

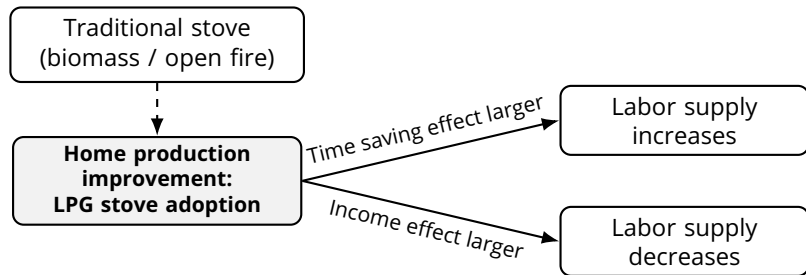
Clean Energy Access and Home Production Improvement: Labor Supply and Gender Difference

Kyungtae (Tae) Lee

CUNY Graduate Center

ASSA 2026 — IAEE Session

Home Production & Labor Supply



- Time saving Effect: Productivity home production $\uparrow$ $\rightarrow$ save time by reducing home work time spending $\rightarrow$ labor supply $\uparrow$
- Income Effect: Household has more resources with free time $\rightarrow$ real income $\uparrow$ $\rightarrow$ labor supply $\downarrow$.

Cooking Technology



Traditional Stove



LPG Stove

Research Questions

Main question

- What is the impact of the home production improvement on the men's and women's labor supply?

Sub-questions

- How do men and women reallocate time?
- *Extensive margin*: What is the impact on employment?
- *Intensive margin*: What is the impact on workdays per year?
- Heterogeneity: Do effects vary across household expenditure quintiles?

Contributions

- **Home production channel:** (Afridi et al., 2018; Chiappori, 1997; Apps and Rees, 1997)
 - Provides new causal evidence that improvements in home production technology (LPG cookstoves) can generate **opposite-signed labor-supply responses** for men and women.
- **Modern energy access:** (Berkouwer and Dean, 2022; Hanna et al., 2016; Verma and Imelda, 2022; Dinkelman, 2011; Greenwood et al., 2005; Afridi et al., 2023; Shen et al., 2025; Li and Zhou, 2023; Su and Azam, 2023)
 - Expands the literature on clean energy and labor supply by showing gender-differentiated labor responses to LPG adoption.
- **Working women puzzle:** (Afridi et al., 2018; Fukui et al., 2023)
 - Providing empirical evidence of women's labor supply decrease with modern energy access.

Main Findings

Men

- **Substitution Effect** > Income Effect
- Employment ↑ **13 p.p.**
- Workdays ↑ **20 days/year**
- Time in fuel/cooking ↓

Women

- Substitution Effect < **Income Effect**
- Employment ↓ **31 p.p.**
- Workdays ↓ **20 days/year**
- Saved time reallocated to unpaid domestic work

Data

Multi-Tier Framework (MTF) Survey – Nepal, 2017

- Cross-sectional, nationally representative (~ 6,000 households).
- Household survey with individual-level information.
- Rich data on energy access, stove type, and time use.

Geographic data: GADM(Global Administrative Areas)

- Average land slope from GADM (municipality level).
- Linked to MTF data via province–district–municipality identifiers.

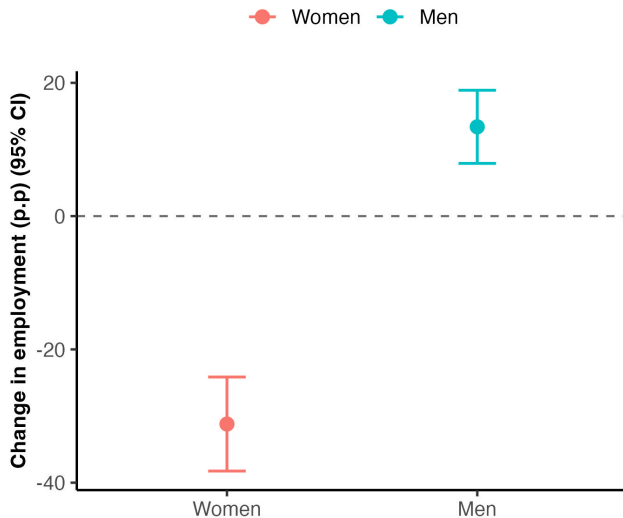
Empirical Strategy

- **Identification:** Control-function IV framework using average land slope as an instrument for LPG adoption.
- **Endogeneity:** Households self-select into LPG based on accessibility, income, or preferences.
- **Models:**
 - **Time use (HH-level):** IV-Tobit for censored time outcomes.
 - **Employment (Extensive margin):** IV-Probit for binary outcome.
 - **Workdays (Intensive margin):** IV-Linear for continuous outcome.

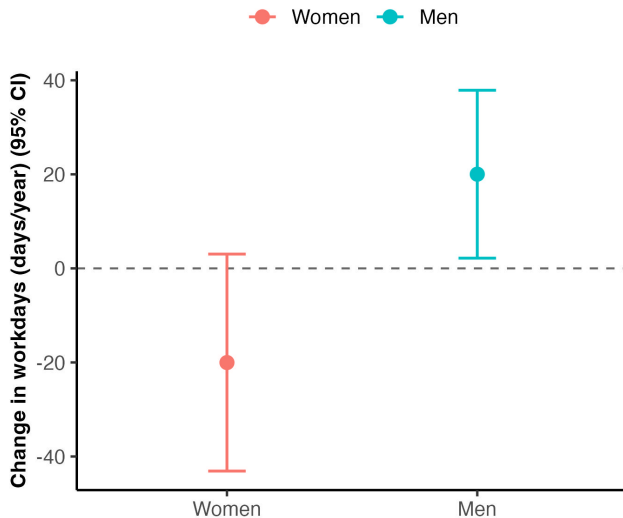
IV Strategy

Empirical Strategy

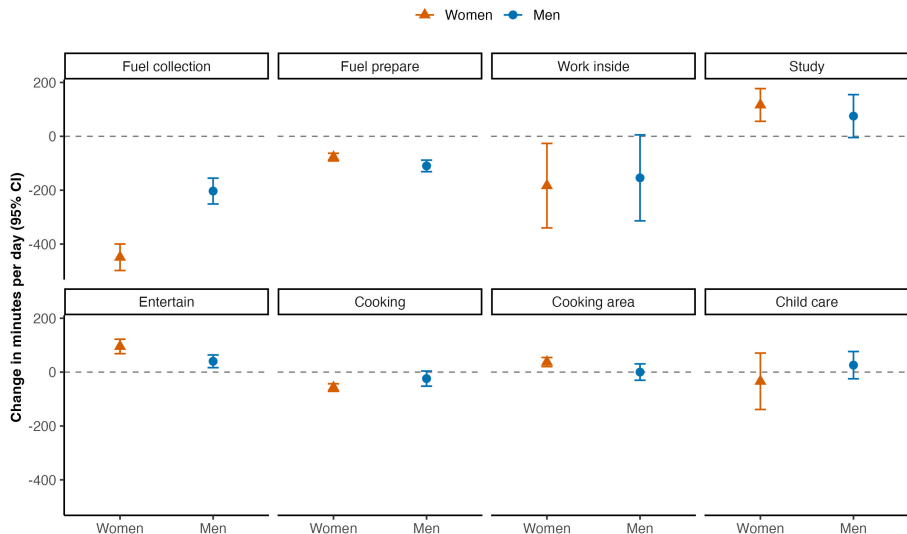
Employment (Average Marginal Effect)



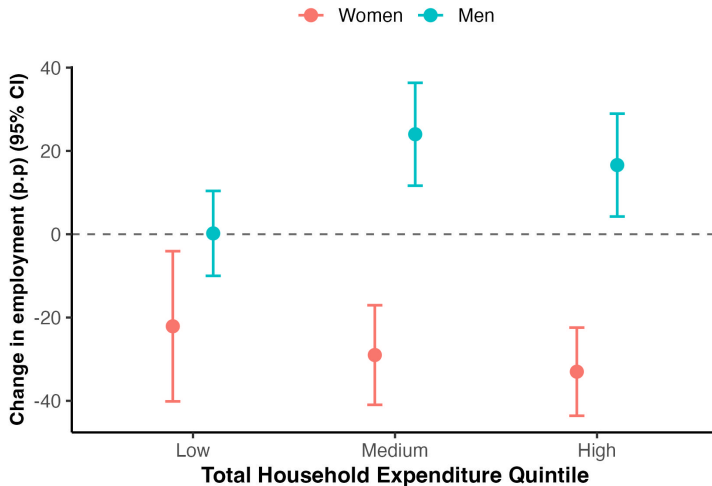
Work Days per Year



Time Allocation (Minutes/Day)



Heterogeneity by Household Expenditure Quintile



Policy Implications

- Home production improvement increases welfare, but **may not increase women's labor supply**.
- Clean energy stove adoption alone may not be sufficient for women's economic empowerment.
- Need complementary policies:
 - Promote **female-oriented industries** and job opportunities.
 - Incentivize employers to **hire women**.
 - Address structural **labor market inequality** and constraints on women's work.
- Home production technological improvements must be paired with labor market reforms to achieve **gender equity**.

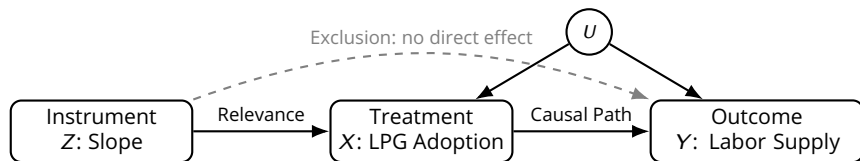
Appendix: Empirical Strategy

$$Y_{ihj} = \gamma_0 + \gamma_1 T_{ihj} + M'_{ihj}\gamma_2 + \hat{r}_{ihj} + u_{ihj} \quad (1)$$

- Y_{ihj} - Outcome variable:
 - Time allocation (household level, Tobit model)
 - Employment (extensive margin, IV-Probit)
 - Workdays (intensive margin, IV-Linear)
- T_{ihj} — LPG adoption indicator (endogenous).
- M_{ihj} — vector of household and individual controls.
- $\hat{r}_{ihj}$ — generalized residual from the first-stage (control-function correction).
- u_{ihj} — error term.

IV logic: same specification across outcomes; only functional form differs (Tobit, Probit, Linear).

Appendix: IV Strategy (Compact Diagram)



Back

Appendix: Theoretical Derivation

Total labor supply for member i :

$$l_i = T - L_i(w_i, s_i^*) - t_i(w_1, w_2, A)$$

Differentiating w.r.t. A :

$$\frac{\partial l_i}{\partial A} = -\frac{\partial L_i}{\partial s_i^*} \frac{\partial s_i^*}{\partial A} - \frac{\partial t_i}{\partial A}$$

Since $\frac{\partial t_i}{\partial A} < 0$, $\frac{\partial s_i^*}{\partial A} > 0$, and $\frac{\partial L_i}{\partial s_i^*} > 0$, the first term is negative (income effect) and the second is positive (time-saving effect). The net effect of improved home technology on labor supply is ambiguous.

back

Table: Work Outside Minutes per Day

	Work outside-women			Work outside-men		
	OLS	2Sls	IV-Tobit	OLS	2Sls	IV-Tobit
LPG	5.962 (7.229)	-64.412* (36.659)	-67.967 (61.318)	2.513 (10.363)	337.504*** (52.170)	163.636*** (39.408)
Total expenditure (Dollar)	0.006 (0.006)	0.011* (0.007)	0.018 (0.016)	0.019** (0.008)	-0.007 (0.010)	0.010 (0.010)
Urban	-34.203*** (5.784)	-22.158*** (8.188)	-118.352*** (20.752)	-27.384*** (8.100)	-85.835*** (12.444)	-81.373*** (13.231)
Bank account own	10.768* (6.402)	23.408** (9.112)	39.866* (22.446)	12.403 (9.008)	-49.974*** (13.974)	-17.381 (14.634)
Household size	-4.779* (2.787)	-7.531** (3.105)	-17.743** (9.009)	4.378 (3.840)	18.082*** (4.819)	15.001*** (5.692)
Stove burner number	-21.165*** (6.444)	-2.642 (11.129)	-73.677*** (23.594)	34.281*** (7.939)	-49.914*** (15.871)	2.678 (14.821)
Age (HH head)	0.473* (0.285)	0.679** (0.311)	1.561* (0.827)	-0.602* (0.364)	-1.644*** (0.429)	-1.630*** (0.532)
Gender (HH head)	35.538*** (8.776)	42.369*** (9.342)	102.098*** (24.765)	-13.664 (13.114)	-46.636*** (15.285)	-39.816** (17.961)
Educ year (HH head)	0.343 (0.699)	1.401 (0.887)	1.585 (2.318)	-0.771 (0.933)	-5.687*** (1.307)	-3.470** (1.453)
Elevation	0.017*** (0.003)	0.011*** (0.004)	0.052*** (0.011)	-0.044*** (0.004)	-0.021*** (0.006)	-0.050*** (0.007)
Self emp (HH head)	22.604*** (5.720)	19.971*** (5.827)	100.881*** (17.926)	-2.813 (7.682)	7.880 (8.976)	5.430 (11.124)
Non farm emp (HH head)	15.411** (6.782)	23.563*** (7.982)	33.725 (21.312)	78.689*** (8.937)	38.243*** (11.806)	86.104*** (13.231)
Age (main cook)	-0.159 (0.275)	-0.121 (0.276)	-0.117 (0.769)	-0.696* (0.362)	-0.931** (0.401)	-0.952* (0.496)
Women number	38.832*** (5.072)	41.284*** (5.205)	102.985*** (14.057)	3.752 (6.643)	-8.011 (7.514)	-4.854 (8.831)
Men number	-1.504 (4.174)	-0.779 (4.192)	-6.116 (13.150)	53.826*** (6.567)	50.270*** (7.196)	64.989*** (8.277)
Kids number	-5.431 (4.939)	-5.773 (4.981)	-12.547 (15.162)	4.039 (7.292)	4.486 (8.055)	0.927 (9.573)
Generalized residual			38.354 (37.182)			-109.384*** (23.902)
Constant	35.880 (56.623)	-27.324 (64.575)	-472.116*** (161.366)	203.086*** (72.662)	495.874*** (83.746)	256.044** (99.988)
Fuel availability	Yes	Yes	Yes	Yes	Yes	Yes
House quality	Yes	Yes	Yes	Yes	Yes	Yes
N	4905	4905	4905	4525	4525	4525

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table: Time Allocation Effects of LPG Adoption (Women)

	(1) IV Tobit Work Inside	(2) IV Tobit Fuel collection	(3) IV Tobit Fuel preparation	(4) IV Tobit Cooking	(5) IV Tobit Cooking area	(6) IV Tobit Childcare	(7) IV Tobit Study	(8) IV Tobit Entertain
LPG	-183.109** (80.020)	-448.887*** (25.094)	-77.136*** (7.243)	-57.284*** (7.174)	37.325*** (8.614)	-34.033 (53.426)	116.499*** (30.972)	95.351*** (13.722)
Total HH Expenditure (USD)	0.066*** (0.020)	0.009 (0.007)	0.004** (0.002)	0.007*** (0.002)	0.008*** (0.002)	0.005 (0.015)	0.001 (0.008)	0.010*** (0.004)
Urban	52.429* (27.392)	8.128 (7.881)	1.652 (2.239)	4.459* (2.382)	-2.686 (2.844)	3.049 (17.727)	33.842*** (10.322)	-14.194*** (4.588)
Bank Account Own	108.454*** (29.980)	25.108*** (8.569)	-8.466*** (2.427)	-0.521 (2.609)	1.352 (3.136)	27.805 (19.458)	-6.218 (11.305)	22.148*** (5.018)
Household Size	12.377 (11.498)	2.626 (3.432)	2.896*** (0.971)	3.702*** (1.028)	3.897*** (1.216)	31.510*** (7.399)	57.587*** (4.396)	-5.235*** (1.983)
Stove Burner Number	56.497* (31.420)	42.096*** (9.154)	9.280*** (2.590)	-1.649 (2.757)	2.991 (3.273)	39.079* (20.207)	-33.282*** (11.961)	-10.419* (5.341)
Age (HH head)	-0.582 (1.106)	0.244 (0.326)	0.164* (0.094)	0.147 (0.095)	-0.008 (0.111)	0.707 (0.693)	-0.876** (0.404)	0.209 (0.182)
Gender (HH head)	95.210*** (32.841)	33.581*** (10.134)	-0.836 (2.986)	-5.486* (2.896)	-11.579*** (3.500)	-6.830 (22.149)	-3.947 (12.390)	-1.980 (5.527)
Educ Years (HH head)	2.780 (2.988)	0.168 (0.943)	-0.036 (0.272)	0.509* (0.266)	-1.146*** (0.315)	1.231 (1.993)	3.867*** (1.116)	0.827* (0.502)
Self-Employed (HH head)	92.887*** (23.752)	2.785 (6.959)	3.001 (1.995)	4.874** (2.037)	6.628*** (2.435)	27.982* (15.330)	11.662 (8.748)	22.296*** (3.900)
Non-Farm Employed (HH head)	156.945*** (27.687)	27.059*** (8.469)	-1.016 (2.433)	-4.323* (2.441)	-2.716 (2.897)	-21.060 (18.424)	-13.916 (10.493)	-17.221*** (4.637)
Age (main cook)	-0.704 (1.057)	-0.835*** (0.309)	-0.171* (0.088)	-0.136 (0.090)	-0.296*** (0.105)	-7.001*** (0.684)	-2.097*** (0.400)	-0.397** (0.171)
Women Number	25.357 (17.741)	11.378** (5.556)	-1.874 (1.595)	4.024** (1.616)	11.485*** (1.882)	-2.889 (11.996)	16.828*** (6.413)	18.141*** (3.068)
Men Number	2.665 (16.641)	-11.917** (5.127)	-3.845*** (1.478)	2.679* (1.492)	1.525 (1.747)	-59.990*** (11.477)	-63.327*** (6.398)	13.013*** (2.831)
Kids Number	-29.288 (19.651)	-19.139*** (5.820)	-0.252 (1.638)	1.095 (1.732)	0.012 (2.044)	352.925*** (12.116)	-47.386*** (7.038)	-3.801 (3.342)
Elevation	0.095*** (0.014)	0.041*** (0.004)	0.005*** (0.001)	-0.003*** (0.001)	-0.006*** (0.002)	0.009 (0.009)	-0.010* (0.006)	-0.003 (0.002)
Generalized Residual	170.750*** (48.614)	139.905*** (14.803)	12.745*** (4.279)	19.012*** (4.356)	-18.173*** (5.222)	44.674 (32.177)	-48.303** (18.884)	-38.559*** (8.315)
Constant	-1025.454*** (183.824)	99.105* (57.119)	49.510*** (15.637)	64.018*** (18.083)	51.177** (19.915)	-427.061*** (123.714)	-249.949*** (78.039)	-116.955*** (43.939)
Fuel availability	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
House quality	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	4905	4905	4905	4905	4905	4905	4905	4905

Sample includes the household has at least one adult women. Standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table: Time Allocation Effects of LPG Adoption (Men)

	(1) IV Tobit Paid work	(2) IV Tobit Fuel collection	(3) IV Tobit Fuel preparation	(4) IV Tobit Cooking	(5) IV Tobit Cooking area	(6) IV Tobit Childcare	(7) IV Tobit Study	(8) IV Tobit Leisure
LPG	-154.170* (81.458)	-203.190*** (24.445)	-109.812*** (10.956)	-24.133* (14.298)	0.170 (15.505)	25.896 (25.806)	75.151* (40.669)	40.146*** (12.037)
Total HH Expenditure (USD)	0.036* (0.021)	0.007 (0.007)	-0.004 (0.003)	0.002 (0.004)	0.005 (0.004)	0.002 (0.007)	0.013 (0.010)	0.007** (0.003)
Urban	47.276* (27.494)	-25.111*** (8.027)	-0.737 (3.365)	13.594*** (5.085)	12.173** (5.728)	6.254 (8.667)	25.563* (13.688)	-17.484*** (4.052)
Bank Account Own	96.631*** (30.603)	4.311 (8.902)	-10.315*** (3.681)	-15.059*** (5.495)	-3.075 (6.147)	3.004 (9.542)	-36.807*** (15.082)	23.756*** (4.458)
Household Size	-6.986 (11.929)	7.177** (3.473)	0.942 (1.468)	-1.488 (2.183)	-0.321 (2.407)	10.097*** (3.603)	53.216*** (5.874)	-9.553*** (1.760)
Stove Burner Number	18.870 (31.231)	11.427 (9.032)	10.805*** (3.732)	4.071 (5.291)	8.895 (5.796)	-7.139 (9.499)	-22.608 (15.340)	-8.412* (4.582)
Age (HH head)	-0.279 (1.129)	-0.380 (0.328)	-0.118 (0.142)	0.021 (0.205)	0.283 (0.219)	0.136 (0.341)	-1.057* (0.562)	0.053 (0.162)
Gender (HH head)	25.120 (38.585)	-22.978** (11.449)	-1.499 (5.156)	5.838 (6.924)	3.779 (7.583)	-2.539 (12.257)	89.287*** (18.260)	6.365 (5.377)
Educ Years (HH head)	3.725 (3.045)	-2.977*** (0.918)	-0.298 (0.408)	0.577 (0.560)	0.265 (0.603)	-0.353 (0.967)	7.306*** (1.494)	0.688 (0.441)
Self-Employed (HH head)	227.412*** (25.081)	15.453** (6.913)	10.481*** (2.991)	20.619*** (4.374)	-3.365 (4.861)	35.496*** (7.449)	36.905*** (11.657)	19.327*** (3.405)
Non-Farm Employed (HH head)	74.298*** (27.786)	-2.967 (8.260)	-1.159 (3.608)	-2.648 (5.117)	14.486** (5.625)	-23.928*** (8.974)	-9.419 (13.726)	-11.754*** (4.041)
Age (main cook)	-0.748 (1.065)	-0.570* (0.305)	-0.267** (0.132)	0.345* (0.190)	0.004 (0.206)	-2.679*** (0.333)	-1.244** (0.536)	-0.168 (0.150)
Women Number	21.143 (18.262)	-7.651 (5.472)	0.366 (2.389)	-18.615*** (3.536)	-7.276* (3.817)	-13.145** (5.900)	-68.340*** (9.153)	10.897*** (2.697)
Men Number	51.347*** (16.998)	6.143 (5.114)	6.735*** (2.194)	12.655*** (3.182)	9.368*** (3.506)	-16.984*** (5.686)	43.821*** (7.970)	24.457*** (2.526)
Kids Number	4.338 (19.858)	-8.942 (5.849)	-1.194 (2.464)	-4.280 (3.758)	0.952 (4.128)	102.085*** (5.944)	-70.774*** (9.948)	-0.184 (2.952)
Elevation	0.079*** (0.014)	0.033*** (0.004)	0.012*** (0.002)	0.042*** (0.003)	0.030*** (0.003)	0.018*** (0.007)	-0.000 (0.001)	0.001 (0.002)
Generalized Residual	116.547** (49.241)	76.519*** (14.812)	19.723*** (6.424)	7.856 (8.695)	12.180 (9.310)	-11.476 (15.628)	-56.128** (24.889)	-17.054** (7.314)
Constant	-744.483*** (186.311)	200.551*** (57.182)	10.437 (22.758)	-98.921*** (30.990)	-107.536*** (31.131)	-45.692 (54.929)	-515.205*** (101.852)	-67.680** (33.095)
Fuel availability	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
House quality	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	4525	4525	4525	4525	4525	4525	4525	4525

Sample includes the household has at least one adult men. Standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Extensive Margin - Employment

	(1)	(2)	(3)	(4)
	Female		Male	
	LPM	IV	LPM	IV
<i>Dependent variable: Employment</i>				
LPG	-0.090*** (0.017)	-0.944*** (0.133)	0.043*** (0.012)	0.905*** (0.181)
Total HH Expenditure(Dollar)	-0.000*** (0.000)	-0.000* (0.000)	-0.000 (0.000)	-0.000*** (0.000)
Married	-0.086*** (0.027)	-0.221*** (0.072)	0.149*** (0.021)	0.551*** (0.084)
Urban	-0.039*** (0.014)	0.022 (0.043)	-0.035*** (0.010)	-0.385*** (0.070)
Bank Account Own	-0.030* (0.016)	0.066 (0.055)	-0.019* (0.011)	-0.292*** (0.095)
Household Size	0.002 (0.003)	-0.009 (0.010)	0.001 (0.002)	0.025* (0.014)
Stove Burner Number	-0.104*** (0.015)	-0.092 (0.061)	-0.021** (0.009)	-0.305*** (0.071)
House Quality	0.068*** (0.013)	0.263*** (0.038)	-0.009 (0.007)	-0.124** (0.055)
Age	0.004*** (0.001)	0.014*** (0.003)	0.004*** (0.001)	0.023*** (0.005)
Educ year	0.013*** (0.002)	0.050*** (0.005)	-0.000 (0.001)	-0.010 (0.007)
Kids Number	-0.011 (0.010)	-0.047 (0.029)	0.018*** (0.007)	0.117** (0.050)
HH Head	0.149*** (0.023)	0.405*** (0.063)	0.050*** (0.011)	0.423*** (0.086)
Cons	0.285*** (0.095)	-1.522 (1.335)	0.488*** (0.108)	0.019 (0.440)
Generalized Residual		0.467*** (0.077)		-0.432*** (0.108)
Availability	Yes	Yes	Yes	Yes
Cook Frequency	Yes	Yes	Yes	Yes
N	5155	5155	4114	4114

Control-function estimation is employed. The generalized residual is obtained from the first-stage probit model. Standard errors are bootstrapped with 800 replications and reported in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table: Extensive Margin Quintile

	(1)	(2) Female Quintile 2nd	(3)	(4)	(5) Male Quintile 2nd	(6)
	1st	2nd	3rd	1st	2nd	3rd
Dependent variable: Employment						
LPG	-0.649** (0.299)	-0.898*** (0.229)	-1.018*** (0.205)	0.015 (0.521)	1.471*** (0.376)	0.906*** (0.312)
Total HH Expenditure(Dollar)	-0.004*** (0.001)	0.000 (0.001)	-0.000 (0.000)	-0.001 (0.002)	0.000 (0.001)	-0.000 (0.000)
Married	-0.025 (0.152)	-0.280* (0.152)	-0.303** (0.118)	0.709*** (0.167)	0.649*** (0.166)	0.400*** (0.131)
Urban	-0.185** (0.081)	0.111 (0.079)	0.110 (0.083)	-0.196 (0.151)	-0.492*** (0.126)	-0.397*** (0.146)
Bank Account Own	0.252** (0.078)	-0.057 (0.093)	0.111 (0.102)	-0.161 (0.162)	-0.270* (0.152)	-0.310* (0.167)
Household Size	0.063** (0.025)	-0.034 (0.024)	-0.002 (0.014)	0.045 (0.045)	0.052 (0.044)	0.035 (0.023)
Stove Burner Number	-0.227** (0.091)	-0.166 (0.102)	0.136 (0.088)	-0.075 (0.174)	-0.500*** (0.150)	-0.296** (0.141)
House Quality	0.149** (0.062)	0.290*** (0.076)	0.334*** (0.078)	0.133 (0.095)	-0.155 (0.109)	-0.410*** (0.131)
Age	0.008 (0.005)	0.014*** (0.005)	0.021*** (0.004)	0.032*** (0.010)	0.020** (0.010)	0.026*** (0.008)
Educ year	0.031*** (0.011)	0.057*** (0.010)	0.057*** (0.008)	-0.011 (0.016)	-0.013 (0.015)	-0.003 (0.013)
Kids Number	-0.015 (0.055)	0.016 (0.059)	-0.149*** (0.047)	0.083 (0.100)	0.191* (0.099)	0.047 (0.081)
HH Head	0.494*** (0.107)	0.461*** (0.122)	0.218* (0.118)	0.419*** (0.158)	0.381** (0.152)	0.478*** (0.144)
Cons	0.256 (0.558)	-0.676 (2.033)	-2.714 (1.823)	0.085 (0.616)	-0.247 (1.989)	0.711 (1.146)
Generalized Residual	0.436** (0.179)	0.474*** (0.140)	0.412*** (0.123)	0.066 (0.312)	-0.630*** (0.226)	-0.522*** (0.198)
Availability	Yes	Yes	Yes	Yes	Yes	Yes
Cook Frequency	Yes	Yes	Yes	Yes	Yes	Yes
N	1593	1619	1936	1191	1262	1645

Female and male samples are analyzed separately by total household expenditure quintile. The third quintile corresponds to the highest level of total household expenditure. The generalized residual is obtained from the first-stage probit model. Standard errors are bootstrapped with 800 replications and reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table: Work Days Per Year

	(1)	(2)	(3)	(4)
	Female		Male	
	OLS	IV	OLS	IV
<i>Dependent variable: Workdays per Year</i>				
LPG	8.996* (5.349)	-19.981* (11.770)	15.971*** (3.006)	20.028** (9.108)
Total HH Expenditure(Dollar)	0.000 (0.002)	0.001 (0.003)	0.001 (0.002)	0.001 (0.002)
Married	4.258 (5.852)	2.036 (5.640)	3.912 (3.862)	4.108 (3.886)
Urban	-6.013 (4.896)	0.604 (5.709)	0.586 (2.715)	-0.356 (3.271)
Bank Account Own	0.484 (5.903)	4.568 (6.526)	-3.826 (3.247)	-4.645 (3.680)
Household Size	0.613 (1.030)	0.066 (1.055)	1.929*** (0.576)	2.014*** (0.622)
Stove Burner Number	-11.485*** (4.325)	-3.239 (5.600)	-8.838*** (2.943)	-9.932** (3.959)
House Quality	21.109*** (5.486)	25.369*** (5.342)	-4.993** (2.394)	-5.500** (2.632)
Age	-0.242 (0.315)	-0.153 (0.348)	-0.331* (0.178)	-0.348** (0.172)
Educ year	-0.253 (0.495)	0.081 (0.528)	0.068 (0.304)	0.036 (0.295)
Kids Number	-0.680 (3.336)	-0.793 (3.671)	0.334 (1.845)	0.437 (1.846)
HH Head	0.041 (5.798)	-0.334 (5.564)	6.501** (2.937)	6.704** (2.993)
Non-Farm Work	-12.538* (6.897)	-5.991 (7.079)	-3.717 (4.013)	-4.079 (3.993)
Self Employed	29.375*** (4.811)	29.058*** (5.123)	16.605*** (2.640)	16.318*** (2.739)
Cons	168.500*** (51.880)	135.933** (55.098)	287.257*** (27.552)	289.259*** (26.517)
Generalized Residual		20.122** (8.102)		-2.670 (5.524)
availability	Yes	Yes	Yes	Yes
cook frequency	Yes	Yes	Yes	Yes
N	1072	1069	2586	2586

Estimation follows a control-function approach. The generalized residual is obtained from the first-stage probit model. In column (2), three observations are dropped because the first-stage predicted probabilities are extremely close to 0 or 1. Standard errors are bootstrapped with 800 replications and reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

References I

- Afridi, Farzana, Sisir Debnath, Taryn Dinkelman, and Komal Sareen (2023) "Time for clean energy? cleaner fuels and women's time in home production," *The World Bank Economic Review*, 37 (2), 283–304.
- Afridi, Farzana, Taryn Dinkelman, and Kanika Mahajan (2018) "Why are fewer married women joining the work force in rural India? A decomposition analysis over two decades," *Journal of Population Economics*, 31 (3), pp. 783–818, <https://www.jstor.org/stable/48699813>.
- Apps, Patricia F. and Ray Rees (1997) "Collective Labor Supply and Household Production," *Journal of Political Economy*, 105 (1), 178–190, 10.1086/262070.
- Berkouwer, Susanna B and Joshua T Dean (2022) "The impact of reduced charcoal usage on indoor air quality and health in Nairobi, Kenya.."
- Chiappori, Pierre-André (1997) "Introducing Household Production in Collective Models of Labor Supply," *Journal of Political Economy*, 105 (1), 191–209, 10.1086/262071.
- Dinkelman, Taryn (2011) "The effects of rural electrification on employment: New evidence from South Africa," *American Economic Review*, 101 (7), 3078–3108.
- Fukui, Masao, Emi Nakamura, and Jón Steinsson (2023) "Women, wealth effects, and slow recoveries," *American Economic Journal: Macroeconomics*, 15 (1), 269–313.
- Greenwood, Jeremy, Ananth Seshadri, and Mehmet Yorukoglu (2005) "Engines of Liberation," *The Review of Economic Studies*, 72 (1), 109–133, 10.1111/0034-6527.00326.
- Hanna, Rema, Esther Duflo, and Michael Greenstone (2016) "Up in smoke: the influence of household behavior on the long-run impact of improved cooking stoves," *American Economic Journal: Economic Policy*, 8 (1), 80–114.
- Li, Meng and Shaojie Zhou (2023) "Pollutive cooking fuels and rural labor supply: Evidence from a large-scale population census in China," *Energy Policy*, 183, 113780, <https://doi.org/10.1016/j.enpol.2023.113780>.
- Shen, Zheng, Jiangliang Zheng, Mengling Zhang, and Zhenping Song (2025) "The impact of clean cooking energy on female employment in rural China," *Energy for Sustainable Development*, 86, 101713, <https://doi.org/10.1016/j.esd.2025.101713>.
- Su, Qinghe and Mehtabul Azam (2023) "Does access to liquefied petroleum gas (LPG) reduce the household burden of women? Evidence from India," *Energy Economics*, 119, 106529, <https://doi.org/10.1016/j.eneco.2023.106529>.
- Verma, Anjali P and Imelda (2022) "Clean Energy Access: Gender Disparity, Health and Labour Supply," *The Economic Journal*, 133 (650), 845–871, 10.1093/ej/ueac057.