Role of subsidies in shaping consumption behaviour

Abhinav, Debayan, Nandini, Shreya

October 25, 2024

Introduction to LPG Subsidies in India

- India is the second largest consumer of liquefied petroleum gases within the world, with LPG consumption growing at a mean rate of 8.4%.
- The paper "Fuel Subsidy Reform in Developing Countries: Direct Benefit Transfer of LPG Cooking Gas Subsidy in India." , published by Centre for Global Development , provides a detailed picture of the India's household subsidies for the purchase of LPG cooking gas—the largest cash transfer program in the world.
- The direct benefit transfer scheme called **PaHaL** that rolled out on **15th November 2014** has transferred a total of nearly $10 billion in public subsidy to LPG consumers and currently involves approximately 40 million subsidy transfer transactions every day with the help of digitilization.

- **Pradhan Mantri Ujjwala Yojana (PMUY)**launched on 1 May 2016 was targeted to supply 80 million connections in eight years to all rural households.The scheme led to a rise in LPG consumption by 56% in 2019 as compared to 2014.
- The subsidy on LPG is the largest component of the Ministry's expenditure, with approximately 87% of its total budget allocated thereto. For 2020-21, the budget allocation for LPG subsidy has increased by 9.3% from the revised estimate for the same in 2019-20.
- The reform has been a success, both in diversion of LPG to the commercial market and changing the consumption pattern towards cleaner fuel

HCES DATA 2022-23

- By analysing the HCES Data 2022-23 , we have tried to study
  a) the impact of education level and social groups on subsidy access and
  b)the relationship between LPG subsidy and change in consumer's expenditure on LPG v/s other fuels
- For this purpose we have used levels **1,2, 3, 7, 8**
- We categorised fuels into two groups - LPG and other fuels (kerosene,firewood, charcoal, dung cake, coal).
- The main variables of study
  (a) Total value of consumption of LPG (in Rs.) per capita of a household during last 30 days.
  (b) Total value of consumption of other fuels (in Rs.) per capita of a household during last 30 days.

(c) Whether received LPG subsidy or not during last 3 months

(d) Whether received kerosene subsidy or not during last 3 months

(e) Whether the household received free electricity during last 30 days

(f) Is any one or more member beneficiary of PMJAY(Ayushman Bharat)

(g) Highest Education level attained

(h) Social group of the head of the household

(i) Household type (agriculture or non agriculture)

Methodology

- logit regression : LPG subsidy and education level

$$\log\left(\frac{P(\text{LPG\_Subsidy}=1)}{P(\text{LPG\_Subsidy}=0)}\right) = \beta_0 + \beta_1 \cdot \text{Household\_Type} +$$

$$\beta_2 \cdot \text{Education\_Level} + \beta_3 \cdot \text{Social\_Group\_HouseholdHead}$$

- Where:

$$\log\left(\frac{P(\text{LPG\_Subsidy}=1)}{P(\text{LPG\_Subsidy}=0)}\right)$$

is the log of the odds of the household receiving the LPG subsidy.

- logit regression : Kerosene Subsidy and education level

$$\log\left(\frac{P(\text{Kerosene\_Subsidy}=1)}{P(\text{Kerosene\_Subsidy}=0)}\right) = \beta_0 + \beta_1 \cdot \text{Household\_Type} +$$

$$\beta_2 \cdot \text{Education\_Level} + \beta_3 \cdot \text{Social\_Group\_HouseholdHead}$$

- Where:

$$\log\left(\frac{P(\text{Kerosene\_Subsidy}=1)}{P(\text{Kerosene\_Subsidy}=0)}\right)$$

is the log of the odds of the household receiving the Kerosene subsidy.

- logit regression : Interaction between household type(agri) and education level attained

$$\log \frac{P(subsidy\_group{=}1)}{P(subsidy\_group{=}0)} =$$

$$\beta_0 + \beta_1(agri\_var) + \beta_2(Education\_Level) + \beta_3(agri\_var \times Education\_Level)$$

- MLR to study the impact of subsidies on LPG consumption expenditure:

$$\log(\text{LPG\_PC}) = \beta_0 + \beta_1 \cdot \text{LPG\_Subsidy} + \beta_2 \cdot \text{Electricity\_Subsidy} +$$

$$\beta_3 \cdot \text{Kerosene\_Subsidy} + \beta_4 \cdot \text{Health\_Subsidy}$$

$$+\beta_5 \cdot \text{Highest\_Educational\_Level} + \beta_6 \cdot \text{Social\_Group} + \beta_7 \cdot \text{Broad\_Activities} +$$

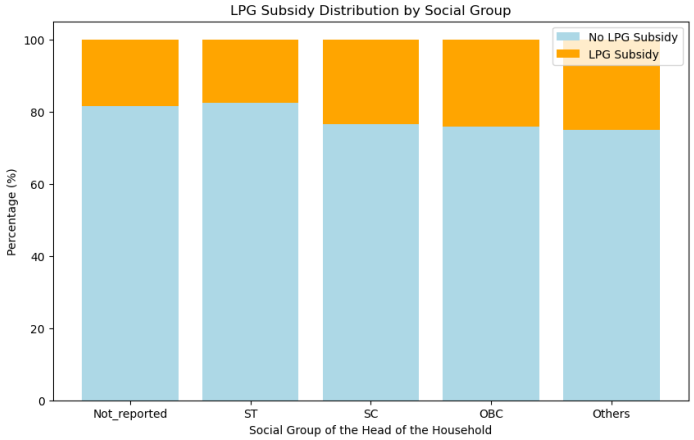
$$\beta_8 \cdot \text{District} + \beta_9 \cdot \text{Sector} + \beta_{10} \cdot \text{State}$$

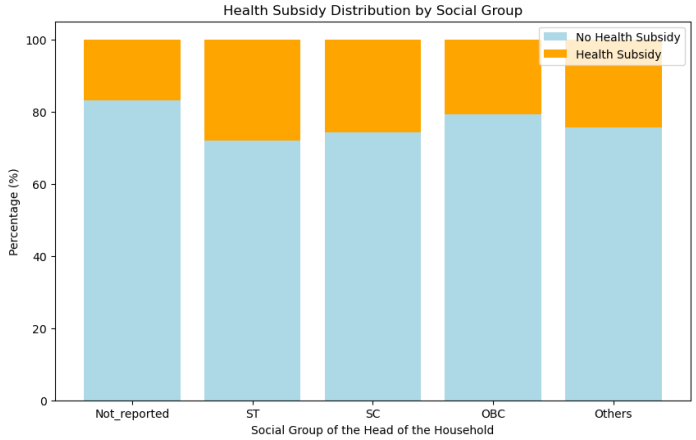
- Where:

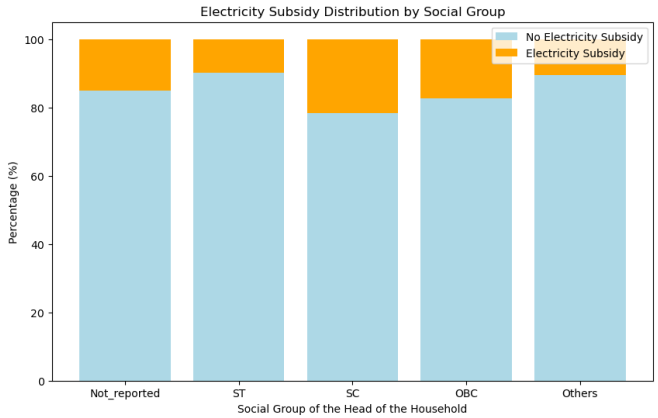
$$\log(\text{LPG\_PC})$$

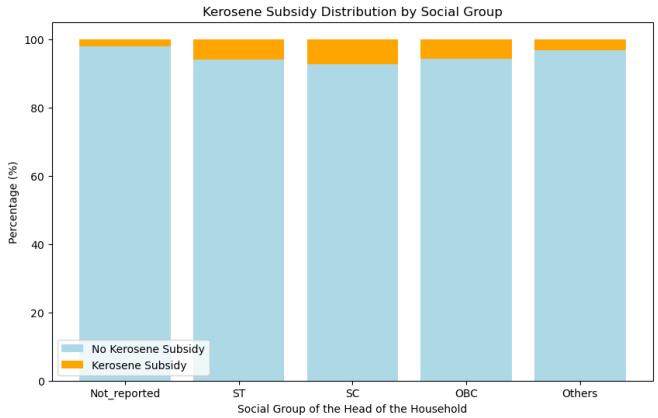
is the natural logarithm of LPG consumption per capita.

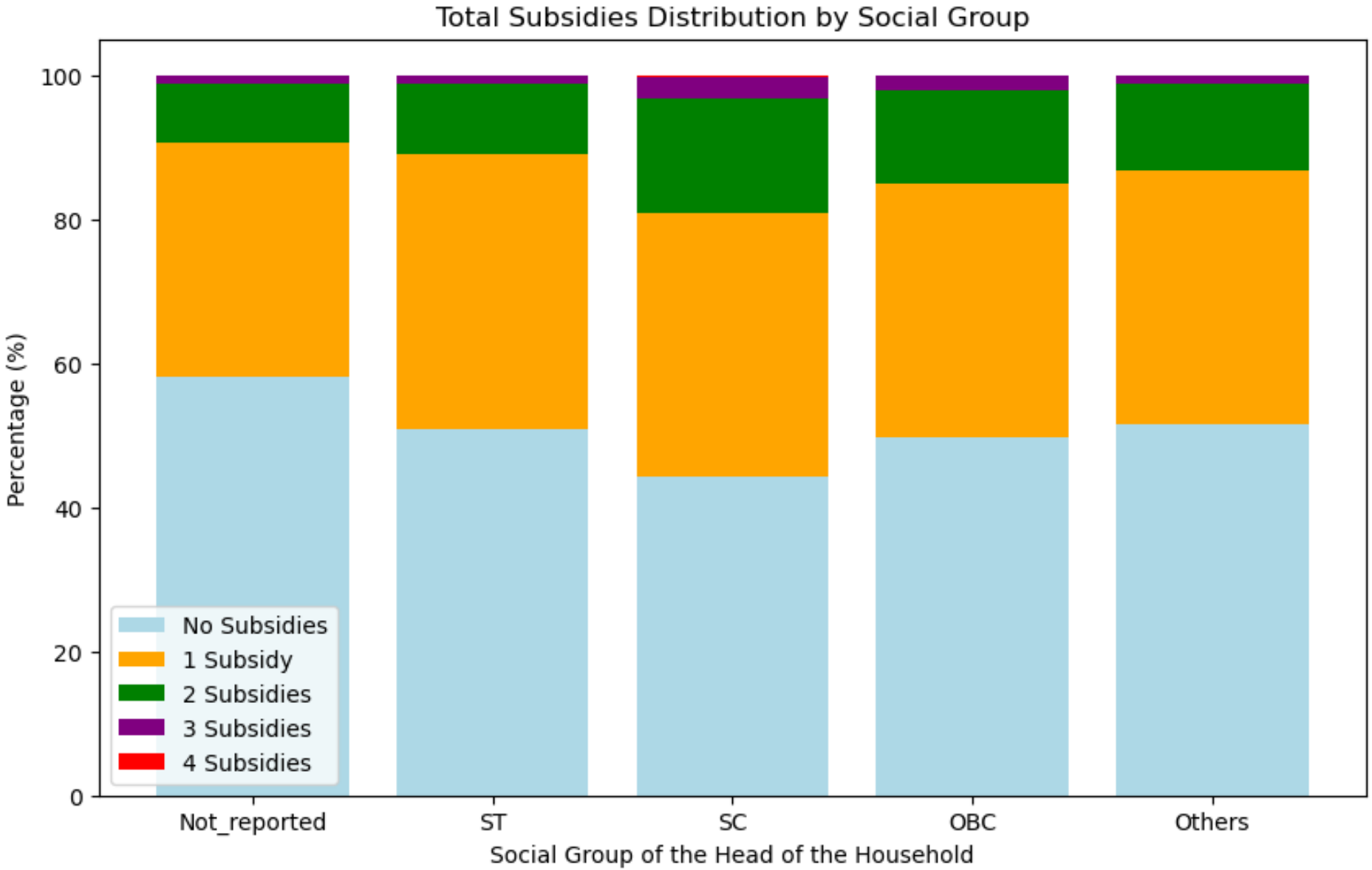
People receiving subsidies in different social groups










Total Subsidies Distribution by Social Group
Percentage (%)
100
80
60
40
20
0
No Subsidies
1 Subsidy
2 Subsidies
3 Subsidies
4 Subsidies
Not_reported
ST
SC
OBC
Others
Social Group of the Head of the Household

Highest Educational Level Attained (Column 7)

- **Not literate:**
  - Not able to read or write a simple message with understanding in any language - **01**
- **Literate with non-formal education:**
  - NFEC, AEC, TLC, literate without any schooling, etc. - **02**
- **Literate with formal education:**
  - Below primary - **03**
  - Primary - **04**
  - Upper primary/middle - **05**
  - Secondary - **06**
  - Higher secondary - **07**
  - Diploma / certificate course (up to secondary) - **08**
  - Diploma / certificate course (higher secondary) - **10**
  - Diploma / certificate course (graduation above) - **11**
  - Graduate - **12**
  - Post graduate and above - **13**

Household Characteristics Questionnaire - HCQ: 13

Household Type (based on major source of income)

- Self employment in agriculture - **01**
- Self employment in non agriculture - **02**
- regular wage/salary earning in agriculture- **03**
- regular wage/salary earning in non-agriculture- **04**
- casual labour in agriculture - **05**
- casual labour in non-agriculture- **06**
- Not at all employed (last 365 days) - **09**

Education level and availing the LPG subsidy

lpg_subsidy	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
householdtype						
2	.0049279	.0020806	2.37	0.018	.0008499	.0090058
3	.0270597	.0035106	7.71	0.000	.0201791	.0339402
4	.0833347	.0030454	27.36	0.000	.077366	.0893035
5	-.2764853	.0034238	-80.75	0.000	-.2831958	-.2697748
6	-.3858215	.0031817	-121.26	0.000	-.3920575	-.3795855
9	-.3125163	.0033629	-92.93	0.000	-.3191074	-.3059251
highesteducationallevelattainedc						
2	.0384801	.0057342	6.71	0.000	.0272413	.0497188
3	.0923303	.003067	30.10	0.000	.086319	.0983416
4	.0923166	.002927	31.54	0.000	.0865799	.0980534
5	.089553	.0029077	30.80	0.000	.083854	.0952521
6	.2185627	.0028786	75.93	0.000	.2129208	.2242046
7	.2604039	.002988	87.15	0.000	.2545476	.2662602
8	.2473907	.0129357	19.12	0.000	.2220371	.2727442
10	.2560907	.0085227	30.05	0.000	.2393866	.2727948
11	.2865358	.0104205	27.50	0.000	.266112	.3069595
12	.2484091	.0031112	79.84	0.000	.2423112	.2545071
13	.2825576	.0048635	58.10	0.000	.2730254	.2920898
socialgroupoftheheadofthehouseho						
1	-.0053791	.0132418	-0.41	0.685	-.0313325	.0205744
2	.4126292	.0131733	31.32	0.000	.3868101	.4384483
3	.3854344	.0130756	29.48	0.000	.3598067	.4110621
9	.3920796	.0130965	29.94	0.000	.3664109	.4177483
_cons	-1.595439	.0131818	-121.03	0.000	-1.621275	-1.569603

Figure: The odds ratio of 1.2819 means individuals whose highest educational level attained is 12 are about 28.19% more likely to receive the LPG subsidy compared to base category (non-literate)

Education level and availing the Kerosene subsidy

kerosene_subsidy	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
householdtype						
2	-.087155	.0046298	-18.82	0.000	-.0962292	-.0780808
3	.2918427	.0064686	45.12	0.000	.2791644	.3045209
4	.517363	.0054702	94.58	0.000	.5066417	.5280844
5	.6722899	.0051642	130.18	0.000	.6621683	.6824115
6	.6009965	.004868	123.46	0.000	.5914553	.6105376
9	.1465507	.0065943	22.22	0.000	.133626	.1594753
highesteducationallevelattainedc						
2	.5244949	.0086179	60.86	0.000	.5076041	.5413856
3	.2001047	.0053366	37.50	0.000	.1896452	.2105641
4	.1778706	.0051392	34.61	0.000	.167798	.1879432
5	.3488164	.0049317	70.73	0.000	.3391505	.3584824
6	.0612681	.0054872	11.17	0.000	.0505133	.0720228
7	-.1663419	.0062497	-26.62	0.000	-.178591	-.1540927
8	.6179312	.020867	29.61	0.000	.5770326	.6588298
10	.4215589	.0150964	27.92	0.000	.3919705	.4511473
11	-.3106088	.0268388	-11.57	0.000	-.3632118	-.2580058
12	-.3430605	.0072401	-47.38	0.000	-.3572508	-.3288702
13	-.5853915	.0140328	-41.72	0.000	-.6128952	-.5578877
socialgroupoftheheadofthehouseho						
1	.9439067	.0353679	26.69	0.000	.874587	1.013226
2	1.081202	.0353062	30.62	0.000	1.012004	1.150401
3	.9291995	.035227	26.38	0.000	.8601559	.9982431
9	.4275931	.0353388	12.10	0.000	.3583304	.4968559
_cons	-4.008402	.0353758	-113.31	0.000	-4.077738	-3.939067

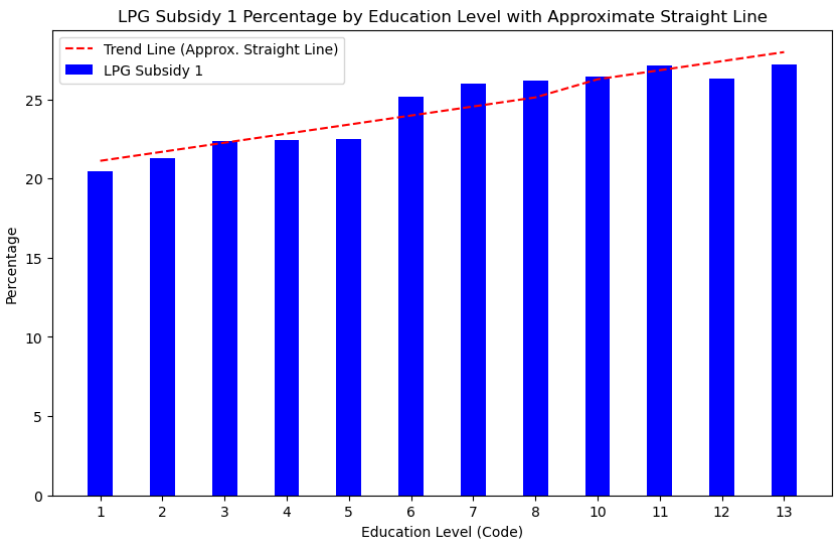
Figure: Education level and Kerosene subsidy

Interaction of Agri HH and education to see a reverse trend

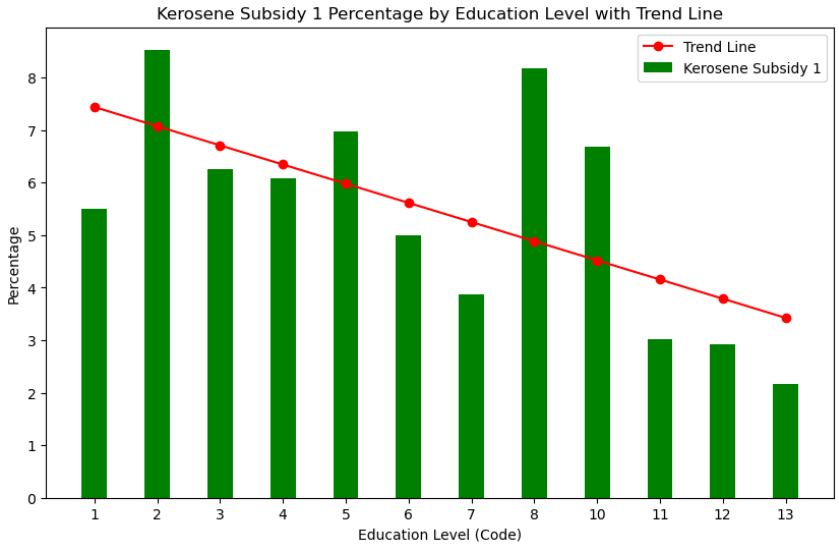
subsidy_group	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
1.agri_var	.022248	.002943	7.56	0.000	.0164798	.0280161
highesteducationallevelattainedc						
2	.0337915	.0067344	5.02	0.000	.0205924	.0469907
3	.0341198	.0036396	9.37	0.000	.0269863	.0412532
4	.0977546	.0034998	27.93	0.000	.0908951	.1046141
5	.0774951	.003463	22.38	0.000	.0707078	.0842824
6	-.0064334	.0034441	-1.87	0.062	-.0131837	.0003169
7	-.1514826	.0035165	-43.08	0.000	-.1583748	-.1445903
8	-.0652899	.0144806	-4.51	0.000	-.0936714	-.0369084
10	.0024599	.0093733	0.26	0.793	-.0159114	.0208312
11	-.332811	.0116756	-28.50	0.000	-.3556947	-.3099273
12	-.2810859	.0034807	-80.75	0.000	-.287908	-.2742638
13	-.279829	.0052082	-53.73	0.000	-.2900369	-.2696212
agri_var#highesteducationallevelattainedc						
1 2	-.0021744	.0093516	-0.23	0.816	-.0205032	.0161544
1 3	-.0240726	.0050359	-4.78	0.000	-.0339427	-.0142025
1 4	-.0383168	.0048074	-7.97	0.000	-.0477391	-.0288944
1 5	-.0239352	.0047715	-5.02	0.000	-.0332872	-.0145833
1 6	.0344294	.0048074	7.16	0.000	.0250071	.0438518
1 7	.1554995	.0050287	30.92	0.000	.1456435	.1653556
1 8	.2751337	.0233548	11.78	0.000	.2293592	.3209082
1 10	.1446656	.0155629	9.30	0.000	.1141628	.1751683
1 11	.1311358	.0192568	6.81	0.000	.0933932	.1688784
1 12	.1718683	.0052801	32.55	0.000	.1615195	.1822171
1 13	.122601	.0090635	13.53	0.000	.1048368	.1403652
_cons	.0261456	.0021661	12.07	0.000	.0219001	.030391

Figure: Education and interaction of Edu and agri shows reverse trends on availing subsidies

Different subsidies w.r.t Education level



(a) LPG Subsidy



(b) Kerosene Subsidy

Impact of Fuel subsidy on consumption expenditure of LPG

```
. reg log_lpg_pc lpg_subsidy electricity_subsidy kerosene_subsidy health_subsidy i.highesteducationallevelattainedc i.socialgroupoftheheadofthehouseho i.broadactivitiesfr
> omwhichmaximumi i.district i.sector i.state
```

Source	SS	df	MS		
Model	123859.202	127	975.269306	Number of obs	= 414,794
Residual	164485.168	414,666	.396669049	F(127, 414666)	= 2458.65
				Prob > F	= 0.0000
				R-squared	= 0.4296
				Adj R-squared	= 0.4294
Total	288344.37	414,793	.695152449	Root MSE	= .62982

log_lpg_pc	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
lpg_subsidy	.0347092	.0025565	13.58	0.000	.0296985	.0397198
electricity_subsidy	-.2049909	.0040176	-51.02	0.000	-.2128654	-.1971165
kerosene_subsidy	-.1161545	.0052345	-22.19	0.000	-.126414	-.1058949
health_subsidy	-.1013522	.0027479	-36.88	0.000	-.106738	-.0959664

- The positive and significant coefficient (0.0347) indicates that if household receives lpg subsidy it leads to a 3.47% increase in per capita LPG consumption.
- The model explains about 42.96% of the variation in per capita electricity consumption.

Impact of Fuel subsidy on consumption expenditure of other fuels

```
. reg log_other_fuels_pc lpg_subsidy kerosene_subsidy electricity_subsidy health_subsidy i.highesteducationallevelattainedc i.socialgroupoftheheadofthehouseho i.broadacti
> vitiesfromwhichmaximumi i.district i.sector i.state
```

Source	SS	df	MS		
Model	553592.874	127	4358.999	Number of obs	= 538,387
Residual	284588.742	538,259	.528720824	F(127, 538259)	= 8244.42
				Prob > F	= 0.0000
Total	838181.616	538,386	1.5568414	R-squared	= 0.6605
				Adj R-squared	= 0.6604
				Root MSE	= .72713

log_other_fuels_pc	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
lpg_subsidy	-.0618483	.0026901	-22.99	0.000	-.0671208	-.0565758
kerosene_subsidy	-.0847	.0040181	-21.08	0.000	-.0925754	-.0768245
electricity_subsidy	.0049839	.0040472	1.23	0.218	-.0029485	.0129164
health_subsidy	-.0212461	.0026702	-7.96	0.000	-.0264796	-.0160125

- The negative coefficient (-0.0618) means that if a household receives LPG subsidy , it leads to about a 6.18% decrease in other fuel consumption per capita like firewood, coal, kerosene, etc.

Impact of Fuel subsidy on consumption expenditure of electricity

log_elec_pc	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
kerosene_subsidy	-.077598	.0046999	-16.51	0.000	-.0868097	-.0683864
lpg_subsidy	.071154	.002301	30.92	0.000	.0666442	.0756638
electricity_subsidy	-.2075618	.0036067	-57.55	0.000	-.2146307	-.2004928
health_subsidy	-.0784055	.002468	-31.77	0.000	-.0832428	-.0735682

Figure

The negative coefficient (-0.2075) means that if a household receives free electricity , it leads to about a 20.75% decrease in electricity consumption

Conclusion

- **Rural Economic Transformation:**
  With more households transitioning to LPG, savings in time (due to quicker cooking and less time spent collecting firewood) and health improvements could allow families to reallocate their resources towards education, productive activities, or small-scale enterprises. This could foster **economic empowerment** in rural areas.
- **Agricultural Households:**
  Agricultural households generally receive more subsidies, especially when higher education levels are present. The government should also provide educational campaigns to improve awareness and utilization of subsidy programs among less-educated and agricultural households.
- **Education Level and Subsidy Impact:**
  Higher education levels are associated with greater subsidy receipt (positive coefficients) in the case of LPG consumption. Hence, the government should target subsidies more effectively towards households with lower education levels to increase LPG adoption.

THANK YOU!