.293)	-0.626** (0.255)
Ln (forestland area per capita) (b_5)	0.274*** (0.078)	0.124** (0.052)	0.130*** (0.050)	0.138* (0.085)
Tibetan family (b_61)	1.954*** (0.383)	0.540* (0.283)	0.695** (0.311)	0.689* (0.402)
Yi family (b_62)	-0.082 (0.381)	-0.134 (0.215)	0.338* (0.191)	-1.468** (0.617)

Zhuang family (b_63)	-0.394 (0.430)	-0.222 (0.436)	-0.569 (0.358)	1.142 (0.700)
Other ethnic family (b_64)	-0.044 (0.447)	0.112 (0.375)	0.378 (0.312)	0.530 (0.442)
Off-farm income ratio * Tibetan (b_71)			-0.432 (0.387)	
Off-farm income ratio * Yi (b_72)			-1.479*** (0.496)	
Off-farm income ratio * Zhuang (b_73)			1.496 (1.103)	
Off-farm income ratio * Other ethnic minority group (b_74)			-0.697 (0.690)	
Ln (forestland area per capita) * Tibetan (b_81)				-0.091 (0.104)
Ln (forestland area per capita) * Yi (b_82)				0.327** (0.134)
Ln (forestland area per capita) * Zhuang (b_83)				-0.444*** (0.155)
Ln (forestland area per capita) * Other ethnic minority group (b_84)				-0.126 (0.120)
Inverse Mills ratio		0.030 (0.091)	0.006 (0.084)	0.034 (0.077)
Test: (<i>p</i> -value)				
b_4 + b_71 = 0			0.005	
b_4 + b_72 = 0			0.0001	
b_4 + b_73 = 0			0.282	
b_4 + b_74 = 0			0.123	
b_5 + b_81 = 0				0.388
b_5 + b_82 = 0				0.0003
b_5 + b_83 = 0				0.031
b_5 + b_84 = 0				0.912
Household and head characteristics	Yes	Yes	Yes	Yes
Village characteristics	Yes	Yes	Yes	Yes
Log pseudolikelihood		-444.636	-441.953	-440.394
Wald test of indep. eqns. (rho = 0): <i>p</i> -value		0.746	0.941	0.659

Observations	322	322	322	322
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Notes: The same set of household and head characteristics, as well as village energy prices and other characteristics as in table 3, are controlled for. Constant is not reported, and standard errors in parentheses are clustered at the village level. Significance is denoted by *** for $p < 0.01$, ** for $p < 0.05$, and * for $p < 0.1$.

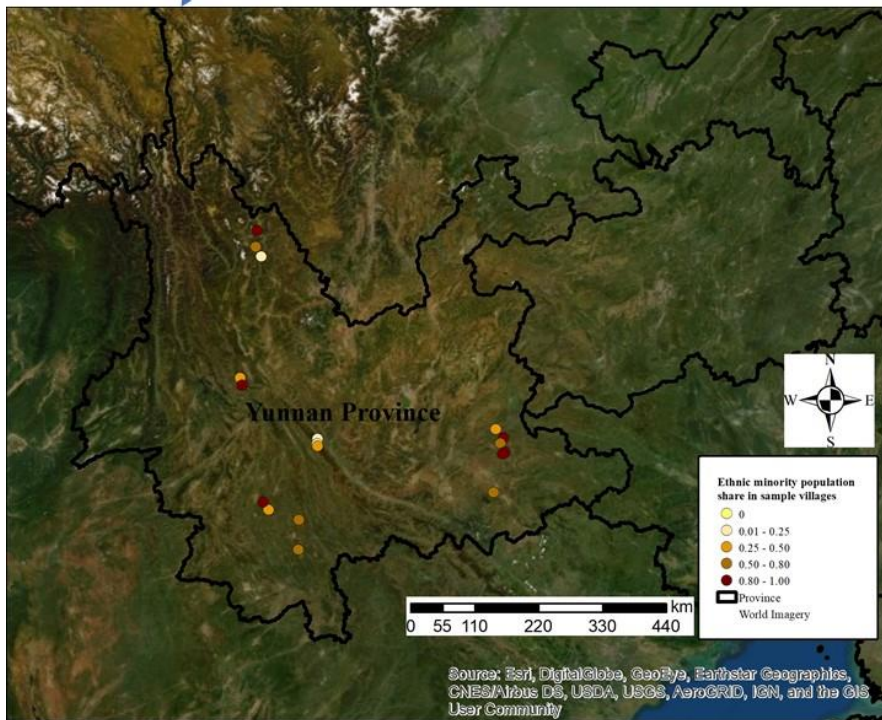
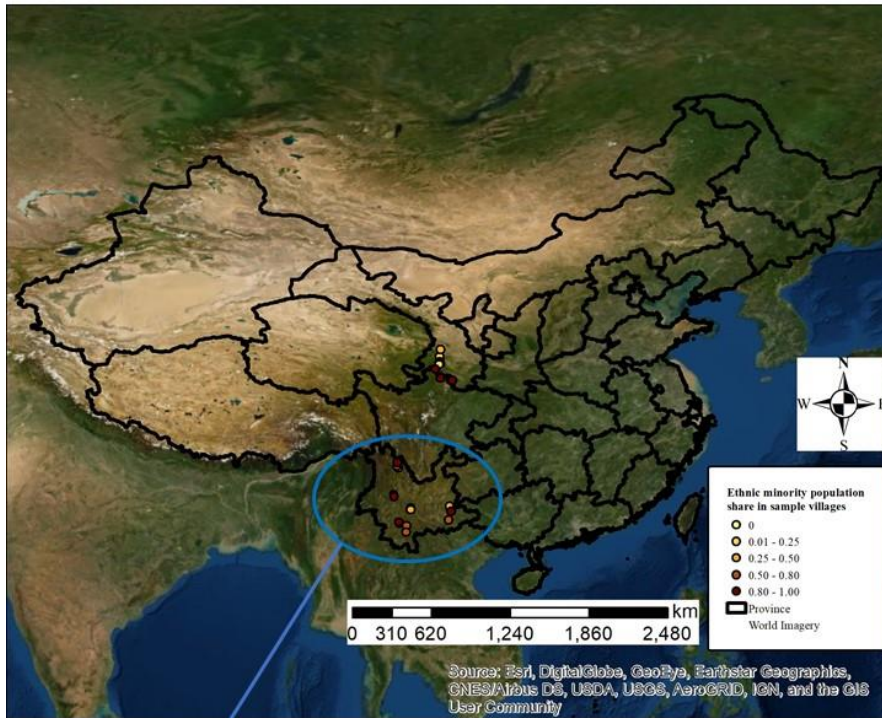


Figure A1. Sample villages and ethnic minority population.

Source: Authors' own compilation based on data from the village survey in Gansu and Yunnan, conducted by Peking University in August 2013.