Consumer WTP for Carbon Offsets

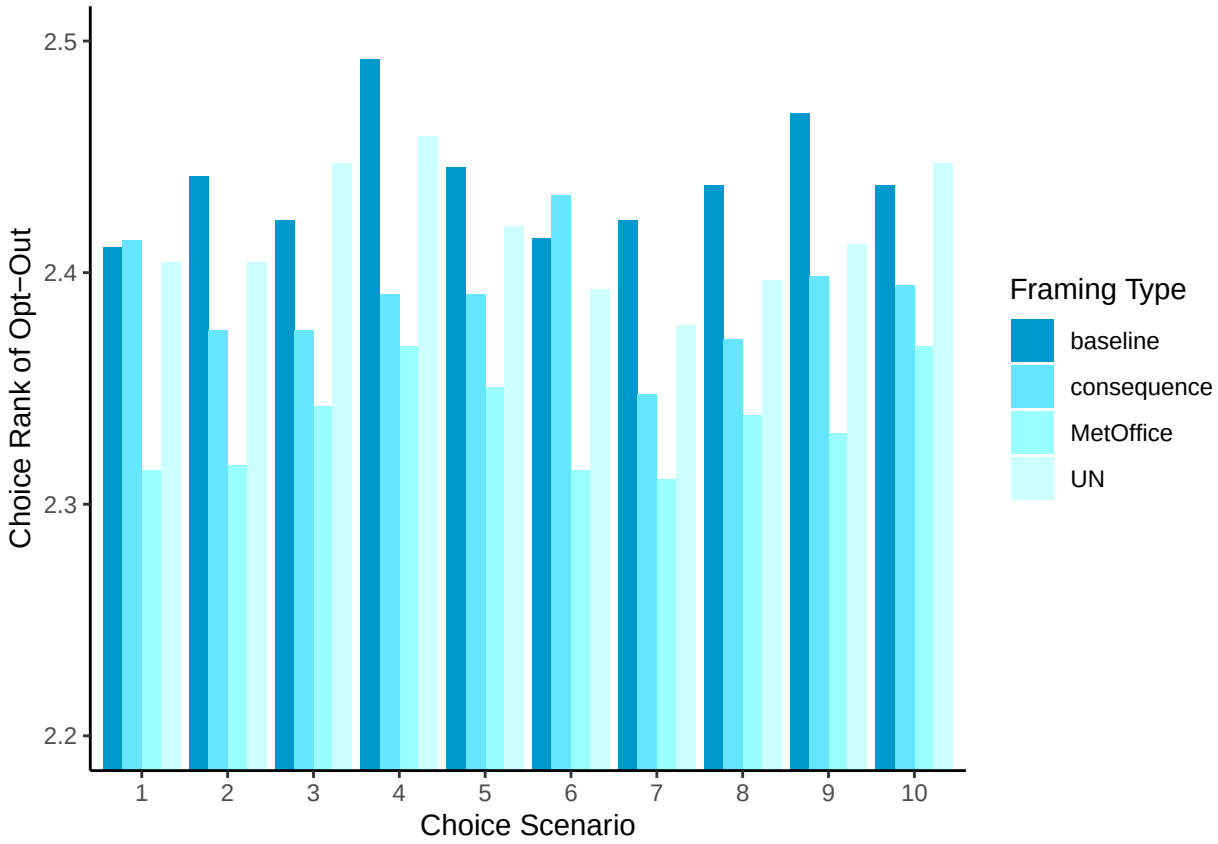
Summary Statistics for respondents

	Variable	Group	Frequency	Percentage
1	Location	England	1073	84.09
2	Location	NorthernIreland	20	1.57
3	Location	Scotland	102	7.99
4	Location	Wales	81	6.35
5	Age	18-24	136	10.66
6	Age	25-34	255	19.98
7	Age	35-44	265	20.77
8	Age	45-54	219	17.16
9	Age	55-64	224	17.55
10	Age	65+	177	13.87
11	Gender	Man	580	45.45
12	Gender	Woman	689	54.00
13	Gender	Non-binary	7	0.55
14	Diet	Flexitarian	173	13.56
15	Diet	Omnivorous	969	75.94
16	Diet	Pescatarian	21	1.65
17	Diet	Vegan	26	2.04
18	Diet	Vegetarian	79	6.19
19	Diet	Others	8	0.63
20	Meat Consumption	Twice a day or more	58	4.55
21	Meat Consumption	Once a day	179	14.03
22	Meat Consumption	3-5 times weekly	611	47.88
23	Meat Consumption	2 times weekly	313	24.53
24	Meat Consumption	Never	115	9.01
25	Climate is Important	1-Not Important	54	4.23
26	Climate is Important	2	79	6.19
27	Climate is Important	3	331	25.94
28	Climate is Important	4	420	32.92
29	Climate is Important	5-Very Important	392	30.72
30	Familiar with Climate Change	1-Not Familiar	4	0.31
31	Familiar with Climate Change	2	75	5.88
32	Familiar with Climate Change	3	549	43.03
33	Familiar with Climate Change	4	478	37.46
34	Familiar with Climate Change	5-Very Familiar	170	13.32
35	Climate Change Cause	Both human and natural	905	70.92
36	Climate Change Cause	Human	242	18.97
37	Climate Change Cause	Natural	64	5.02
38	Climate Change Cause	No Climate Change	27	2.12
39	Climate Change Cause	Not Know	38	2.98
40	I am environmentally friendly	Strongly agree	127	9.95
41	I am environmentally friendly	Agree	520	40.75
42	I am environmentally friendly	Neutral	488	38.24

```
## 43 I am environmentally friendly              Disagree       102       7.99
## 44 I am environmentally friendly     Strongly disagree        39       3.06
## 45    Concerned with environment        Strongly agree       157      12.30
## 46    Concerned with environment                 Agree       486      38.09
## 47    Concerned with environment               Neutral       404      31.66
## 48    Concerned with environment              Disagree       178      13.95
## 49    Concerned with environment     Strongly disagree        51       4.00
## 50                     Education     No qualifications        24       1.88
## 51                     Education          GCSE/O-Level       243      19.04
## 52                     Education   A-Level/Higher/BTEC       241      18.89
## 53                     Education  Degree or equivalent       410      32.13
## 54                     Education            Vocational       149      11.68
## 55                     Education          Postgraduate       202      15.83
## 56                     Education                 Other         7       0.55
## 57                Household Size                     0         2       0.16
## 58                Household Size                     1       277      21.71
## 59                Household Size                     2       424      33.23
## 60                Household Size                     3       263      20.61
## 61                Household Size                     4       211      16.54
## 62                Household Size                     5        74       5.80
## 63                Household Size                     6        17       1.33
## 64                Household Size                     7         5       0.39
## 65                Household Size                     8         1       0.08
## 66                Household Size                    10         2       0.16
## 67            Number of Children                     0       835      65.44
## 68            Number of Children                     1       219      17.16
## 69            Number of Children                     2       158      12.38
## 70            Number of Children                     3        50       3.92
## 71            Number of Children                     4        13       1.02
## 72            Number of Children                     6         1       0.08
## 73           Is the main shopper                    No       289      22.65
## 74           Is the main shopper                   Yes       987      77.35
## 75                        Income             < £10,000        80       6.27
## 76                        Income     £10,001 - £20,000       173      13.56
## 77                        Income     £20,001 - £30,000       254      19.91
## 78                        Income     £30,001 - £40,000       225      17.63
## 79                        Income     £40,001 - £50,000       172      13.48
## 80                        Income     £50,001 - £60,000       142      11.13
## 81                        Income             > £60,001       165      12.93
## 82                        Income         Not Specified        65       5.09
## 83             Where do you live            Citycentre       292      22.88
## 84             Where do you live             Ruralarea       235      18.42
## 85             Where do you live          Townorsuburb       749      58.70
```

Opt-out Rank by Information Treatment

```
## `summarise()` has grouped output by 'framing_effect'. You can override using
## the `.groups` argument.
```



The above table presents the rank of opt-out for each chocie scenario by information treatment. Lower the rank, higher the preference for opt-out. The summary shows that Met Office has a poitive effect on the preference for opt-out, and equivalently, the endorsement has a negative effect on the preference for carbon offset.

Summary of PCA

for Q9

Factor loadings for Q9:

```
## Standard deviations (1, .., p=15):
##  [1] 2.4449246 1.8707724 0.8688969 0.8126817 0.7717738 0.7367027 0.6726539
##  [8] 0.6458357 0.6225510 0.6218641 0.5661055 0.5478628 0.4985988 0.4942617
## [15] 0.4597596
##
## Rotation (n x k) = (15 x 15):
##               PC1        PC2         PC3          PC4         PC5          PC6
## Q9_1  -0.28055790 0.08969099 -0.01809095  0.465105846  0.51736702 -0.391487380
## Q9_2  -0.30165609 0.06243437 -0.10447931  0.149123245 -0.23976862 -0.633688311
## Q9_3  -0.25534486 0.09965919 -0.38960705  0.641873715 -0.24371138  0.487245142
## Q9_4  -0.29517817 0.08744077  0.11523794 -0.129574023  0.60172841  0.175649519
## Q9_5  -0.34338927 0.10756369 -0.04558215 -0.216140393 -0.09240375  0.075432130
## Q9_6  -0.32765725 0.13341929  0.05339357 -0.307194312 -0.07027835 -0.033500916
## Q9_7  -0.32313276 0.14438537 -0.09702601 -0.197636025 -0.35408946 -0.108806247
```

```
## Q9_8  -0.32109315 0.13885569 -0.06691886 -0.167509966  0.12766305  0.246003811
## Q9_9  -0.31698934 0.13629589  0.03659775 -0.168437063 -0.06257662  0.104621120
## Q9_10 -0.05207092 0.32532352  0.79583861  0.278754931 -0.18758423  0.170994200
## Q9_11  0.13201110 0.39330701  0.19513463  0.058173856 -0.04648334 -0.164470230
## Q9_12  0.15527865 0.39005636 -0.13350031 -0.004979848 -0.12122042 -0.157379077
## Q9_13  0.15097224 0.41115573 -0.21287112 -0.030238104  0.15830757  0.008792343
## Q9_14  0.19498997 0.39490021 -0.16733819 -0.068710882  0.12661099  0.056474782
## Q9_15  0.19905515 0.38044631 -0.20235622 -0.096555857  0.03413161  0.049771980
##               PC7          PC8         PC9        PC10         PC11
## Q9_1   0.30600170 -0.364141155  0.09499251 -0.17099886 -0.046270325
## Q9_2  -0.09093742  0.568195464 -0.18730801  0.12902158  0.149283271
## Q9_3  -0.20166199 -0.000446123 -0.05026494 -0.01202977  0.006464309
## Q9_4  -0.52428739  0.320105704 -0.04109848  0.04828097 -0.263000358
## Q9_5  -0.05989655 -0.117864172 -0.12898073 -0.24114062 -0.161168202
## Q9_6  -0.10940430 -0.158723003  0.12650254 -0.40527713  0.296833851
## Q9_7  -0.03680158 -0.238665332 -0.02268343 -0.18526720 -0.277665005
## Q9_8   0.22057898  0.073073913  0.22851066  0.27064837  0.673824843
## Q9_9   0.42159352 -0.065495041 -0.11366383  0.59286695 -0.399578636
## Q9_10  0.16084983  0.219072722  0.06352699 -0.17351881 -0.028797163
## Q9_11 -0.44746529 -0.481320939 -0.33850675  0.37578837  0.240881406
## Q9_12 -0.19488636  0.018588709  0.77030072  0.12263453 -0.203512537
## Q9_13  0.11777418  0.116921542  0.03148230  0.02520948 -0.027020537
## Q9_14  0.14575234  0.060335128 -0.28453726 -0.18123943  0.016416713
## Q9_15  0.20012005  0.197718389 -0.24381991 -0.22433203 -0.014356284
##               PC12         PC13        PC14        PC15
## Q9_1   0.073959534  0.004850394 -0.03400913 -0.04868215
## Q9_2  -0.012465223 -0.036640130 -0.02273799  0.07586218
## Q9_3   0.012794469 -0.094540477  0.10227418  0.03641470
## Q9_4   0.082998576  0.102227821  0.10281705 -0.06148196
## Q9_5  -0.141995619 -0.220146631 -0.78114317  0.10217376
## Q9_6  -0.035272983 -0.458210195  0.48048566  0.15481320
## Q9_7   0.001066073  0.643258239  0.19542458 -0.25849760
## Q9_8   0.093130890  0.289081548 -0.18050518 -0.09969326
## Q9_9   0.076586110 -0.270051422  0.19351380  0.11842329
## Q9_10 -0.046216945  0.064318958 -0.02519886 -0.01468974
## Q9_11  0.026520867 -0.049810662 -0.04571043 -0.07882435
## Q9_12  0.215115088 -0.073956449 -0.12117409  0.10891120
## Q9_13 -0.820675102 -0.012164001  0.09103065 -0.15795875
## Q9_14  0.182198317  0.287118068  0.04539293  0.70528961
## Q9_15  0.442218904 -0.236378965 -0.01639274 -0.56648333
```

Importance of components:

```
## Importance of components:
##                            PC1    PC2     PC3     PC4     PC5     PC6     PC7
## Standard deviation     2.4449 1.8708 0.86890 0.81268 0.77177 0.73670 0.67265
## Proportion of Variance 0.3985 0.2333 0.05033 0.04403 0.03971 0.03618 0.03016
## Cumulative Proportion  0.3985 0.6318 0.68216 0.72619 0.76590 0.80208 0.83225
##                            PC8     PC9    PC10    PC11    PC12    PC13    PC14
## Standard deviation     0.64584 0.62255 0.62186 0.56611 0.54786 0.49860 0.49426
## Proportion of Variance 0.02781 0.02584 0.02578 0.02137 0.02001 0.01657 0.01629
## Cumulative Proportion  0.86005 0.88589 0.91167 0.93304 0.95305 0.96962 0.98591
##                           PC15
## Standard deviation     0.45976
```

```
## Proportion of Variance 0.01409
## Cumulative Proportion  1.00000
```

for Q10

Factor loadings for Q10:

```
## Standard deviations (1, .., p=13):
##  [1] 3.0450201 0.8133522 0.6909953 0.6552695 0.6336439 0.5355692 0.5154163
##  [8] 0.4956216 0.4868869 0.4713560 0.4280445 0.4228192 0.3722779
##
## Rotation (n x k) = (13 x 13):
##              PC1          PC2         PC3         PC4         PC5         PC6
## Q10_1  0.2390361  0.699421565  0.07516256  0.09251933 -0.46544205  0.08653526
## Q10_2  0.2707082  0.465197906  0.07375957 -0.15583464  0.02421393 -0.27794445
## Q10_3  0.2745820  0.200535143  0.01159933 -0.39953268  0.53671993 -0.08686160
## Q10_4  0.2886799  0.004467465 -0.03767438 -0.25207699  0.38020008  0.19102908
## Q10_5  0.2655558  0.087559382 -0.59124583  0.35370410  0.18850290  0.51873708
## Q10_6  0.2832510 -0.120810474 -0.37585763  0.08093827 -0.08456392 -0.26214102
## Q10_7  0.2829975 -0.255275900 -0.17374929 -0.19373162 -0.16106438 -0.42547667
## Q10_8  0.2812398 -0.184794951 -0.28440972  0.04259160 -0.27827343 -0.21999799
## Q10_9  0.2889450 -0.122221900  0.18379364  0.12084258  0.09842844 -0.12963826
## Q10_10 0.2600478 -0.032261266  0.38318345  0.72239962  0.28816650 -0.23228115
## Q10_11 0.2909976 -0.198363004  0.30746045 -0.13504967 -0.13551275  0.26037770
## Q10_12 0.2906152 -0.206234882  0.31714171 -0.09595646 -0.14719757  0.32221894
## Q10_13 0.2840109 -0.186358836  0.09857721 -0.09525121 -0.26708769  0.24820092
##               PC7         PC8          PC9         PC10        PC11
## Q10_1  -0.13298826  0.31618566 -0.134622560  0.27564788 -0.05850282
## Q10_2   0.16164825 -0.51513390  0.366503161 -0.38222722  0.12660976
## Q10_3   0.03031972  0.16509997 -0.384077518 -0.09734531 -0.29831017
## Q10_4  -0.20866184  0.22223398  0.092914335  0.21791106  0.58341664
## Q10_5  -0.05375803 -0.14104966  0.132213997 -0.11841717 -0.28800562
## Q10_6   0.51487982  0.16267651  0.213439468  0.31391936  0.26580148
## Q10_7  -0.22497287  0.33118235  0.287591106 -0.07948103 -0.46108164
## Q10_8  -0.47604436 -0.26455928 -0.456503957 -0.18966292  0.32200370
## Q10_9   0.11671740 -0.48938556 -0.244114996  0.61058376 -0.25358993
## Q10_10 -0.05259386  0.25351118  0.004264633 -0.22794495  0.07931562
## Q10_11 -0.10564149 -0.03707151  0.327672655  0.04347687  0.01446710
## Q10_12 -0.14878911 -0.09003989  0.156674014 -0.01394474 -0.09552083
## Q10_13  0.56286352  0.13688723 -0.381753451 -0.37315666  0.03702411
##               PC12         PC13
## Q10_1  -0.008778289 -0.008571299
## Q10_2  -0.112789275  0.045572740
## Q10_3   0.389909642 -0.053186685
## Q10_4  -0.418594895  0.077426853
## Q10_5  -0.057724302 -0.044117054
## Q10_6   0.409585403  0.086066627
## Q10_7  -0.342425891  0.029691237
## Q10_8   0.173481472 -0.058795814
## Q10_9  -0.275155286 -0.033929715
## Q10_10  0.017885707 -0.005207989
## Q10_11  0.267885105 -0.695180660
## Q10_12  0.290907181  0.699280707
```

```
## Q10_13 -0.330283135 -0.043423673
```

Importance of components:

```
## Importance of components:
##                           PC1     PC2     PC3     PC4     PC5     PC6     PC7
## Standard deviation     3.0450 0.81335 0.69100 0.65527 0.63364 0.53557 0.51542
## Proportion of Variance 0.7132 0.05089 0.03673 0.03303 0.03088 0.02206 0.02043
## Cumulative Proportion  0.7132 0.76413 0.80086 0.83389 0.86477 0.88684 0.90727
##                           PC8     PC9    PC10    PC11    PC12    PC13
## Standard deviation     0.4956 0.48689 0.47136 0.42804 0.42282 0.37228
## Proportion of Variance 0.0189 0.01824 0.01709 0.01409 0.01375 0.01066
## Cumulative Proportion  0.9262 0.94440 0.96149 0.97559 0.98934 1.00000
```

Basic Logit Model

Basic Logit Model Coefficients

```
##
## Model estimated on: Mon Nov 11 08:34:19 PM 2024
##
## Call:
## gmnl(formula = f, data = dt, model = "mnl", method = "nr")
##
## Frequencies of categories:
##
##        1        2        3        4        5        6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 0h:0m:8s
##
## Coefficients:
##                      Estimate Std. Error  z-value  Pr(>|z|)
## I                 -0.9858758  0.0355302 -27.7476 < 2.2e-16 ***
## price             -0.0318596  0.0018653 -17.0803 < 2.2e-16 ***
## location_EU       -0.0193157  0.0179737  -1.0747    0.2825
## location_UK        0.1726739  0.0178102   9.6952 < 2.2e-16 ***
## certificate_NGO    0.0993108  0.0182718   5.4352 5.474e-08 ***
## certificate_UK     0.3372772  0.0185896  18.1433 < 2.2e-16 ***
## project_renewable  0.1324178  0.0209696   6.3148 2.706e-10 ***
## project_landfill  -0.2605849  0.0230259 -11.3170 < 2.2e-16 ***
## project_manure    -0.1361997  0.0209358  -6.5056 7.740e-11 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by Newton-Raphson maximisation
## Log Likelihood: -20883
## Number of observations: 12760
## Number of iterations: 4
## Exit of MLE: gradient close to zero (gradtol)
```

Basic Logit Model Willingness to Pay

```
##
## Willigness-to-pay respect to:  price
##
##                    Estimate Std. Error  t-value  Pr(>|t|)
## I                 -30.94442    2.76300 -11.1996 < 2.2e-16 ***
## location_EU        -0.60628    0.56778  -1.0678    0.2856
## location_UK         5.41985    0.64571   8.3936 < 2.2e-16 ***
## certificate_NGO     3.11714    0.60496   5.1526 2.569e-07 ***
## certificate_UK     10.58637    0.94537  11.1981 < 2.2e-16 ***
## project_renewable   4.15630    0.68590   6.0597 1.364e-09 ***
## project_landfill   -8.17917    0.89143  -9.1753 < 2.2e-16 ***
## project_manure     -4.27500    0.66996  -6.3809 1.760e-10 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Mixed Logit Model

Mixed Logit Model Coefficients

```
##
## Model estimated on: Mon Nov 11 08:34:19 PM 2024
##
## Call:
## gmnl(formula = f, data = dt, model = "mixl", ranp = randpar,
##     R = 2000, haltons = NA, panel = T, method = "bhhh", iterlim = 5000)
##
## Frequencies of categories:
##
##        1        2        3        4        5        6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 0h:22m:4s
##
## Coefficients:
##                        Estimate Std. Error  z-value  Pr(>|z|)
## price                -0.0566953  0.0026145 -21.6852 < 2.2e-16 ***
## I                    -2.3087007  0.0640344 -36.0541 < 2.2e-16 ***
## location_EU          -0.0348243  0.0246893  -1.4105    0.1584
## location_UK           0.3656202  0.0248577  14.7085 < 2.2e-16 ***
## certificate_NGO       0.1969127  0.0247100   7.9690 1.554e-15 ***
## certificate_UK        0.6176641  0.0274737  22.4820 < 2.2e-16 ***
## project_renewable     0.2507852  0.0285017   8.7990 < 2.2e-16 ***
## project_landfill     -0.4877729  0.0331036 -14.7347 < 2.2e-16 ***
## project_manure       -0.2526061  0.0293147  -8.6171 < 2.2e-16 ***
## sd.I                  2.9160525  0.0769373  37.9017 < 2.2e-16 ***
## sd.location_EU        0.6330962  0.0381528  16.5937 < 2.2e-16 ***
## sd.location_UK        0.8182854  0.0371775  22.0102 < 2.2e-16 ***
## sd.certificate_NGO    0.5366750  0.0441214  12.1636 < 2.2e-16 ***
## sd.certificate_UK     0.6198115  0.0389616  15.9083 < 2.2e-16 ***
## sd.project_renewable  0.8285760  0.0429289  19.3011 < 2.2e-16 ***
```

```
## sd.project_landfill   0.6180166  0.0510129  12.1149 < 2.2e-16 ***
## sd.project_manure     0.8137545  0.0417698  19.4819 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -16722
## Number of observations: 12760
## Number of iterations: 38
## Exit of MLE: successive function values within relative tolerance limit (reltol)
## Simulation based on 2000 draws
```

Mixed Logit Model Willingness to Pay

```
##
## Willigness-to-pay respect to:  price
##
##                       Estimate Std. Error  t-value  Pr(>|t|)
## I                    -40.72122    2.76497 -14.7276 < 2.2e-16 ***
## location_EU           -0.61424    0.43944  -1.3978    0.1622
## location_UK            6.44887    0.54963  11.7330 < 2.2e-16 ***
## certificate_NGO        3.47318    0.47492   7.3132 2.609e-13 ***
## certificate_UK        10.89446    0.78485  13.8809 < 2.2e-16 ***
## project_renewable      4.42339    0.52780   8.3807 < 2.2e-16 ***
## project_landfill      -8.60341    0.74085 -11.6129 < 2.2e-16 ***
## project_manure        -4.45551    0.52792  -8.4397 < 2.2e-16 ***
## sd.I                  51.43379    2.87065  17.9171 < 2.2e-16 ***
## sd.location_EU        11.16665    0.92067  12.1289 < 2.2e-16 ***
## sd.location_UK        14.43305    1.00596  14.3475 < 2.2e-16 ***
## sd.certificate_NGO     9.46596    0.94210  10.0478 < 2.2e-16 ***
## sd.certificate_UK     10.93233    0.92275  11.8476 < 2.2e-16 ***
## sd.project_renewable  14.61455    1.10346  13.2443 < 2.2e-16 ***
## sd.project_landfill   10.90067    1.08531  10.0438 < 2.2e-16 ***
## sd.project_manure     14.35313    1.06609  13.4634 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

mixed logit + co2 consumption

mixed logit + co2 consumption Coefficients

```
##
## Model estimated on: Mon Nov 11 08:34:19 PM 2024
##
## Call:
## gmnl(formula = f, data = dt, model = "mixl", ranp = randpar,
##     R = 2000, haltons = NA, mvar = mvarlist_ctr_e, panel = T,
##     method = "bhhh", iterlim = 5000)
##
## Frequencies of categories:
##
```

```
##        1        2        3        4        5        6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 0h:27m:49s
##
## Coefficients:
##                                Estimate  Std. Error  z-value  Pr(>|z|)
## price                       -0.05654390  0.00260875 -21.6747 < 2.2e-16 ***
## I                           -2.59610283  0.08398051 -30.9132 < 2.2e-16 ***
## location_EU                 -0.01400703  0.04049285  -0.3459 0.7294076
## location_UK                  0.47578771  0.03965356  11.9986 < 2.2e-16 ***
## certificate_NGO              0.30034662  0.04034475   7.4445 9.726e-14 ***
## certificate_UK               0.68517300  0.04288756  15.9760 < 2.2e-16 ***
## project_renewable            0.25020629  0.04595092   5.4451 5.178e-08 ***
## project_landfill            -0.60168140  0.05349095 -11.2483 < 2.2e-16 ***
## project_manure              -0.32213100  0.04775785  -6.7451 1.529e-11 ***
## I.co2_value                  0.20169695  0.03218652   6.2665 3.692e-10 ***
## location_EU.co2_value       -0.01355635  0.01984155  -0.6832 0.4944611
## location_UK.co2_value       -0.07461066  0.01873876  -3.9816 6.845e-05 ***
## certificate_NGO.co2_value   -0.06681580  0.01962825  -3.4041 0.0006639 ***
## certificate_UK.co2_value    -0.04382327  0.01996544  -2.1950 0.0281667 *
## project_renewable.co2_value -0.00022583  0.02194946  -0.0103 0.9917911
## project_landfill.co2_value   0.07378631  0.02562846   2.8791 0.0039884 **
## project_manure.co2_value     0.04415989  0.02315591   1.9071 0.0565118 .
## sd.I                         2.90656420  0.07695297  37.7707 < 2.2e-16 ***
## sd.location_EU               0.63355281  0.03830623  16.5392 < 2.2e-16 ***
## sd.location_UK               0.81893373  0.03770799  21.7178 < 2.2e-16 ***
## sd.certificate_NGO           0.52734596  0.04456089  11.8343 < 2.2e-16 ***
## sd.certificate_UK            0.61124872  0.03936717  15.5269 < 2.2e-16 ***
## sd.project_renewable         0.82290309  0.04299883  19.1378 < 2.2e-16 ***
## sd.project_landfill          0.60656876  0.05175610  11.7198 < 2.2e-16 ***
## sd.project_manure            0.81115005  0.04190579  19.3565 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -16708
## Number of observations: 12760
## Number of iterations: 41
## Exit of MLE: successive function values within relative tolerance limit (reltol)
## Simulation based on 2000 draws
```

Note that the coefficient for "I.co2_value" measures the utility for opt-out conditional on co2 consumption. This coefficient is positive means lower baseline utility for carbon offsetting.

mixed logit + co2 consumption Willingness to Pay

```
##
## Willigness-to-pay respect to:  price
##
##                               Estimate  Std. Error  t-value  Pr(>|t|)
## I                          -45.9130501   3.1462364 -14.5930 < 2.2e-16 ***
## location_EU                 -0.2477196   0.7169734  -0.3455 0.7297130
```

```
## location_UK                   8.4144838   0.8232108  10.2215 < 2.2e-16 ***
## certificate_NGO               5.3117424   0.7682719   6.9139 4.716e-12 ***
## certificate_UK               12.1175409   1.0232953  11.8417 < 2.2e-16 ***
## project_renewable             4.4249919   0.8292583   5.3361 9.498e-08 ***
## project_landfill            -10.6409608   1.0955786  -9.7126 < 2.2e-16 ***
## project_manure               -5.6970073   0.8631328  -6.6004 4.101e-11 ***
## I.co2_value                   3.5670860   0.5926035   6.0193 1.751e-09 ***
## location_EU.co2_value        -0.2397492   0.3510885  -0.6829 0.4946866
## location_UK.co2_value        -1.3195175   0.3382106  -3.9015 9.561e-05 ***
## certificate_NGO.co2_value    -1.1816624   0.3526752  -3.3506 0.0008065 ***
## certificate_UK.co2_value     -0.7750310   0.3558102  -2.1782 0.0293901 *
## project_renewable.co2_value  -0.0039938   0.3881852  -0.0103 0.9917911
## project_landfill.co2_value    1.3049384   0.4575387   2.8521 0.0043434 **
## project_manure.co2_value      0.7809842   0.4113982   1.8984 0.0576479 .
## sd.I                         51.4036756   2.8739322  17.8862 < 2.2e-16 ***
## sd.location_EU               11.2046186   0.9261326  12.0983 < 2.2e-16 ***
## sd.location_UK               14.4831495   1.0173555  14.2361 < 2.2e-16 ***
## sd.certificate_NGO            9.3263106   0.9470515   9.8477 < 2.2e-16 ***
## sd.certificate_UK            10.8101624   0.9261396  11.6723 < 2.2e-16 ***
## sd.project_renewable         14.5533491   1.1043075  13.1787 < 2.2e-16 ***
## sd.project_landfill          10.7273954   1.0947671   9.7988 < 2.2e-16 ***
## sd.project_manure            14.3454922   1.0691193  13.4180 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

mixed logit + framing effect

mixed logit + framing effect Coefficients

```
##
## Model estimated on: Mon Nov 11 08:34:19 PM 2024
##
## Call:
## gmnl(formula = f, data = dt, model = "mixl", ranp = randpar,
##     R = 2000, haltons = NA, mvar = mvarlist_ctrl_f, panel = T,
##     method = "bhhh", iterlim = 5000)
##
## Frequencies of categories:
##
##        1        2        3        4        5        6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 0h:31m:53s
##
## Coefficients:
##                                          Estimate Std. Error  z-value  Pr(>|z|)
## price                                  -0.0567011  0.0026150 -21.6829 < 2.2e-16 ***
## I                                      -2.4051778  0.0997483 -24.1125 < 2.2e-16 ***
## location_EU                             0.0586052  0.0562328   1.0422 0.2973243
## location_UK                             0.4158360  0.0549578   7.5665 3.841e-14 ***
## certificate_NGO                         0.1872555  0.0553873   3.3808 0.0007226 ***
## certificate_UK                          0.6217519  0.0593334  10.4789 < 2.2e-16 ***
```

```
## project_renewable                              0.2443827  0.0633107   3.8601 0.0001134 ***
## project_landfill                              -0.5139291  0.0747136  -6.8787 6.042e-12 ***
## project_manure                                -0.3546322  0.0662622  -5.3520 8.701e-08 ***
## I.framing_effectconsequence                   -0.1133359  0.1218870  -0.9298 0.3524519
## I.framing_effectMetOffice                      0.2120373  0.1031619   2.0554 0.0398420 *
## I.framing_effectUN                            -0.0026007  0.1201287  -0.0216 0.9827277
## location_EU.framing_effectconsequence         -0.0916926  0.0787856  -1.1638 0.2444953
## location_EU.framing_effectMetOffice           -0.1357801  0.0675733  -2.0094 0.0444975 *
## location_EU.framing_effectUN                  -0.1036988  0.0787782  -1.3163 0.1880601
## location_UK.framing_effectconsequence         -0.1082280  0.0769819  -1.4059 0.1597569
## location_UK.framing_effectMetOffice           -0.0430491  0.0656822  -0.6554 0.5122002
## location_UK.framing_effectUN                  -0.0406622  0.0757156  -0.5370 0.5912411
## certificate_NGO.framing_effectconsequence      0.0233037  0.0786311   0.2964 0.7669498
## certificate_NGO.framing_effectMetOffice        0.0105095  0.0671651   0.1565 0.8756610
## certificate_NGO.framing_effectUN               0.0044858  0.0778144   0.0576 0.9540292
## certificate_UK.framing_effectconsequence      -0.0385091  0.0813694  -0.4733 0.6360255
## certificate_UK.framing_effectMetOffice         0.0149383  0.0696794   0.2144 0.8302457
## certificate_UK.framing_effectUN               -0.0131673  0.0808431  -0.1629 0.8706171
## project_renewable.framing_effectconsequence    0.0973237  0.0903183   1.0776 0.2812284
## project_renewable.framing_effectMetOffice     -0.0822648  0.0763485  -1.0775 0.2812611
## project_renewable.framing_effectUN             0.0975909  0.0886033   1.1014 0.2707065
## project_landfill.framing_effectconsequence     0.0736738  0.1049719   0.7018 0.4827774
## project_landfill.framing_effectMetOffice      -0.0080229  0.0896247  -0.0895 0.9286717
## project_landfill.framing_effectUN              0.0691378  0.1029094   0.6718 0.5016910
## project_manure.framing_effectconsequence       0.0899468  0.0926874   0.9704 0.3318312
## project_manure.framing_effectMetOffice         0.1628706  0.0795047   2.0486 0.0405046 *
## project_manure.framing_effectUN                0.1036882  0.0922537   1.1239 0.2610359
## sd.I                                           2.8893123  0.0765411  37.7485 < 2.2e-16 ***
## sd.location_EU                                 0.6306618  0.0383360  16.4509 < 2.2e-16 ***
## sd.location_UK                                 0.8203273  0.0371909  22.0572 < 2.2e-16 ***
## sd.certificate_NGO                             0.5347654  0.0438317  12.2004 < 2.2e-16 ***
## sd.certificate_UK                              0.6191049  0.0390368  15.8595 < 2.2e-16 ***
## sd.project_renewable                           0.8201365  0.0430001  19.0729 < 2.2e-16 ***
## sd.project_landfill                            0.6153003  0.0510482  12.0533 < 2.2e-16 ***
## sd.project_manure                              0.8104552  0.0418911  19.3467 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -16714
## Number of observations: 12760
## Number of iterations: 46
## Exit of MLE: successive function values within relative tolerance limit (reltol)
## Simulation based on 2000 draws
```

mixed logit + framing effect Willingness to Pay

```
##
## Willigness-to-pay respect to:  price
##
##                                          Estimate Std. Error  t-value  Pr(>|t|)
## I                                      -42.418529   3.131848 -13.5442 < 2.2e-16 ***
## location_EU                              1.033580   0.991331   1.0426 0.2971246
```

```
## location_UK                                    7.333825   1.040362   7.0493 1.798e-12 ***
## certificate_NGO                                3.302501   0.993044   3.3256 0.0008822 ***
## certificate_UK                                10.965427   1.215538   9.0210 < 2.2e-16 ***
## project_renewable                              4.310016   1.125862   3.8282 0.0001291 ***
## project_landfill                              -9.063828   1.402890  -6.4608 1.041e-10 ***
## project_manure                                -6.254414   1.187324  -5.2677 1.382e-07 ***
## I.framing_effectconsequence                   -1.998830   2.153275  -0.9283 0.3532653
## I.framing_effectMetOffice                      3.739562   1.825997   2.0480 0.0405643 *
## I.framing_effectUN                            -0.045867   2.118669  -0.0216 0.9827280
## location_EU.framing_effectconsequence         -1.617122   1.392511  -1.1613 0.2455204
## location_EU.framing_effectMetOffice           -2.394663   1.199051  -1.9971 0.0458109 *
## location_EU.framing_effectUN                  -1.828867   1.392193  -1.3137 0.1889611
## location_UK.framing_effectconsequence         -1.908746   1.360680  -1.4028 0.1606798
## location_UK.framing_effectMetOffice           -0.759229   1.159158  -0.6550 0.5124785
## location_UK.framing_effectUN                  -0.717132   1.335892  -0.5368 0.5913930
## certificate_NGO.framing_effectconsequence      0.410991   1.387007   0.2963 0.7669894
## certificate_NGO.framing_effectMetOffice        0.185348   1.184560   0.1565 0.8756625
## certificate_NGO.framing_effectUN               0.079114   1.372396   0.0576 0.9540304
## certificate_UK.framing_effectconsequence      -0.679160   1.435347  -0.4732 0.6360934
## certificate_UK.framing_effectMetOffice         0.263457   1.228949   0.2144 0.8302538
## certificate_UK.framing_effectUN               -0.232223   1.425708  -0.1629 0.8706110
## project_renewable.framing_effectconsequence    1.716434   1.595860   1.0756 0.2821267
## project_renewable.framing_effectMetOffice     -1.450850   1.348002  -1.0763 0.2817943
## project_renewable.framing_effectUN             1.721147   1.565664   1.0993 0.2716339
## project_landfill.framing_effectconsequence     1.299336   1.852696   0.7013 0.4831024
## project_landfill.framing_effectMetOffice      -0.141494   1.580654  -0.0895 0.9286719
## project_landfill.framing_effectUN              1.219337   1.815903   0.6715 0.5019168
## project_manure.framing_effectconsequence       1.586333   1.637139   0.9690 0.3325619
## project_manure.framing_effectMetOffice         2.872441   1.409681   2.0377 0.0415846 *
## project_manure.framing_effectUN                1.828680   1.628711   1.1228 0.2615319
## sd.I                                          50.956890   2.847997  17.8922 < 2.2e-16 ***
## sd.location_EU                                11.122566   0.921554  12.0694 < 2.2e-16 ***
## sd.location_UK                                14.467569   1.008437  14.3465 < 2.2e-16 ***
## sd.certificate_NGO                             9.431303   0.937047  10.0649 < 2.2e-16 ***
## sd.certificate_UK                             10.918743   0.923324  11.8255 < 2.2e-16 ***
## sd.project_renewable                          14.464206   1.099558  13.1546 < 2.2e-16 ***
## sd.project_landfill                           10.851645   1.085342   9.9984 < 2.2e-16 ***
## sd.project_manure                             14.293462   1.065448  13.4154 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

mixed logit + co2 consumption + framing effect

mixed logit + co2 consumption + framing effect Coefficients

```
##
## Model estimated on: Mon Nov 11 08:34:19 PM 2024
##
## Call:
## gmnl(formula = f, data = dt, model = "mixl", ranp = randpar,
##     R = 2000, haltons = NA, mvar = mvarlist_ctrl_ef, panel = T,
##     method = "bhhh", iterlim = 5000)
```

```
##
## Frequencies of categories:
##
##        1        2        3        4        5        6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 0h:38m:35s
##
## Coefficients:
##                                                Estimate  Std. Error  z-value  Pr(>|z|)
## price                                       -0.05651981  0.00260902 -21.6633 < 2.2e-16 ***
## I                                           -2.68215135  0.11300019 -23.7358 < 2.2e-16 ***
## location_EU                                  0.07458409  0.06390540   1.1671 0.2431694
## location_UK                                  0.53913769  0.06237044   8.6441 < 2.2e-16 ***
## certificate_NGO                              0.28490181  0.06313142   4.5128 6.397e-06 ***
## certificate_UK                               0.68638455  0.06712155  10.2260 < 2.2e-16 ***
## project_renewable                            0.24656755  0.07220467   3.4148 0.0006382 ***
## project_landfill                            -0.62679786  0.08486867  -7.3855 1.519e-13 ***
## project_manure                              -0.41703503  0.07521362  -5.5447 2.945e-08 ***
## I.co2_value                                  0.21220235  0.03230951   6.5678 5.106e-11 ***
## I.framing_effectconsequence                 -0.18490422  0.12194513  -1.5163 0.1294460
## I.framing_effectMetOffice                    0.22884590  0.10304475   2.2208 0.0263618 *
## I.framing_effectUN                           0.00686357  0.12006232   0.0572 0.9544124
## location_EU.co2_value                       -0.01238052  0.01985709  -0.6235 0.5329683
## location_EU.framing_effectconsequence       -0.08890881  0.07870672  -1.1296 0.2586357
## location_EU.framing_effectMetOffice         -0.13224441  0.06748742  -1.9595 0.0500494 .
## location_EU.framing_effectUN                -0.10004740  0.07875628  -1.2703 0.2039629
## location_UK.co2_value                       -0.07642822  0.01877194  -4.0714 4.673e-05 ***
## location_UK.framing_effectconsequence       -0.11561250  0.07680957  -1.5052 0.1322769
## location_UK.framing_effectMetOffice         -0.05780051  0.06551100  -0.8823 0.3776133
## location_UK.framing_effectUN                -0.05218670  0.07552855  -0.6910 0.4895949
## certificate_NGO.co2_value                   -0.06590338  0.01966305  -3.3516 0.0008034 ***
## certificate_NGO.framing_effectconsequence    0.02578773  0.07849791   0.3285 0.7425224
## certificate_NGO.framing_effectMetOffice      0.01709290  0.06705509   0.2549 0.7987939
## certificate_NGO.framing_effectUN             0.01174897  0.07771622   0.1512 0.8798354
## certificate_UK.co2_value                    -0.04418181  0.01997914  -2.2114 0.0270083 *
## certificate_UK.framing_effectconsequence    -0.03041914  0.08119715  -0.3746 0.7079333
## certificate_UK.framing_effectMetOffice       0.01764233  0.06951591   0.2538 0.7996590
## certificate_UK.framing_effectUN             -0.00702314  0.08070727  -0.0870 0.9306557
## project_renewable.co2_value                  0.00070152  0.02197470   0.0319 0.9745325
## project_renewable.framing_effectconsequence  0.09301744  0.09023179   1.0309 0.3026008
## project_renewable.framing_effectMetOffice   -0.08806715  0.07624685  -1.1550 0.2480795
## project_renewable.framing_effectUN           0.10027039  0.08859862   1.1317 0.2577447
## project_landfill.co2_value                   0.07410465  0.02567466   2.8863 0.0038981 **
## project_landfill.framing_effectconsequence   0.07173761  0.10477122   0.6847 0.4935287
## project_landfill.framing_effectMetOffice    -0.01280449  0.08943450  -0.1432 0.8861545
## project_landfill.framing_effectUN            0.06480529  0.10269863   0.6310 0.5280249
## project_manure.co2_value                     0.04325890  0.02319668   1.8649 0.0621990 .
## project_manure.framing_effectconsequence     0.08727852  0.09255894   0.9430 0.3457061
## project_manure.framing_effectMetOffice       0.15489473  0.07938697   1.9511 0.0510409 .
## project_manure.framing_effectUN              0.09296383  0.09207416   1.0097 0.3126570
## sd.I                                         2.89309445  0.07691874  37.6123 < 2.2e-16 ***
## sd.location_EU                               0.63356922  0.03865070  16.3922 < 2.2e-16 ***
## sd.location_UK                               0.82160720  0.03772922  21.7764 < 2.2e-16 ***
```

```
## sd.certificate_NGO                              0.52456617  0.04414867  11.8818 < 2.2e-16 ***
## sd.certificate_UK                               0.60974293  0.03938647  15.4810 < 2.2e-16 ***
## sd.project_renewable                            0.81485474  0.04293701  18.9779 < 2.2e-16 ***
## sd.project_landfill                             0.60693251  0.05161894  11.7579 < 2.2e-16 ***
## sd.project_manure                               0.80663644  0.04199659  19.2072 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -16699
## Number of observations: 12760
## Number of iterations: 55
## Exit of MLE: successive function values within relative tolerance limit (reltol)
## Simulation based on 2000 draws
```

The effect of co2 consumption is statistically significant and negative. However, the effect of framing effect is largely not statistically significant, and Met Office has a adverse effect on the preference for carbon offsetting and only shift the overall preference, not the preference for carbon offsetting features.

mixed logit + co2 consumption + framing effect Willingness to Pay

```
##
## Willigness-to-pay respect to:  price
##
##                                                Estimate Std. Error  t-value  Pr(>|t|)
## I                                            -47.455064   3.467141 -13.6871 < 2.2e-16 ***
## location_EU                                    1.319610   1.130404   1.1674 0.2430576
## location_UK                                    9.538915   1.207875   7.8973 2.887e-15 ***
## certificate_NGO                                5.040742   1.148956   4.3872 1.148e-05 ***
## certificate_UK                                12.144141   1.370933   8.8583 < 2.2e-16 ***
## project_renewable                              4.362498   1.286161   3.3919 0.0006942 ***
## project_landfill                             -11.089879   1.609317  -6.8910 5.538e-12 ***
## project_manure                                -7.378564   1.357612  -5.4350 5.481e-08 ***
## I.co2_value                                    3.754477   0.597212   6.2867 3.243e-10 ***
## I.framing_effectconsequence                   -3.271494   2.165773  -1.5105 0.1309049
## I.framing_effectMetOffice                      4.048950   1.831300   2.2110 0.0270379 *
## I.framing_effectUN                             0.121436   2.124163   0.0572 0.9544105
## location_EU.co2_value                         -0.219047   0.351474  -0.6232 0.5331369
## location_EU.framing_effectconsequence         -1.573056   1.395335  -1.1274 0.2595872
## location_EU.framing_effectMetOffice           -2.339789   1.200715  -1.9487 0.0513358 .
## location_EU.framing_effectUN                  -1.770130   1.396010  -1.2680 0.2048008
## location_UK.co2_value                         -1.352238   0.339309  -3.9853 6.740e-05 ***
## location_UK.framing_effectconsequence         -2.045522   1.362497  -1.5013 0.1332772
## location_UK.framing_effectMetOffice           -1.022659   1.160447  -0.8813 0.3781753
## location_UK.framing_effectUN                  -0.923335   1.337249  -0.6905 0.4898966
## certificate_NGO.co2_value                     -1.166023   0.353343  -3.3000 0.0009669 ***
## certificate_NGO.framing_effectconsequence      0.456260   1.389163   0.3284 0.7425773
## certificate_NGO.framing_effectMetOffice        0.302423   1.186487   0.2549 0.7988083
## certificate_NGO.framing_effectUN               0.207874   1.375152   0.1512 0.8798463
## certificate_UK.co2_value                      -0.781705   0.356253  -2.1942 0.0282181 *
## certificate_UK.framing_effectconsequence      -0.538203   1.436733  -0.3746 0.7079564
## certificate_UK.framing_effectMetOffice         0.312144   1.230049   0.2538 0.7996766
## certificate_UK.framing_effectUN               -0.124260   1.427895  -0.0870 0.9306532
```

```
## project_renewable.co2_value                    0.012412   0.388795   0.0319 0.9745324
## project_renewable.framing_effectconsequence    1.645749   1.599284   1.0291 0.3034544
## project_renewable.framing_effectMetOffice     -1.558164   1.350702  -1.1536 0.2486661
## project_renewable.framing_effectUN             1.774075   1.570890   1.1293 0.2587528
## project_landfill.co2_value                     1.311127   0.458600   2.8590 0.0042501 **
## project_landfill.framing_effectconsequence     1.269247   1.855086   0.6842 0.4938498
## project_landfill.framing_effectMetOffice      -0.226549   1.582371  -0.1432 0.8861556
## project_landfill.framing_effectUN              1.146594   1.817892   0.6307 0.5282187
## project_manure.co2_value                       0.765376   0.412218   1.8567 0.0633500 .
## project_manure.framing_effectconsequence       1.544211   1.640067   0.9416 0.3464212
## project_manure.framing_effectMetOffice         2.740539   1.411395   1.9417 0.0521705 .
## project_manure.framing_effectUN                1.644801   1.630377   1.0088 0.3130481
## sd.I                                          51.187262   2.866433  17.8575 < 2.2e-16 ***
## sd.location_EU                                11.209684   0.931531  12.0336 < 2.2e-16 ***
## sd.location_UK                                14.536623   1.021163  14.2354 < 2.2e-16 ***
## sd.certificate_NGO                             9.281102   0.940100   9.8725 < 2.2e-16 ***
## sd.certificate_UK                             10.788127   0.925935  11.6511 < 2.2e-16 ***
## sd.project_renewable                          14.417152   1.098714  13.1218 < 2.2e-16 ***
## sd.project_landfill                           10.738403   1.093915   9.8165 < 2.2e-16 ***
## sd.project_manure                             14.271747   1.068443  13.3575 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

mixed logit + 1 PCA + reduced demographic controls

Here we included the first component for Q9 and Q10. Q9 was about respondents' attitude towards carbon offsetting, and Q10 was about respondents' attitude towards climate change.

mixed logit + 1 PCA + reduced demographic controls Coefficients

```
##
## Model estimated on: Mon Nov 11 08:34:19 PM 2024
##
## Call:
## gmnl(formula = f, data = dt, model = "mixl", ranp = randpar,
##     R = 2000, haltons = NA, mvar = mvarlist_p1rd, panel = T,
##     method = "bhhh", iterlim = 5000)
##
## Frequencies of categories:
##
##        1        2        3        4        5        6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 0h:51m:50s
##
## Coefficients:
##                                    Estimate Std. Error  z-value  Pr(>|z|)
## price                            -0.0566745  0.0026130 -21.6895 < 2.2e-16 ***
## I                                -1.8397848  0.1061671 -17.3291 < 2.2e-16 ***
## location_EU                      -0.0354114  0.0624800  -0.5668 0.5708742
## location_UK                       0.1421420  0.0616293   2.3064 0.0210881 *
## certificate_NGO                   0.0525118  0.0632784   0.8299 0.4066213
```

```
## certificate_UK                          0.4371251  0.0647878   6.7470 1.509e-11 ***
## project_renewable                       0.3050207  0.0716099   4.2595 2.049e-05 ***
## project_landfill                       -0.5295554  0.0838596  -6.3148 2.705e-10 ***
## project_manure                         -0.3813855  0.0741248  -5.1452 2.673e-07 ***
## I.Q9_PC1                               -0.5702213  0.0230013 -24.7909 < 2.2e-16 ***
## I.Q10_PC1                              -0.0325002  0.0136107  -2.3878 0.0169476 *
## I.age_group35_54                       -0.3128254  0.0905639  -3.4542 0.0005519 ***
## I.age_group55_                         -0.3978648  0.1095424  -3.6321 0.0002812 ***
## I.is_women                             -0.1190068  0.0777873  -1.5299 0.1260418
## I.income_level30_50k                   -0.3212763  0.0888235  -3.6170 0.0002980 ***
## I.income_level50_                      -0.2414343  0.0964924  -2.5021 0.0123457 *
## location_EU.Q9_PC1                      0.0362322  0.0113766   3.1848 0.0014485 **
## location_EU.Q10_PC1                     0.0090002  0.0088073   1.0219 0.3068282
## location_EU.age_group35_54             -0.0126347  0.0587045  -0.2152 0.8295913
## location_EU.age_group55_                0.0056736  0.0716289   0.0792 0.9368672
## location_EU.is_women                   -0.0276787  0.0503239  -0.5500 0.5823110
## location_EU.income_level30_50k          0.0431326  0.0577400   0.7470 0.4550545
## location_EU.income_level50_             0.0373230  0.0620952   0.6011 0.5477993
## location_UK.Q9_PC1                      0.0243466  0.0112892   2.1566 0.0310350 *
## location_UK.Q10_PC1                     0.0501428  0.0086612   5.7894 7.064e-09 ***
## location_UK.age_group35_54              0.2217705  0.0573124   3.8695 0.0001091 ***
## location_UK.age_group55_                0.3703226  0.0699331   5.2954 1.188e-07 ***
## location_UK.is_women                    0.0026899  0.0489944   0.0549 0.9562156
## location_UK.income_level30_50k          0.0559480  0.0560452   0.9983 0.3181502
## location_UK.income_level50_             0.0032304  0.0607880   0.0531 0.9576181
## certificate_NGO.Q9_PC1                  0.0642834  0.0112894   5.6941 1.240e-08 ***
## certificate_NGO.Q10_PC1                 0.0073295  0.0088820   0.8252 0.4092556
## certificate_NGO.age_group35_54          0.0834503  0.0588152   1.4189 0.1559410
## certificate_NGO.age_group55_            0.0366624  0.0709806   0.5165 0.6054964
## certificate_NGO.is_women                0.0823310  0.0504016   1.6335 0.1023642
## certificate_NGO.income_level30_50k      0.1931871  0.0575951   3.3542 0.0007959 ***
## certificate_NGO.income_level50_        -0.0292557  0.0625423  -0.4678 0.6399464
## certificate_UK.Q9_PC1                   0.0714443  0.0119022   6.0026 1.942e-09 ***
## certificate_UK.Q10_PC1                  0.0047380  0.0090416   0.5240 0.6002608
## certificate_UK.age_group35_54           0.1172845  0.0603139   1.9446 0.0518268 .
## certificate_UK.age_group55_             0.1491709  0.0737731   2.0220 0.0431740 *
## certificate_UK.is_women                 0.1209004  0.0515782   2.3440 0.0190770 *
## certificate_UK.income_level30_50k       0.0844009  0.0592922   1.4235 0.1545985
## certificate_UK.income_level50_         -0.0420565  0.0637771  -0.6594 0.5096194
## project_renewable.Q9_PC1                0.0152133  0.0128690   1.1822 0.2371404
## project_renewable.Q10_PC1               0.0017410  0.0099901   0.1743 0.8616488
## project_renewable.age_group35_54       -0.0949420  0.0665940  -1.4257 0.1539596
## project_renewable.age_group55_         -0.1732817  0.0814929  -2.1263 0.0334750 *
## project_renewable.is_women              0.0559512  0.0571852   0.9784 0.3278657
## project_renewable.income_level30_50k    0.1095132  0.0657906   1.6646 0.0959979 .
## project_renewable.income_level50_      -0.0974908  0.0706750  -1.3794 0.1677637
## project_landfill.Q9_PC1                -0.0292459  0.0158419  -1.8461 0.0648770 .
## project_landfill.Q10_PC1               -0.0529726  0.0117784  -4.4974 6.878e-06 ***
## project_landfill.age_group35_54        -0.1069559  0.0776448  -1.3775 0.1683568
## project_landfill.age_group55_          -0.0602176  0.0942186  -0.6391 0.5227409
## project_landfill.is_women               0.0284416  0.0667590   0.4260 0.6700837
## project_landfill.income_level30_50k     0.2667263  0.0763892   3.4917 0.0004800 ***
## project_landfill.income_level50_        0.0486266  0.0828672   0.5868 0.5573370
## project_manure.Q9_PC1                  -0.0171028  0.0133481  -1.2813 0.2000919
```

```
## project_manure.Q10_PC1               -0.0450975  0.0103945  -4.3386 1.434e-05 ***
## project_manure.age_group35_54         0.1166215  0.0691159   1.6873 0.0915396 .
## project_manure.age_group55_           0.1719010  0.0840237   2.0459 0.0407698 *
## project_manure.is_women               0.0364884  0.0590866   0.6175 0.5368782
## project_manure.income_level30_50k    -0.0265988  0.0675119  -0.3940 0.6935911
## project_manure.income_level50_        0.0969564  0.0733434   1.3220 0.1861846
## sd.I                                  2.4897335  0.0680959  36.5621 < 2.2e-16 ***
## sd.location_EU                        0.6433838  0.0378505  16.9980 < 2.2e-16 ***
## sd.location_UK                        0.7826307  0.0376645  20.7790 < 2.2e-16 ***
## sd.certificate_NGO                    0.5058978  0.0446841  11.3216 < 2.2e-16 ***
## sd.certificate_UK                     0.5947573  0.0402727  14.7683 < 2.2e-16 ***
## sd.project_renewable                  0.8261138  0.0433510  19.0564 < 2.2e-16 ***
## sd.project_landfill                   0.5823501  0.0512732  11.3578 < 2.2e-16 ***
## sd.project_manure                     0.7966691  0.0415196  19.1878 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -16470
## Number of observations: 12760
## Number of iterations: 70
## Exit of MLE: successive function values within relative tolerance limit (reltol)
## Simulation based on 2000 draws
```

mixed logit + 1 PCA + reduced demographic controls Willingness to Pay

```
##
## Willigness-to-pay respect to:  price
##
##                                    Estimate Std. Error  t-value  Pr(>|t|)
## I                                -32.462278   2.823314 -11.4979 < 2.2e-16 ***
## location_EU                       -0.624821   1.103851  -0.5660 0.5713687
## location_UK                        2.508039   1.095246   2.2899 0.0220253 *
## certificate_NGO                    0.926550   1.117969   0.8288 0.4072290
## certificate_UK                     7.712900   1.226710   6.2875 3.227e-10 ***
## project_renewable                  5.381970   1.285346   4.1872 2.824e-05 ***
## project_landfill                  -9.343797   1.561943  -5.9822 2.202e-09 ***
## project_manure                    -6.729396   1.328167  -5.0667 4.048e-07 ***
## I.Q9_PC1                         -10.061330   0.638751 -15.7516 < 2.2e-16 ***
## I.Q10_PC1                         -0.573454   0.241472  -2.3748 0.0175575 *
## I.age_group35_54                  -5.519681   1.619518  -3.4082 0.0006539 ***
## I.age_group55_                    -7.020167   1.958909  -3.5837 0.0003387 ***
## I.is_women                        -2.099827   1.377199  -1.5247 0.1273316
## I.income_level30_50k              -5.668794   1.589054  -3.5674 0.0003605 ***
## I.income_level50_                 -4.260012   1.714242  -2.4851 0.0129526 *
## location_EU.Q9_PC1                 0.639303   0.203810   3.1368 0.0017083 **
## location_EU.Q10_PC1                0.158805   0.155642   1.0203 0.3075737
## location_EU.age_group35_54        -0.222935   1.036001  -0.2152 0.8296210
## location_EU.age_group55_           0.100108   1.263859   0.0792 0.9368670
## location_EU.is_women              -0.488380   0.888412  -0.5497 0.5825096
## location_EU.income_level30_50k     0.761058   1.019704   0.7464 0.4554548
## location_EU.income_level50_        0.658550   1.096346   0.6007 0.5480552
## location_UK.Q9_PC1                 0.429586   0.200088   2.1470 0.0317948 *
```

```
## location_UK.Q10_PC1                    0.884750   0.159338   5.5527 2.813e-08 ***
## location_UK.age_group35_54             3.913053   1.031976   3.7918 0.0001496 ***
## location_UK.age_group55_               6.534196   1.279522   5.1067 3.278e-07 ***
## location_UK.is_women                   0.047463   0.864504   0.0549 0.9562165
## location_UK.income_level30_50k         0.987180   0.989803   0.9974 0.3185944
## location_UK.income_level50_            0.057000   1.072585   0.0531 0.9576183
## certificate_NGO.Q9_PC1                 1.134255   0.206916   5.4817 4.212e-08 ***
## certificate_NGO.Q10_PC1                0.129326   0.156863   0.8244 0.4096844
## certificate_NGO.age_group35_54         1.472448   1.040890   1.4146 0.1571843
## certificate_NGO.age_group55_           0.646893   1.253142   0.5162 0.6057028
## certificate_NGO.is_women               1.452698   0.892238   1.6281 0.1034932
## certificate_NGO.income_level30_50k     3.408711   1.031011   3.3062 0.0009458 ***
## certificate_NGO.income_level50_       -0.516204   1.104046  -0.4676 0.6401015
## certificate_UK.Q9_PC1                  1.260606   0.219800   5.7352 9.737e-09 ***
## certificate_UK.Q10_PC1                 0.083600   0.159659   0.5236 0.6005437
## certificate_UK.age_group35_54          2.069439   1.071157   1.9320 0.0533637 .
## certificate_UK.age_group55_            2.632061   1.310999   2.0077 0.0446778 *
## certificate_UK.is_women                2.133240   0.915948   2.3290 0.0198593 *
## certificate_UK.income_level30_50k      1.489221   1.049296   1.4193 0.1558242
## certificate_UK.income_level50_        -0.742071   1.126037  -0.6590 0.5098884
## project_renewable.Q9_PC1               0.268433   0.227461   1.1801 0.2379489
## project_renewable.Q10_PC1              0.030720   0.176302   0.1742 0.8616726
## project_renewable.age_group35_54      -1.675214   1.178161  -1.4219 0.1550584
## project_renewable.age_group55_        -3.057487   1.449555  -2.1093 0.0349223 *
## project_renewable.is_women             0.987237   1.009535   0.9779 0.3281177
## project_renewable.income_level30_50k   1.932317   1.163906   1.6602 0.0968743 .
## project_renewable.income_level50_     -1.720187   1.250238  -1.3759 0.1688563
## project_landfill.Q9_PC1               -0.516032   0.280526  -1.8395 0.0658393 .
## project_landfill.Q10_PC1              -0.934681   0.213417  -4.3796 1.189e-05 ***
## project_landfill.age_group35_54       -1.887195   1.373119  -1.3744 0.1693219
## project_landfill.age_group55_         -1.062515   1.663333  -0.6388 0.5229618
## project_landfill.is_women              0.501840   1.178152   0.4260 0.6701404
## project_landfill.income_level30_50k    4.706279   1.370450   3.4341 0.0005945 ***
## project_landfill.income_level50_       0.857997   1.462866   0.5865 0.5575272
## project_manure.Q9_PC1                 -0.301772   0.235955  -1.2789 0.2009190
## project_manure.Q10_PC1                -0.795727   0.187932  -4.2341 2.294e-05 ***
## project_manure.age_group35_54          2.057741   1.223774   1.6815 0.0926714 .
## project_manure.age_group55_            3.033125   1.487845   2.0386 0.0414897 *
## project_manure.is_women                0.643823   1.043031   0.6173 0.5370621
## project_manure.income_level30_50k     -0.469325   1.191376  -0.3939 0.6936287
## project_manure.income_level50_         1.710757   1.296828   1.3192 0.1871071
## sd.I                                  43.930365   2.475166  17.7485 < 2.2e-16 ***
## sd.location_EU                        11.352254   0.920043  12.3388 < 2.2e-16 ***
## sd.location_UK                        13.809209   0.989353  13.9578 < 2.2e-16 ***
## sd.certificate_NGO                     8.926367   0.935613   9.5407 < 2.2e-16 ***
## sd.certificate_UK                     10.494258   0.925142  11.3434 < 2.2e-16 ***
## sd.project_renewable                  14.576452   1.107811  13.1579 < 2.2e-16 ***
## sd.project_landfill                   10.275339   1.071627   9.5885 < 2.2e-16 ***
## sd.project_manure                     14.056913   1.054653  13.3285 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

mixed logit + 1 PCA + full demographic controls

mixed logit + 1 PCA + full demographic controls Coefficients

```
##
## Model estimated on: Mon Nov 11 08:34:19 PM 2024
##
## Call:
## gmnl(formula = f, data = dt, model = "mixl", ranp = randpar,
##     R = 2000, haltons = NA, mvar = mvarlist_p1d, panel = T, method = "bhhh",
##     iterlim = 5000)
##
## Frequencies of categories:
##
##        1        2        3        4        5        6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 0h:49m:21s
##
## Coefficients:
##                                              Estimate Std. Error  z-value  Pr(>|z|)
## price                                      -0.0565876  0.0026150 -21.6393 < 2.2e-16 ***
## I                                          -1.4299251  0.1264840 -11.3052 < 2.2e-16 ***
## location_EU                                 0.0011752  0.0757942   0.0155 0.9876292
## location_UK                                 0.1046603  0.0753352   1.3893 0.1647528
## certificate_NGO                             0.0323132  0.0771402   0.4189 0.6752973
## certificate_UK                              0.4687394  0.0789922   5.9340 2.956e-09 ***
## project_renewable                           0.2759204  0.0881276   3.1309 0.0017426 **
## project_landfill                           -0.3874343  0.1021878  -3.7914 0.0001498 ***
## project_manure                             -0.3376221  0.0900632  -3.7487 0.0001777 ***
## I.Q9_PC1                                   -0.5686219  0.0232293 -24.4786 < 2.2e-16 ***
## I.Q10_PC1                                  -0.0436651  0.0140994  -3.0970 0.0019552 **
## I.age_group35_54                           -0.3465992  0.0927935  -3.7352 0.0001876 ***
## I.age_group55_                             -0.4005661  0.1144193  -3.5009 0.0004638 ***
## I.is_women                                  0.0622320  0.0790935   0.7868 0.4313901
## I.diet_typeFlexitarian                     -0.2962624  0.1046253  -2.8317 0.0046308 **
## I.diet_typeVegan_Vegetarian                -0.2587047  0.1436974  -1.8003 0.0718063 .
## I.education_levelDegree                    -0.3737250  0.0892612  -4.1869 2.828e-05 ***
## I.education_levelPostgraduate              -0.6007503  0.1169459  -5.1370 2.792e-07 ***
## I.income_level30_50k                       -0.3001856  0.0899412  -3.3376 0.0008451 ***
## I.income_level50_                          -0.0729178  0.0993343  -0.7341 0.4629092
## I.where_liveRuralarea                      -0.3721362  0.1293932  -2.8760 0.0040274 **
## I.where_liveTownorsuburb                   -0.2180337  0.0962691  -2.2648 0.0235228 *
## location_EU.Q9_PC1                          0.0350179  0.0114103   3.0690 0.0021480 **
## location_EU.Q10_PC1                         0.0112073  0.0091480   1.2251 0.2205357
## location_EU.age_group35_54                 -0.0094518  0.0598679  -0.1579 0.8745527
## location_EU.age_group55_                    0.0010014  0.0749184   0.0134 0.9893355
## location_EU.is_women                       -0.0239152  0.0508308  -0.4705 0.6380080
## location_EU.diet_typeFlexitarian           -0.0044530  0.0679641  -0.0655 0.9477597
## location_EU.diet_typeVegan_Vegetarian      -0.1043012  0.0927820  -1.1242 0.2609477
## location_EU.education_levelDegree          -0.0176273  0.0581429  -0.3032 0.7617585
## location_EU.education_levelPostgraduate     0.0890987  0.0747133   1.1925 0.2330487
## location_EU.income_level30_50k              0.0406878  0.0586153   0.6942 0.4875880
## location_EU.income_level50_                 0.0158240  0.0648648   0.2440 0.8072662
```

```
## location_EU.where_liveRuralarea                0.0385483  0.0832957   0.4628 0.6435163
## location_EU.where_liveTownorsuburb             -0.0758835  0.0607195  -1.2497 0.2113950
## location_UK.Q9_PC1                              0.0215424  0.0113457   1.8987 0.0575989 .
## location_UK.Q10_PC1                             0.0476276  0.0089355   5.3302 9.812e-08 ***
## location_UK.age_group35_54                      0.1878668  0.0581624   3.2300 0.0012377 **
## location_UK.age_group55_                        0.3142476  0.0731977   4.2931 1.762e-05 ***
## location_UK.is_women                           -0.0174426  0.0495683  -0.3519 0.7249205
## location_UK.diet_typeFlexitarian                0.0276721  0.0657311   0.4210 0.6737630
## location_UK.diet_typeVegan_Vegetarian          -0.0911685  0.0859819  -1.0603 0.2889980
## location_UK.education_levelDegree               0.0433527  0.0563731   0.7690 0.4418747
## location_UK.education_levelPostgraduate         0.0862461  0.0698595   1.2346 0.2169922
## location_UK.income_level30_50k                  0.0515561  0.0566134   0.9107 0.3624701
## location_UK.income_level50_                    -0.0151911  0.0627402  -0.2421 0.8086821
## location_UK.where_liveRuralarea                 0.2223260  0.0813381   2.7334 0.0062692 **
## location_UK.where_liveTownorsuburb              0.0391802  0.0588475   0.6658 0.5055443
## certificate_NGO.Q9_PC1                          0.0653878  0.0113533   5.7594 8.443e-09 ***
## certificate_NGO.Q10_PC1                         0.0115708  0.0092137   1.2558 0.2091791
## certificate_NGO.age_group35_54                  0.0813555  0.0596940   1.3629 0.1729216
## certificate_NGO.age_group55_                    0.0292125  0.0740334   0.3946 0.6931485
## certificate_NGO.is_women                        0.0720382  0.0510241   1.4118 0.1579954
## certificate_NGO.diet_typeFlexitarian            0.0196265  0.0677657   0.2896 0.7721046
## certificate_NGO.diet_typeVegan_Vegetarian      -0.0155915  0.0909668  -0.1714 0.8639110
## certificate_NGO.education_levelDegree           0.1198746  0.0578400   2.0725 0.0382171 *
## certificate_NGO.education_levelPostgraduate     0.1563110  0.0722154   2.1645 0.0304251 *
## certificate_NGO.income_level30_50k              0.1654413  0.0582237   2.8415 0.0044905 **
## certificate_NGO.income_level50_                -0.0783248  0.0649898  -1.2052 0.2281315
## certificate_NGO.where_liveRuralarea             0.1076950  0.0832485   1.2937 0.1957835
## certificate_NGO.where_liveTownorsuburb         -0.0656279  0.0608614  -1.0783 0.2808921
## certificate_UK.Q9_PC1                           0.0724720  0.0119503   6.0645 1.324e-09 ***
## certificate_UK.Q10_PC1                          0.0047731  0.0093473   0.5106 0.6096008
## certificate_UK.age_group35_54                   0.1226947  0.0613285   2.0006 0.0454340 *
## certificate_UK.age_group55_                     0.1627396  0.0772276   2.1073 0.0350940 *
## certificate_UK.is_women                         0.1303832  0.0521845   2.4985 0.0124718 *
## certificate_UK.diet_typeFlexitarian            -0.0983522  0.0700714  -1.4036 0.1604381
## certificate_UK.diet_typeVegan_Vegetarian       -0.0347440  0.0911941  -0.3810 0.7032114
## certificate_UK.education_levelDegree           -0.0293081  0.0597772  -0.4903 0.6239294
## certificate_UK.education_levelPostgraduate      0.0655391  0.0769657   0.8515 0.3944713
## certificate_UK.income_level30_50k               0.0847709  0.0600163   1.4125 0.1578129
## certificate_UK.income_level50_                 -0.0437415  0.0663386  -0.6594 0.5096602
## certificate_UK.where_liveRuralarea             -0.0525788  0.0858717  -0.6123 0.5403423
## certificate_UK.where_liveTownorsuburb          -0.0292477  0.0619789  -0.4719 0.6370001
## project_renewable.Q9_PC1                        0.0149795  0.0128831   1.1627 0.2449409
## project_renewable.Q10_PC1                      -0.0049853  0.0103833  -0.4801 0.6311358
## project_renewable.age_group35_54               -0.0949285  0.0675196  -1.4059 0.1597419
## project_renewable.age_group55_                 -0.1982478  0.0846822  -2.3411 0.0192281 *
## project_renewable.is_women                      0.0756787  0.0579218   1.3066 0.1913597
## project_renewable.diet_typeFlexitarian          0.0012536  0.0767509   0.0163 0.9869680
## project_renewable.diet_typeVegan_Vegetarian    -0.3994856  0.1027449  -3.8881 0.0001010 ***
## project_renewable.education_levelDegree        -0.0589346  0.0659361  -0.8938 0.3714219
## project_renewable.education_levelPostgraduate   0.0262422  0.0833104   0.3150 0.7527667
## project_renewable.income_level30_50k            0.1219965  0.0665752   1.8325 0.0668826 .
## project_renewable.income_level50_              -0.0937445  0.0735702  -1.2742 0.2025859
## project_renewable.where_liveRuralarea           0.1403855  0.0937354   1.4977 0.1342168
## project_renewable.where_liveTownorsuburb        0.0774047  0.0689388   1.1228 0.2615209
```

```
## project_landfill.Q9_PC1                        -0.0285849  0.0159608  -1.7909 0.0733023 .
## project_landfill.Q10_PC1                       -0.0535056  0.0122054  -4.3838 1.166e-05 ***
## project_landfill.age_group35_54                -0.0768729  0.0787259  -0.9765 0.3288352
## project_landfill.age_group55_                  -0.0332841  0.0986685  -0.3373 0.7358664
## project_landfill.is_women                       0.0556740  0.0675297   0.8244 0.4096909
## project_landfill.diet_typeFlexitarian          -0.0875064  0.0889613  -0.9836 0.3252902
## project_landfill.diet_typeVegan_Vegetarian     -0.2987844  0.1175907  -2.5409 0.0110572 *
## project_landfill.education_levelDegree         -0.1685949  0.0768299  -2.1944 0.0282074 *
## project_landfill.education_levelPostgraduate   -0.0015151  0.0950083  -0.0159 0.9872765
## project_landfill.income_level30_50k             0.2863851  0.0771518   3.7120 0.0002057 ***
## project_landfill.income_level50_                0.0709733  0.0854426   0.8307 0.4061684
## project_landfill.where_liveRuralarea           -0.1674051  0.1097358  -1.5255 0.1271272
## project_landfill.where_liveTownorsuburb        -0.1180580  0.0804728  -1.4671 0.1423610
## project_manure.Q9_PC1                          -0.0160689  0.0134070  -1.1985 0.2307060
## project_manure.Q10_PC1                         -0.0496698  0.0107379  -4.6257 3.734e-06 ***
## project_manure.age_group35_54                   0.1231265  0.0703985   1.7490 0.0802923 .
## project_manure.age_group55_                     0.1784130  0.0879447   2.0287 0.0424892 *
## project_manure.is_women                         0.0547837  0.0597180   0.9174 0.3589470
## project_manure.diet_typeFlexitarian            -0.0479483  0.0797368  -0.6013 0.5476190
## project_manure.diet_typeVegan_Vegetarian       -0.1026262  0.1068372  -0.9606 0.3367608
## project_manure.education_levelDegree           -0.1018538  0.0680800  -1.4961 0.1346300
## project_manure.education_levelPostgraduate     -0.1986179  0.0870338  -2.2821 0.0224847 *
## project_manure.income_level30_50k              -0.0036240  0.0683413  -0.0530 0.9577096
## project_manure.income_level50_                  0.1526224  0.0763803   1.9982 0.0456960 *
## project_manure.where_liveRuralarea             -0.0704915  0.0982507  -0.7175 0.4730870
## project_manure.where_liveTownorsuburb           0.0219897  0.0711599   0.3090 0.7573074
## sd.I                                            2.5237430  0.0699574  36.0754 < 2.2e-16 ***
## sd.location_EU                                  0.6427143  0.0382343  16.8099 < 2.2e-16 ***
## sd.location_UK                                  0.7712525  0.0376592  20.4798 < 2.2e-16 ***
## sd.certificate_NGO                              0.4961395  0.0452625  10.9614 < 2.2e-16 ***
## sd.certificate_UK                               0.5945719  0.0405976  14.6455 < 2.2e-16 ***
## sd.project_renewable                            0.8127453  0.0434272  18.7151 < 2.2e-16 ***
## sd.project_landfill                             0.5616025  0.0530610  10.5841 < 2.2e-16 ***
## sd.project_manure                               0.7931390  0.0419036  18.9277 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -16440
## Number of observations: 12760
## Number of iterations: 58
## Exit of MLE: successive function values within relative tolerance limit (reltol)
## Simulation based on 2000 draws
```

mixed logit + 1 PCA + full demographic controls Willingness to Pay

```
##
## Willigness-to-pay respect to:  price
##
##                                          Estimate Std. Error  t-value  Pr(>|t|)
## I                                      -25.269223   2.828089  -8.9351 < 2.2e-16 ***
## location_EU                              0.020768   1.339384   0.0155 0.9876289
## location_UK                              1.849527   1.334903   1.3855 0.1658951
```

```
## certificate_NGO                                0.571029   1.363759   0.4187 0.6754230
## certificate_UK                                 8.283426   1.475331   5.6146 1.970e-08 ***
## project_renewable                              4.875985   1.571535   3.1027 0.0019177 **
## project_landfill                              -6.846626   1.841592  -3.7178 0.0002010 ***
## project_manure                                -5.966359   1.600547  -3.7277 0.0001932 ***
## I.Q9_PC1                                     -10.048521   0.642603 -15.6372 < 2.2e-16 ***
## I.Q10_PC1                                     -0.771638   0.251598  -3.0669 0.0021626 **
## I.age_group35_54                              -6.125001   1.666153  -3.6761 0.0002368 ***
## I.age_group55_                                -7.078688   2.047169  -3.4578 0.0005446 ***
## I.is_women                                     1.099745   1.398479   0.7864 0.4316409
## I.diet_typeFlexitarian                        -5.235464   1.870094  -2.7996 0.0051170 **
## I.diet_typeVegan_Vegetarian                   -4.571755   2.545776  -1.7958 0.0725231 .
## I.education_levelDegree                       -6.604361   1.612894  -4.0947 4.227e-05 ***
## I.education_levelPostgraduate                -10.616286   2.135396  -4.9716 6.641e-07 ***
## I.income_level30_50k                          -5.304793   1.608081  -3.2988 0.0009709 ***
## I.income_level50_                             -1.288583   1.756119  -0.7338 0.4630906
## I.where_liveRuralarea                         -6.576284   2.312388  -2.8439 0.0044560 **
## I.where_liveTownorsuburb                      -3.853028   1.713983  -2.2480 0.0245764 *
## location_EU.Q9_PC1                             0.618826   0.204510   3.0259 0.0024790 **
## location_EU.Q10_PC1                            0.198052   0.162029   1.2223 0.2215862
## location_EU.age_group35_54                    -0.167030   1.058114  -0.1579 0.8745700
## location_EU.age_group55_                       0.017696   1.323930   0.0134 0.9893355
## location_EU.is_women                          -0.422622   0.898655  -0.4703 0.6381531
## location_EU.diet_typeFlexitarian              -0.078693   1.200980  -0.0655 0.9477570
## location_EU.diet_typeVegan_Vegetarian         -1.843181   1.642269  -1.1223 0.2617188
## location_EU.education_levelDegree             -0.311505   1.027556  -0.3032 0.7617748
## location_EU.education_levelPostgraduate        1.574526   1.323327   1.1898 0.2341157
## location_EU.income_level30_50k                 0.719023   1.036699   0.6936 0.4879519
## location_EU.income_level50_                    0.279638   1.146399   0.2439 0.8072874
## location_EU.where_liveRuralarea                0.681214   1.472783   0.4625 0.6436978
## location_EU.where_liveTownorsuburb            -1.340992   1.075463  -1.2469 0.2124353
## location_UK.Q9_PC1                             0.380692   0.201139   1.8927 0.0584000 .
## location_UK.Q10_PC1                            0.841661   0.163755   5.1397 2.751e-07 ***
## location_UK.age_group35_54                     3.319928   1.042430   3.1848 0.0014486 **
## location_UK.age_group55_                       5.553293   1.325245   4.1904 2.785e-05 ***
## location_UK.is_women                          -0.308241   0.876038  -0.3519 0.7249449
## location_UK.diet_typeFlexitarian               0.489013   1.161889   0.4209 0.6738446
## location_UK.diet_typeVegan_Vegetarian         -1.611104   1.521877  -1.0586 0.2897686
## location_UK.education_levelDegree              0.766116   0.997115   0.7683 0.4422893
## location_UK.education_levelPostgraduate        1.524117   1.236289   1.2328 0.2176446
## location_UK.income_level30_50k                 0.911084   1.001353   0.9099 0.3629005
## location_UK.income_level50_                   -0.268452   1.108795  -0.2421 0.8086937
## location_UK.where_liveRuralarea                3.928881   1.451479   2.7068 0.0067932 **
## location_UK.where_liveTownorsuburb             0.692381   1.040575   0.6654 0.5058054
## certificate_NGO.Q9_PC1                         1.155515   0.208803   5.5340 3.130e-08 ***
## certificate_NGO.Q10_PC1                        0.204476   0.163199   1.2529 0.2102350
## certificate_NGO.age_group35_54                 1.437690   1.057876   1.3590 0.1741355
## certificate_NGO.age_group55_                   0.516236   1.308776   0.3944 0.6932552
## certificate_NGO.is_women                       1.273038   0.903724   1.4087 0.1589364
## certificate_NGO.diet_typeFlexitarian           0.346834   1.197898   0.2895 0.7721715
## certificate_NGO.diet_typeVegan_Vegetarian     -0.275529   1.607469  -0.1714 0.8639051
## certificate_NGO.education_levelDegree          2.118389   1.027288   2.0621 0.0391965 *
## certificate_NGO.education_levelPostgraduate    2.762282   1.284306   2.1508 0.0314922 *
## certificate_NGO.income_level30_50k             2.923631   1.039912   2.8114 0.0049323 **
```

```
## certificate_NGO.income_level50_                -1.384133   1.151125  -1.2024 0.2292016
## certificate_NGO.where_liveRuralarea              1.903156   1.473572   1.2915 0.1965217
## certificate_NGO.where_liveTownorsuburb          -1.159758   1.077297  -1.0765 0.2816842
## certificate_UK.Q9_PC1                            1.280703   0.221257   5.7883 7.110e-09 ***
## certificate_UK.Q10_PC1                           0.084349   0.165312   0.5102 0.6098824
## certificate_UK.age_group35_54                    2.168226   1.091159   1.9871 0.0469129 *
## certificate_UK.age_group55_                      2.875887   1.375320   2.0911 0.0365220 *
## certificate_UK.is_women                          2.304094   0.929051   2.4800 0.0131364 *
## certificate_UK.diet_typeFlexitarian             -1.738052   1.240813  -1.4007 0.1612928
## certificate_UK.diet_typeVegan_Vegetarian        -0.613985   1.610994  -0.3811 0.7031127
## certificate_UK.education_levelDegree            -0.517925   1.056742  -0.4901 0.6240529
## certificate_UK.education_levelPostgraduate       1.158189   1.361383   0.8507 0.3949113
## certificate_UK.income_level30_50k                1.498047   1.063592   1.4085 0.1589895
## certificate_UK.income_level50_                  -0.772987   1.173086  -0.6589 0.5099377
## certificate_UK.where_liveRuralarea              -0.929158   1.518700  -0.6118 0.5406626
## certificate_UK.where_liveTownorsuburb           -0.516857   1.095752  -0.4717 0.6371471
## project_renewable.Q9_PC1                         0.264713   0.228035   1.1608 0.2457046
## project_renewable.Q10_PC1                       -0.088099   0.183471  -0.4802 0.6310996
## project_renewable.age_group35_54                -1.677549   1.196435  -1.4021 0.1608787
## project_renewable.age_group55_                  -3.503378   1.510831  -2.3188 0.0204036 *
## project_renewable.is_women                       1.337372   1.024779   1.3050 0.1918808
## project_renewable.diet_typeFlexitarian           0.022154   1.356331   0.0163 0.9869681
## project_renewable.diet_typeVegan_Vegetarian     -7.059593   1.845363  -3.8256 0.0001305 ***
## project_renewable.education_levelDegree         -1.041474   1.166356  -0.8929 0.3718946
## project_renewable.education_levelPostgraduate    0.463745   1.472325   0.3150 0.7527810
## project_renewable.income_level30_50k             2.155886   1.180479   1.8263 0.0678078 .
## project_renewable.income_level50_               -1.656626   1.302908  -1.2715 0.2035567
## project_renewable.where_liveRuralarea            2.480852   1.661586   1.4931 0.1354207
## project_renewable.where_liveTownorsuburb         1.367873   1.219856   1.1213 0.2621431
## project_landfill.Q9_PC1                         -0.505144   0.282997  -1.7850 0.0742648 .
## project_landfill.Q10_PC1                        -0.945536   0.221118  -4.2762 1.901e-05 ***
## project_landfill.age_group35_54                 -1.358475   1.392546  -0.9755 0.3292957
## project_landfill.age_group55_                   -0.588186   1.743821  -0.3373 0.7358926
## project_landfill.is_women                        0.983855   1.194293   0.8238 0.4100551
## project_landfill.diet_typeFlexitarian           -1.546387   1.574052  -0.9824 0.3258906
## project_landfill.diet_typeVegan_Vegetarian      -5.280031   2.091363  -2.5247 0.0115802 *
## project_landfill.education_levelDegree          -2.979360   1.367564  -2.1786 0.0293622 *
## project_landfill.education_levelPostgraduate    -0.026775   1.678970  -0.0159 0.9872766
## project_landfill.income_level30_50k              5.060915   1.388865   3.6439 0.0002685 ***
## project_landfill.income_level50_                 1.254220   1.511485   0.8298 0.4066555
## project_landfill.where_liveRuralarea            -2.958335   1.947314  -1.5192 0.1287154
## project_landfill.where_liveTownorsuburb         -2.086287   1.427224  -1.4618 0.1438016
## project_manure.Q9_PC1                           -0.283964   0.237296  -1.1967 0.2314369
## project_manure.Q10_PC1                          -0.877751   0.195054  -4.5000 6.794e-06 ***
## project_manure.age_group35_54                    2.175857   1.248982   1.7421 0.0814902 .
## project_manure.age_group55_                      3.152863   1.559935   2.0212 0.0432641 *
## project_manure.is_women                          0.968121   1.056399   0.9164 0.3594388
## project_manure.diet_typeFlexitarian             -0.847328   1.410115  -0.6009 0.5479114
## project_manure.diet_typeVegan_Vegetarian        -1.813581   1.890298  -0.9594 0.3373497
## project_manure.education_levelDegree            -1.799931   1.207812  -1.4902 0.1361608
## project_manure.education_levelPostgraduate      -3.509919   1.549662  -2.2650 0.0235153 *
## project_manure.income_level30_50k               -0.064042   1.207701  -0.0530 0.9577093
## project_manure.income_level50_                   2.697099   1.357003   1.9875 0.0468624 *
## project_manure.where_liveRuralarea              -1.245705   1.737875  -0.7168 0.4734989
```

```
## project_manure.where_liveTownorsuburb           0.388596   1.257558   0.3090 0.7573152
## sd.I                                           44.598855   2.525140  17.6619 < 2.2e-16 ***
## sd.location_EU                                 11.357862   0.927872  12.2408 < 2.2e-16 ***
## sd.location_UK                                 13.629351   0.984240  13.8476 < 2.2e-16 ***
## sd.certificate_NGO                              8.767634   0.942959   9.2980 < 2.2e-16 ***
## sd.certificate_UK                              10.507102   0.933360  11.2573 < 2.2e-16 ***
## sd.project_renewable                           14.362600   1.104000  13.0096 < 2.2e-16 ***
## sd.project_landfill                             9.924477   1.092685   9.0827 < 2.2e-16 ***
## sd.project_manure                              14.016124   1.060791  13.2129 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

mixed logit + co2 consumption + framing effect + 2 PCA

We included the first two coponents for Q9 and Q10. Q9 was about respondents' attitude towards carbon offsetting, and Q10 was about respondents' attitude towards climate change.

mixed logit + co2 consumption + framing effect + PCA Coefficients

```
##
## Model estimated on: Mon Nov 11 08:34:23 PM 2024
##
## Call:
## gmnl(formula = f, data = dt, model = "mixl", ranp = randpar,
##     R = 2000, haltons = NA, mvar = mvarlist_efp2, panel = T,
##     method = "bhhh", iterlim = 5000)
##
## Frequencies of categories:
##
##        1        2        3        4        5        6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 0h:24m:44s
##
## Coefficients:
##                                              Estimate  Std. Error  z-value  Pr(>|z|)
## price                                     -0.05665604  0.00261468 -21.6684 < 2.2e-16 ***
## I                                         -2.45775068  0.11108460 -22.1250 < 2.2e-16 ***
## location_EU                                0.05505988  0.06416457   0.8581 0.3908350
## location_UK                                0.46431399  0.06216577   7.4690 8.082e-14 ***
## certificate_NGO                            0.28679618  0.06323529   4.5354 5.750e-06 ***
## certificate_UK                             0.66194413  0.06707072   9.8693 < 2.2e-16 ***
## project_renewable                          0.28607553  0.07232554   3.9554 7.641e-05 ***
## project_landfill                          -0.55833337  0.08435935  -6.6185 3.628e-11 ***
## project_manure                            -0.38049682  0.07517718  -5.0613 4.163e-07 ***
## I.co2_value                               -0.00385277  0.03285302  -0.1173 0.9066438
## I.framing_effectconsequence                0.12062722  0.12158085   0.9922 0.3211212
## I.framing_effectMetOffice                  0.42769437  0.10273490   4.1631 3.140e-05 ***
## I.framing_effectUN                         0.18280529  0.11976740   1.5263 0.1269262
## I.Q9_PC1                                  -0.56730531  0.02304020 -24.6224 < 2.2e-16 ***
## I.Q9_PC2                                  -0.10542185  0.02288114  -4.6074 4.078e-06 ***
## I.Q10_PC1                                 -0.04506045  0.01315090  -3.4264 0.0006116 ***
```

```
## I.Q10_PC2                                      0.21862841  0.04470206   4.8908 1.004e-06 ***
## location_EU.co2_value                         -0.00214714  0.02024173  -0.1061 0.9155230
## location_EU.framing_effectconsequence         -0.09535546  0.07893579  -1.2080 0.2270422
## location_EU.framing_effectMetOffice           -0.13429003  0.06763114  -1.9856 0.0470751 *
## location_EU.framing_effectUN                  -0.09283547  0.07882909  -1.1777 0.2389241
## location_EU.Q9_PC1                             0.03771759  0.01170071   3.2235 0.0012662 **
## location_EU.Q9_PC2                            -0.00815727  0.01396826  -0.5840 0.5592295
## location_EU.Q10_PC1                            0.01050716  0.00831779   1.2632 0.2065121
## location_EU.Q10_PC2                           -0.00289325  0.02868811  -0.1009 0.9196680
## location_UK.co2_value                         -0.04205812  0.01936318  -2.1721 0.0298507 *
## location_UK.framing_effectconsequence         -0.11986691  0.07697707  -1.5572 0.1194285
## location_UK.framing_effectMetOffice           -0.03664741  0.06541027  -0.5603 0.5752953
## location_UK.framing_effectUN                  -0.00862655  0.07577099  -0.1139 0.9093565
## location_UK.Q9_PC1                             0.01596623  0.01145103   1.3943 0.1632254
## location_UK.Q9_PC2                             0.02054357  0.01324893   1.5506 0.1210014
## location_UK.Q10_PC1                            0.06503277  0.00818334   7.9470 1.998e-15 ***
## location_UK.Q10_PC2                           -0.02010036  0.02842295  -0.7072 0.4794500
## certificate_NGO.co2_value                     -0.05404577  0.02006335  -2.6938 0.0070652 **
## certificate_NGO.framing_effectconsequence     -0.01536607  0.07852085  -0.1957 0.8448496
## certificate_NGO.framing_effectMetOffice        0.00124099  0.06678386   0.0186 0.9851744
## certificate_NGO.framing_effectUN              -0.03166234  0.07774207  -0.4073 0.6838067
## certificate_NGO.Q9_PC1                         0.05529630  0.01154300   4.7905 1.664e-06 ***
## certificate_NGO.Q9_PC2                         0.03506531  0.01374948   2.5503 0.0107630 *
## certificate_NGO.Q10_PC1                        0.00269844  0.00835139   0.3231 0.7466100
## certificate_NGO.Q10_PC2                       -0.06207570  0.02929962  -2.1187 0.0341199 *
## certificate_UK.co2_value                      -0.03227338  0.02061230  -1.5657 0.1174109
## certificate_UK.framing_effectconsequence      -0.05852611  0.08126154  -0.7202 0.4713901
## certificate_UK.framing_effectMetOffice         0.03341706  0.06949926   0.4808 0.6306401
## certificate_UK.framing_effectUN               -0.02771335  0.08096828  -0.3423 0.7321446
## certificate_UK.Q9_PC1                          0.06709038  0.01210533   5.5422 2.987e-08 ***
## certificate_UK.Q9_PC2                          0.02879190  0.01430023   2.0134 0.0440738 *
## certificate_UK.Q10_PC1                         0.00758221  0.00850910   0.8911 0.3728915
## certificate_UK.Q10_PC2                        -0.02743261  0.02971206  -0.9233 0.3558603
## project_renewable.co2_value                    0.00146432  0.02238884   0.0654 0.9478522
## project_renewable.framing_effectconsequence    0.03676587  0.09026229   0.4073 0.6837711
## project_renewable.framing_effectMetOffice     -0.12219858  0.07598396  -1.6082 0.1077880
## project_renewable.framing_effectUN             0.06693243  0.08858943   0.7555 0.4499280
## project_renewable.Q9_PC1                       0.00975927  0.01321963   0.7382 0.4603682
## project_renewable.Q9_PC2                       0.00565527  0.01569717   0.3603 0.7186425
## project_renewable.Q10_PC1                     -0.00813694  0.00943328  -0.8626 0.3883695
## project_renewable.Q10_PC2                     -0.06527288  0.03344110  -1.9519 0.0509529 .
## project_landfill.co2_value                     0.04274747  0.02631749   1.6243 0.1043120
## project_landfill.framing_effectconsequence     0.07042015  0.10470953   0.6725 0.5012472
## project_landfill.framing_effectMetOffice      -0.03747847  0.08916990  -0.4203 0.6742634
## project_landfill.framing_effectUN              0.04673546  0.10263809   0.4553 0.6488631
## project_landfill.Q9_PC1                       -0.02138227  0.01608744  -1.3291 0.1838057
## project_landfill.Q9_PC2                       -0.00065599  0.01778653  -0.0369 0.9705798
## project_landfill.Q10_PC1                      -0.05133187  0.01107289  -4.6358 3.555e-06 ***
## project_landfill.Q10_PC2                       0.07287836  0.03817339   1.9091 0.0562440 .
## project_manure.co2_value                       0.01662153  0.02371533   0.7009 0.4833797
## project_manure.framing_effectconsequence       0.10480875  0.09261350   1.1317 0.2577694
## project_manure.framing_effectMetOffice         0.14781777  0.07923395   1.8656 0.0620993 .
## project_manure.framing_effectUN                0.10925449  0.09214119   1.1857 0.2357293
## project_manure.Q9_PC1                         -0.01451520  0.01360907  -1.0666 0.2861604
```

```
## project_manure.Q9_PC2                          0.02331103  0.01657859   1.4061 0.1596966
## project_manure.Q10_PC1                        -0.03535694  0.00982944  -3.5970 0.0003219 ***
## project_manure.Q10_PC2                         0.06103233  0.03390373   1.8002 0.0718345 .
## sd.I                                           2.52410175  0.06935439  36.3943 < 2.2e-16 ***
## sd.location_EU                                 0.63722030  0.03816605  16.6960 < 2.2e-16 ***
## sd.location_UK                                 0.79147916  0.03738999  21.1682 < 2.2e-16 ***
## sd.certificate_NGO                             0.50581349  0.04444827  11.3798 < 2.2e-16 ***
## sd.certificate_UK                              0.59396002  0.03983433  14.9108 < 2.2e-16 ***
## sd.project_renewable                           0.82306218  0.04320287  19.0511 < 2.2e-16 ***
## sd.project_landfill                            0.58403211  0.05122990  11.4002 < 2.2e-16 ***
## sd.project_manure                              0.80486954  0.04152086  19.3847 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -16475
## Number of observations: 12760
## Number of iterations: 34
## Exit of MLE: successive function values within relative tolerance limit (reltol)
## Simulation based on 2000 draws
```

mixed logit + co2 consumption + framing effect + PCA Willingness to Pay

```
##
## Willigness-to-pay respect to:  price
##
##                                                Estimate Std. Error  t-value  Pr(>|t|)
## I                                            -43.380203   3.279320 -13.2284 < 2.2e-16 ***
## location_EU                                    0.971827   1.131845   0.8586 0.3905488
## location_UK                                    8.195313   1.175478   6.9719 3.127e-12 ***
## certificate_NGO                                5.062058   1.149370   4.4042 1.062e-05 ***
## certificate_UK                                11.683557   1.357280   8.6081 < 2.2e-16 ***
## project_renewable                              5.049338   1.289505   3.9157 9.014e-05 ***
## project_landfill                              -9.854789   1.573912  -6.2613 3.817e-10 ***
## project_manure                                -6.715909   1.346363  -4.9882 6.095e-07 ***
## I.co2_value                                   -0.068003   0.579942  -0.1173 0.9066556
## I.framing_effectconsequence                    2.129115   2.147067   0.9916 0.3213738
## I.framing_effectMetOffice                      7.548963   1.846618   4.0880 4.351e-05 ***
## I.framing_effectUN                             3.226581   2.117249   1.5239 0.1275214
## I.Q9_PC1                                     -10.013147   0.638590 -15.6801 < 2.2e-16 ***
## I.Q9_PC2                                      -1.860734   0.414320  -4.4911 7.087e-06 ***
## I.Q10_PC1                                     -0.795334   0.234936  -3.3853 0.0007109 ***
## I.Q10_PC2                                      3.858872   0.810615   4.7604 1.932e-06 ***
## location_EU.co2_value                         -0.037898   0.357262  -0.1061 0.9155202
## location_EU.framing_effectconsequence         -1.683059   1.396700  -1.2050 0.2281934
## location_EU.framing_effectMetOffice           -2.370268   1.200337  -1.9747 0.0483057 *
## location_EU.framing_effectUN                  -1.638580   1.393573  -1.1758 0.2396699
## location_EU.Q9_PC1                             0.665729   0.209787   3.1734 0.0015068 **
## location_EU.Q9_PC2                            -0.143979   0.246612  -0.5838 0.5593362
## location_EU.Q10_PC1                            0.185455   0.147126   1.2605 0.2074820
## location_EU.Q10_PC2                           -0.051067   0.506389  -0.1008 0.9196732
## location_UK.co2_value                         -0.742341   0.343777  -2.1594 0.0308215 *
## location_UK.framing_effectconsequence         -2.115695   1.362416  -1.5529 0.1204471
```

```
## location_UK.framing_effectMetOffice          -0.646840   1.155046  -0.5600 0.5754709
## location_UK.framing_effectUN                 -0.152262   1.337437  -0.1138 0.9093599
## location_UK.Q9_PC1                            0.281810   0.202485   1.3918 0.1639960
## location_UK.Q9_PC2                            0.362602   0.234363   1.5472 0.1218199
## location_UK.Q10_PC1                           1.147852   0.156248   7.3463 2.036e-13 ***
## location_UK.Q10_PC2                          -0.354779   0.501689  -0.7072 0.4794616
## certificate_NGO.co2_value                    -0.953928   0.357839  -2.6658 0.0076805 **
## certificate_NGO.framing_effectconsequence    -0.271217   1.385981  -0.1957 0.8448561
## certificate_NGO.framing_effectMetOffice       0.021904   1.178754   0.0186 0.9851743
## certificate_NGO.framing_effectUN             -0.558852   1.372312  -0.4072 0.6838362
## certificate_NGO.Q9_PC1                        0.976000   0.209261   4.6640 3.101e-06 ***
## certificate_NGO.Q9_PC2                        0.618916   0.244390   2.5325 0.0113255 *
## certificate_NGO.Q10_PC1                       0.047628   0.147442   0.3230 0.7466711
## certificate_NGO.Q10_PC2                      -1.095659   0.519690  -2.1083 0.0350056 *
## certificate_UK.co2_value                     -0.569637   0.365475  -1.5586 0.1190863
## certificate_UK.framing_effectconsequence     -1.033007   1.435137  -0.7198 0.4716500
## certificate_UK.framing_effectMetOffice        0.589823   1.227091   0.4807 0.6307525
## certificate_UK.framing_effectUN              -0.489151   1.429215  -0.3423 0.7321618
## certificate_UK.Q9_PC1                         1.184170   0.221990   5.3343 9.589e-08 ***
## certificate_UK.Q9_PC2                         0.508188   0.253167   2.0073 0.0447152 *
## certificate_UK.Q10_PC1                        0.133829   0.150530   0.8890 0.3739772
## certificate_UK.Q10_PC2                       -0.484196   0.524961  -0.9223 0.3563481
## project_renewable.co2_value                   0.025846   0.395168   0.0654 0.9478518
## project_renewable.framing_effectconsequence   0.648931   1.593625   0.4072 0.6838578
## project_renewable.framing_effectMetOffice    -2.156850   1.344847  -1.6038 0.1087609
## project_renewable.framing_effectUN            1.181382   1.565387   0.7547 0.4504351
## project_renewable.Q9_PC1                      0.172255   0.233512   0.7377 0.4607152
## project_renewable.Q9_PC2                      0.099818   0.276968   0.3604 0.7185521
## project_renewable.Q10_PC1                    -0.143620   0.166574  -0.8622 0.3885781
## project_renewable.Q10_PC2                    -1.152090   0.593860  -1.9400 0.0523794 .
## project_landfill.co2_value                    0.754509   0.465386   1.6213 0.1049635
## project_landfill.framing_effectconsequence    1.242942   1.849471   0.6721 0.5015504
## project_landfill.framing_effectMetOffice     -0.661509   1.574214  -0.4202 0.6743281
## project_landfill.framing_effectUN             0.824898   1.811939   0.4553 0.6489243
## project_landfill.Q9_PC1                      -0.377405   0.284514  -1.3265 0.1846776
## project_landfill.Q9_PC2                      -0.011578   0.313942  -0.0369 0.9705802
## project_landfill.Q10_PC1                     -0.906026   0.201131  -4.5047 6.648e-06 ***
## project_landfill.Q10_PC2                      1.286330   0.676015   1.9028 0.0570650 .
## project_manure.co2_value                      0.293376   0.418736   0.7006 0.4835380
## project_manure.framing_effectconsequence      1.849913   1.638086   1.1293 0.2587656
## project_manure.framing_effectMetOffice        2.609038   1.404521   1.8576 0.0632259 .
## project_manure.framing_effectUN               1.928382   1.628515   1.1841 0.2363594
## project_manure.Q9_PC1                        -0.256199   0.240536  -1.0651 0.2868246
## project_manure.Q9_PC2                         0.411448   0.293585   1.4015 0.1610763
## project_manure.Q10_PC1                       -0.624063   0.176865  -3.5285 0.0004180 ***
## project_manure.Q10_PC2                        1.077243   0.599915   1.7957 0.0725486 .
## sd.I                                         44.551324   2.517342  17.6978 < 2.2e-16 ***
## sd.location_EU                               11.247173   0.922371  12.1938 < 2.2e-16 ***
## sd.location_UK                               13.969898   0.990770  14.1000 < 2.2e-16 ***
## sd.certificate_NGO                            8.927794   0.932829   9.5707 < 2.2e-16 ***
## sd.certificate_UK                            10.483613   0.918964  11.4081 < 2.2e-16 ***
## sd.project_renewable                         14.527350   1.104176  13.1567 < 2.2e-16 ***
## sd.project_landfill                          10.308382   1.072390   9.6125 < 2.2e-16 ***
## sd.project_manure                            14.206243   1.059446  13.4091 < 2.2e-16 ***
```

```
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

- Higher meeting consumption, i.e., higher co2 value consistently reduce the WTP.
- The framing effects is either non-significant or seems to mitigate the preference premium relative to the base line for both endosement and carbon offset approaches.

Latent Class Models, Marginal Utiltiy Without Interaction Terms

This specification allows marginal utility paramters varies by class and treating the co2 consumption, framing effect, and PCAs of as demographics.

Latent Class Treating co2 consumption + framing effect + PCA as demographics, 2 classes

The marginal utility coefficients are:

```
##
## Model estimated on: Mon Nov 11 08:34:24 PM 2024
##
## Call:
## gmnl(formula = f1, data = dt, model = "lc", Q = q, panel = TRUE,
##     method = "bhhh", iterlim = 5000)
##
## Frequencies of categories:
##
##        1        2        3        4        5        6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 0h:0m:7s
##
## Coefficients:
##                             Estimate Std. Error  z-value  Pr(>|z|)
## class.1.I                -0.3412401  0.0444907  -7.6699 1.732e-14 ***
## class.1.price            -0.0392215  0.0021731 -18.0486 < 2.2e-16 ***
## class.1.location_EU      -0.0674888  0.0210293  -3.2093  0.001331 **
## class.1.location_UK       0.1332018  0.0202700   6.5714 4.985e-11 ***
## class.1.certificate_NGO   0.0346578  0.0211352   1.6398  0.101045
## class.1.certificate_UK    0.3286375  0.0214574  15.3158 < 2.2e-16 ***
## class.1.project_renewable  0.1725005  0.0239655   7.1979 6.115e-13 ***
## class.1.project_landfill  -0.2166329  0.0279751  -7.7438 9.548e-15 ***
## class.1.project_manure    -0.1158708  0.0247819  -4.6756 2.931e-06 ***
## class.2.I                -3.4833513  0.0947536 -36.7622 < 2.2e-16 ***
## class.2.price            -0.0361526  0.0040437  -8.9406 < 2.2e-16 ***
## class.2.location_EU       0.0698498  0.0382584   1.8257  0.067890 .
## class.2.location_UK       0.4050697  0.0368772  10.9843 < 2.2e-16 ***
## class.2.certificate_NGO   0.3069834  0.0368541   8.3297 < 2.2e-16 ***
## class.2.certificate_UK    0.5321108  0.0414124  12.8491 < 2.2e-16 ***
## class.2.project_renewable  0.1321055  0.0441377   2.9930  0.002762 **
## class.2.project_landfill  -0.5899856  0.0512568 -11.5104 < 2.2e-16 ***
```

```
## class.2.project_manure    -0.3172132  0.0462331  -6.8612 6.830e-12 ***
## (class)2                  -0.1611202  0.0180500  -8.9263 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -17728
## Number of observations: 12760
## Number of iterations: 17
## Exit of MLE: successive function values within relative tolerance limit (reltol)
```

The class membership probabilities are:

```
##   Class_1   Class_2
## 0.5401931 0.4598069
```

The effects of demographics are:

```
## $Class_2
##                                   coef         se           z     p_val
## (Intercept)                 -0.149983959 0.31567659 -0.47511904 0.6347021
## co2_value                   -0.062426525 0.05376809 -1.16103288 0.2456285
## framing_effectconsequence    0.084897472 0.17910269  0.47401562 0.6354888
## framing_effectMetOffice      0.029019525 0.15531606  0.18684175 0.8517847
## framing_effectUN             0.211272942 0.17884787  1.18129975 0.2374837
## Q9_PC1                      -0.004564753 0.02456431 -0.18582863 0.8525792
## Q9_PC2                       0.023945740 0.03251407  0.73647310 0.4614428
## Q10_PC1                      0.028215217 0.02405627  1.17288399 0.2408423
## Q10_PC2                     -0.010359090 0.07100578 -0.14589080 0.8840076
## age_group35_54              -0.066550842 0.14920830 -0.44602640 0.6555782
## age_group55_                 0.111347702 0.17249486  0.64551315 0.5185947
## is_women                    -0.110452853 0.12078982 -0.91442188 0.3604952
## diet_typeFlexitarian        -0.183729298 0.16724314 -1.09857599 0.2719531
## diet_typeVegan_Vegetarian   -0.096426840 0.22442044 -0.42967048 0.6674354
## education_levelDegree       -0.029093947 0.13310473 -0.21857937 0.8269777
## education_levelPostgraduate -0.011785081 0.17108551 -0.06888416 0.9450818
## hh_size                      0.052519069 0.06372989  0.82408846 0.4098893
## income_level30_50k           0.031553116 0.13564570  0.23261421 0.8160610
## income_level50_              0.121105992 0.15493393  0.78166216 0.4344131
## n_children                  -0.032906571 0.09032623 -0.36430803 0.7156280
## is_shopper                  -0.008792004 0.14447281 -0.06085577 0.9514741
## where_liveRuralarea         -0.165097285 0.19340100 -0.85365268 0.3932975
## where_liveTownorsuburb      -0.025255604 0.14988913 -0.16849523 0.8661937
```

Latent Class Treating co2 consumption + framing effect + PCA as demographics, 3 classes

The marginal utility coefficients are:

```
##
## Model estimated on: Mon Nov 11 08:34:24 PM 2024
##
```

```
## Call:
## gmnl(formula = f2, data = dt, model = "lc", Q = q, panel = TRUE,
##     method = "bhhh", iterlim = 5000)
##
## Frequencies of categories:
##
##        1        2        3        4        5        6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 0h:0m:7s
##
## Coefficients:
##                             Estimate Std. Error  z-value  Pr(>|z|)
## class.1.I                 -0.4745246  0.0471349 -10.0674 < 2.2e-16 ***
## class.1.price             -0.0292255  0.0022267 -13.1249 < 2.2e-16 ***
## class.1.location_EU       -0.0160290  0.0215339  -0.7444 0.4566576
## class.1.location_UK        0.1652015  0.0207310   7.9688 1.554e-15 ***
## class.1.certificate_NGO    0.0831284  0.0215511   3.8573 0.0001147 ***
## class.1.certificate_UK     0.3615126  0.0222526  16.2459 < 2.2e-16 ***
## class.1.project_renewable  0.2162835  0.0249448   8.6705 < 2.2e-16 ***
## class.1.project_landfill  -0.2422197  0.0288237  -8.4035 < 2.2e-16 ***
## class.1.project_manure    -0.1329240  0.0257051  -5.1711 2.327e-07 ***
## class.2.I                  0.4650589  0.2682802   1.7335 0.0830101 .
## class.2.price             -0.2428531  0.0126570 -19.1872 < 2.2e-16 ***
## class.2.location_EU       -1.0364971  0.1197874  -8.6528 < 2.2e-16 ***
## class.2.location_UK        0.3849672  0.1132237   3.4001 0.0006737 ***
## class.2.certificate_NGO   -0.2754939  0.1083798  -2.5419 0.0110242 *
## class.2.certificate_UK     0.6164478  0.1292306   4.7701 1.841e-06 ***
## class.2.project_renewable -0.5736398  0.1286163  -4.4601 8.193e-06 ***
## class.2.project_landfill  -0.4348426  0.1711899  -2.5401 0.0110815 *
## class.2.project_manure     0.0152187  0.1361393   0.1118 0.9109915
## class.3.I                 -3.8803868  0.1083355 -35.8182 < 2.2e-16 ***
## class.3.price             -0.0374090  0.0042698  -8.7614 < 2.2e-16 ***
## class.3.location_EU        0.0668430  0.0403760   1.6555 0.0978202 .
## class.3.location_UK        0.4087315  0.0387818  10.5393 < 2.2e-16 ***
## class.3.certificate_NGO    0.3206281  0.0387231   8.2800 2.220e-16 ***
## class.3.certificate_UK     0.5416737  0.0437614  12.3779 < 2.2e-16 ***
## class.3.project_renewable  0.1305824  0.0463554   2.8170 0.0048477 **
## class.3.project_landfill  -0.6003817  0.0546129 -10.9934 < 2.2e-16 ***
## class.3.project_manure    -0.3435792  0.0489108  -7.0246 2.147e-12 ***
## (class)2                  -1.6289501  0.0320951 -50.7539 < 2.2e-16 ***
## (class)3                  -0.0863485  0.0189983  -4.5451 5.492e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -16649
## Number of observations: 12760
## Number of iterations: 16
## Exit of MLE: successive function values within relative tolerance limit (reltol)
```

The class membership probabilities are:

```
##    Class_1    Class_2    Class_3
```

```
## 0.47316897 0.09280518 0.43402585
```

The effects of demographics are:

```
## $Class_2
##                                    coef         se           z       p_val
## (Intercept)                 -1.200192938 0.57146938 -2.10018764 0.035712338
## co2_value                   -0.089546545 0.09870194 -0.90724197 0.364278853
## framing_effectconsequence   -0.174497590 0.33223056 -0.52523039 0.599423038
## framing_effectMetOffice      0.118729938 0.27258967  0.43556287 0.663153914
## framing_effectUN             0.136305864 0.32163340  0.42379262 0.671717058
## Q9_PC1                      -0.098124991 0.03779067 -2.59654037 0.009416784
## Q9_PC2                      -0.015006169 0.06106078 -0.24575789 0.805869654
## Q10_PC1                      0.046928028 0.04439955  1.05694825 0.290535207
## Q10_PC2                     -0.059367866 0.13124772 -0.45233445 0.651028063
## age_group35_54              -0.211556654 0.27050249 -0.78208765 0.434163065
## age_group55_                -0.155906887 0.30457468 -0.51188394 0.608732238
## is_women                    -0.181161495 0.21687437 -0.83532920 0.403532378
## diet_typeFlexitarian        -0.112570392 0.29519274 -0.38134539 0.702946979
## diet_typeVegan_Vegetarian   -0.695311606 0.47459484 -1.46506356 0.142903577
## education_levelDegree        0.144657256 0.23677899  0.61093789 0.541240698
## education_levelPostgraduate  0.124062526 0.31028794  0.39983032 0.689281494
## hh_size                     -0.065718438 0.11891431 -0.55265376 0.580500519
## income_level30_50k          -0.277385197 0.24723136 -1.12196606 0.261876872
## income_level50_             -0.059710521 0.27842045 -0.21446169 0.830187038
## n_children                  -0.001985845 0.17051358 -0.01164626 0.990707839
## is_shopper                  -0.190155187 0.25497474 -0.74578050 0.455800022
## where_liveRuralarea          0.162394440 0.36503317  0.44487584 0.656409480
## where_liveTownorsuburb       0.407572898 0.28731975  1.41853423 0.156034853
##
## $Class_3
##                                    coef         se           z      p_val
## (Intercept)                 -0.03364188 0.33155043 -0.10146838 0.91917866
## co2_value                   -0.08885280 0.05636304 -1.57643724 0.11492507
## framing_effectconsequence    0.05918829 0.18762297  0.31546398 0.75240939
## framing_effectMetOffice      0.07805707 0.16339423  0.47772230 0.63284787
## framing_effectUN             0.28117046 0.18809870  1.49480277 0.13496592
## Q9_PC1                      -0.02518443 0.02709806 -0.92938128 0.35269153
## Q9_PC2                       0.01695829 0.03420063  0.49584725 0.62000219
## Q10_PC1                      0.03002545 0.02515003  1.19385338 0.23253533
## Q10_PC2                     -0.02046908 0.07429723 -0.27550256 0.78293016
## age_group35_54              -0.10412838 0.15642164 -0.66569041 0.50560901
## age_group55_                 0.14692233 0.18181488  0.80808752 0.41904020
## is_women                    -0.13264861 0.12694275 -1.04494828 0.29604687
## diet_typeFlexitarian        -0.29870212 0.17600798 -1.69709423 0.08967885
## diet_typeVegan_Vegetarian   -0.29710989 0.23311372 -1.27452768 0.20247647
## education_levelDegree        0.05773852 0.14002979  0.41233029 0.68009735
## education_levelPostgraduate  0.03462402 0.17962690  0.19275523 0.84715067
## hh_size                      0.03967065 0.06671657  0.59461468 0.55210106
## income_level30_50k           0.01121950 0.14235074  0.07881589 0.93717907
## income_level50_              0.13510254 0.16299918  0.82885414 0.40718695
## n_children                  -0.02464829 0.09437299 -0.26117950 0.79395409
## is_shopper                  -0.05943277 0.15242382 -0.38991783 0.69659731
## where_liveRuralarea         -0.10522863 0.20199565 -0.52094505 0.60240505
```

```
## where_liveTownorsuburb       0.06348247 0.15645723  0.40574965 0.68492655
```

We can't do an LC esimtation with more than 3 classes due to lack of variation and the hessian matrix would be singular.

Latent Class Models, Marginal Utiltiy With Interaction Terms

This specification interacts the marginal utility parameters with the co2 consumption, framing effect, and PCAs. This specification would be similar to the mixed logit model with the exception that the marginal utility parameters are allowed to vary by class, but without being random parameters.

Latent Class interact with co2 consumption + framing effect + PCA, 2 classes

The marginal utility coefficients are:

```
##
## Model estimated on: Mon Nov 11 08:34:24 PM 2024
##
## Call:
## gmnl(formula = f1, data = dt, model = "lc", Q = q, panel = TRUE,
##     method = "bhhh", iterlim = 5000)
##
## Frequencies of categories:
##
##        1        2        3        4        5        6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 0h:1m:29s
##
## Coefficients:
##                                                    Estimate  Std. Error  z-value  Pr(>|z|)
## class.1.I                                       -0.34444834  0.04465853  -7.7129 1.221e-14 ***
## class.1.price                                   -0.03480341  0.00428775  -8.1169 4.441e-16 ***
## class.1.location_EU                              0.02612167  0.05200069   0.5023 0.6154332
## class.1.location_UK                              0.28004120  0.05300178   5.2836 1.267e-07 ***
## class.1.certificate_NGO                          0.02421002  0.05397572   0.4485 0.6537669
## class.1.certificate_UK                           0.26383806  0.05699769   4.6289 3.676e-06 ***
## class.1.project_renewable                        0.21618254  0.05873168   3.6809 0.0002325 ***
## class.1.project_landfill                        -0.31146105  0.06984478  -4.4593 8.222e-06 ***
## class.1.project_manure                          -0.27432365  0.06505697  -4.2167 2.479e-05 ***
## class.1.price:co2_value                         -0.00118238  0.00117883  -1.0030 0.3158573
## class.1.price:framing_effectconsequence         -0.01110029  0.00497544  -2.2310 0.0256799 *
## class.1.price:framing_effectMetOffice            0.00013758  0.00418395   0.0329 0.9737675
## class.1.price:framing_effectUN                  -0.00360270  0.00492740  -0.7312 0.4646829
## class.1.location_EU:co2_value                    0.00519319  0.01502441   0.3456 0.7296058
## class.1.location_EU:framing_effectconsequence   -0.12101755  0.06532170  -1.8526 0.0639341 .
## class.1.location_EU:framing_effectMetOffice     -0.14499036  0.05475179  -2.6481 0.0080936 **
## class.1.location_EU:framing_effectUN            -0.08368630  0.06486678  -1.2901 0.1970070
## class.1.location_UK:co2_value                   -0.06152076  0.01538081  -3.9998 6.339e-05 ***
## class.1.location_UK:framing_effectconsequence   -0.16165232  0.06728477  -2.4025 0.0162830 *
## class.1.location_UK:framing_effectMetOffice     -0.01442206  0.05611382  -0.2570 0.7971676
```

```
## class.1.location_UK:framing_effectUN                -0.03514117  0.06516192  -0.5393 0.5896868
## class.1.certificate_NGO:co2_value                   -0.02687459  0.01607775  -1.6715 0.0946151 .
## class.1.certificate_NGO:framing_effectconsequence    0.01922058  0.06938931   0.2770 0.7817830
## class.1.certificate_NGO:framing_effectMetOffice      0.08480764  0.05703878   1.4868 0.1370566
## class.1.certificate_NGO:framing_effectUN             0.08119141  0.06727280   1.2069 0.2274715
## class.1.certificate_UK:co2_value                    -0.01253344  0.01639282  -0.7646 0.4445284
## class.1.certificate_UK:framing_effectconsequence     0.08814691  0.07180163   1.2276 0.2195803
## class.1.certificate_UK:framing_effectMetOffice       0.09729107  0.06012113   1.6183 0.1056085
## class.1.certificate_UK:framing_effectUN              0.15401325  0.07108767   2.1665 0.0302711 *
## class.1.project_renewable:co2_value                 -0.01975792  0.01698424  -1.1633 0.2447039
## class.1.project_renewable:framing_effectconsequence  0.08206402  0.07445929   1.1021 0.2704040
## class.1.project_renewable:framing_effectMetOffice   -0.06764584  0.06105159  -1.1080 0.2678570
## class.1.project_renewable:framing_effectUN           0.01889592  0.07202891   0.2623 0.7930609
## class.1.project_landfill:co2_value                   0.02645724  0.02043211   1.2949 0.1953597
## class.1.project_landfill:framing_effectconsequence   0.13853136  0.08784221   1.5770 0.1147845
## class.1.project_landfill:framing_effectMetOffice     0.02416044  0.07381056   0.3273 0.7434181
## class.1.project_landfill:framing_effectUN            0.06365703  0.08591901   0.7409 0.4587566
## class.1.project_manure:co2_value                     0.01231719  0.01911689   0.6443 0.5193751
## class.1.project_manure:framing_effectconsequence     0.19157458  0.08244454   2.3237 0.0201428 *
## class.1.project_manure:framing_effectMetOffice       0.14105372  0.06891893   2.0467 0.0406913 *
## class.1.project_manure:framing_effectUN              0.20137745  0.08087882   2.4899 0.0127791 *
## class.2.I                                           -3.51097936  0.09574295 -36.6709 < 2.2e-16 ***
## class.2.price                                       -0.01862446  0.00869673  -2.1415 0.0322298 *
## class.2.location_EU                                  0.12893971  0.10025780   1.2861 0.1984146
## class.2.location_UK                                  0.39384184  0.09500483   4.1455 3.391e-05 ***
## class.2.certificate_NGO                              0.49355358  0.09510959   5.1893 2.111e-07 ***
## class.2.certificate_UK                               0.70810644  0.10988008   6.4444 1.161e-10 ***
## class.2.project_renewable                            0.12487839  0.10781826   1.1582 0.2467700
## class.2.project_landfill                            -0.60118947  0.13401768  -4.4859 7.261e-06 ***
## class.2.project_manure                              -0.36443608  0.12109770  -3.0094 0.0026173 **
## class.2.price:co2_value                             -0.00744175  0.00276301  -2.6933 0.0070738 **
## class.2.price:framing_effectconsequence             -0.00689547  0.00983838  -0.7009 0.4833814
## class.2.price:framing_effectMetOffice               -0.00248212  0.00882688  -0.2812 0.7785571
## class.2.price:framing_effectUN                      -0.01938214  0.00951650  -2.0367 0.0416813 *
## class.2.location_EU:co2_value                       -0.03902193  0.03419225  -1.1413 0.2537657
## class.2.location_EU:framing_effectconsequence        0.00658105  0.11330094   0.0581 0.9536812
## class.2.location_EU:framing_effectMetOffice          0.03632315  0.10305699   0.3525 0.7244956
## class.2.location_EU:framing_effectUN                -0.07832540  0.11234401  -0.6972 0.4856823
## class.2.location_UK:co2_value                        0.00105147  0.03417404   0.0308 0.9754544
## class.2.location_UK:framing_effectconsequence        0.08002041  0.11128620   0.7191 0.4721097
## class.2.location_UK:framing_effectMetOffice         -0.03303828  0.09934509  -0.3326 0.7394659
## class.2.location_UK:framing_effectUN                 0.02523403  0.11336272   0.2226 0.8238503
## class.2.certificate_NGO:co2_value                   -0.08788468  0.03354764  -2.6197 0.0088008 **
## class.2.certificate_NGO:framing_effectconsequence    0.02147935  0.10961174   0.1960 0.8446427
## class.2.certificate_NGO:framing_effectMetOffice     -0.10791400  0.09925200  -1.0873 0.2769162
## class.2.certificate_NGO:framing_effectUN            -0.11398248  0.11259154  -1.0124 0.3113689
## class.2.certificate_UK:co2_value                    -0.05001066  0.03913932  -1.2778 0.2013340
## class.2.certificate_UK:framing_effectconsequence    -0.14405942  0.12596082  -1.1437 0.2527546
## class.2.certificate_UK:framing_effectMetOffice      -0.07019183  0.11402350  -0.6156 0.5381646
## class.2.certificate_UK:framing_effectUN             -0.21564560  0.12647060  -1.7051 0.0881749 .
## class.2.project_renewable:co2_value                  0.01438950  0.03751145   0.3836 0.7012727
## class.2.project_renewable:framing_effectconsequence  0.00847322  0.12279573   0.0690 0.9449876
## class.2.project_renewable:framing_effectMetOffice   -0.10019856  0.11088217  -0.9036 0.3661816
## class.2.project_renewable:framing_effectUN           0.11937438  0.12515622   0.9538 0.3401834
```

```
## class.2.project_landfill:co2_value                   0.07368949  0.04548708   1.6200 0.1052303
## class.2.project_landfill:framing_effectconsequence  -0.11995387  0.14902724  -0.8049 0.4208702
## class.2.project_landfill:framing_effectMetOffice    -0.17889877  0.13460242  -1.3291 0.1838182
## class.2.project_landfill:framing_effectUN           -0.05890704  0.15047583  -0.3915 0.6954486
## class.2.project_manure:co2_value                     0.04612135  0.04220569   1.0928 0.2744923
## class.2.project_manure:framing_effectconsequence    -0.05331936  0.13951895  -0.3822 0.7023385
## class.2.project_manure:framing_effectMetOffice       0.03465735  0.12676456   0.2734 0.7845462
## class.2.project_manure:framing_effectUN             -0.09170416  0.13897237  -0.6599 0.5093351
## (class)2                                            -0.16251577  0.01804042  -9.0084 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -17660
## Number of observations: 12760
## Number of iterations: 15
## Exit of MLE: successive function values within relative tolerance limit (reltol)

##      AIC      BIC
## 35485.49 36104.18
```

The class membership probabilities are:

```
##   Class_1   Class_2
## 0.5405398 0.4594602
```

The effects of demographics are:

```
## $Class_2
##                                   coef         se           z     p_val
## (Intercept)                 -0.27706383 0.26928171 -1.02889955 0.3035269
## age_group35_54               0.01687408 0.14393905  0.11723074 0.9066772
## age_group55_                 0.21461920 0.16138350  1.32987078 0.1835609
## is_women                    -0.05672937 0.11697192 -0.48498275 0.6276886
## diet_typeFlexitarian        -0.17437595 0.15894831 -1.09706072 0.2726148
## diet_typeVegan_Vegetarian   -0.01878985 0.20874883 -0.09001175 0.9282779
## education_levelDegree       -0.03686092 0.13211409 -0.27900827 0.7802385
## education_levelPostgraduate -0.01573016 0.16999594 -0.09253254 0.9262749
## hh_size                      0.04971871 0.06331892  0.78521101 0.4323299
## income_level30_50k           0.03911787 0.13487259  0.29003572 0.7717889
## income_level50_              0.13410448 0.15350885  0.87359447 0.3823391
## n_children                  -0.05309249 0.08930491 -0.59450803 0.5521724
## is_shopper                  -0.03132222 0.14260838 -0.21963798 0.8261531
## where_liveRuralarea         -0.11939830 0.19058367 -0.62648756 0.5309952
## where_liveTownorsuburb       0.03137536 0.14660774  0.21400888 0.8305401
```

Latent Class interact with co2 consumption + framing effect + PCA, 3 classes

The marginal utility coefficients are:

```
##
## Model estimated on: Mon Nov 11 08:34:24 PM 2024
```

```
##
## Call:
## gmnl(formula = f1, data = dt, model = "lc", Q = q, panel = TRUE,
##     method = "bhhh", iterlim = 5000)
##
## Frequencies of categories:
##
##        1        2        3        4        5        6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 0h:1m:34s
##
## Coefficients:
##                                                  Estimate  Std. Error  z-value  Pr(>|z|)
## class.1.I                                       9.4246e-01  3.0266e-01   3.1140  0.001846 **
## class.1.price                                  -1.2806e-01  2.7608e-02  -4.6387 3.507e-06 ***
## class.1.location_EU                            -2.4175e-01  2.9770e-01  -0.8121  0.416755
## class.1.location_UK                            -1.4595e-01  3.0339e-01  -0.4811  0.630474
## class.1.certificate_NGO                        -5.2612e-01  2.9135e-01  -1.8058  0.070949 .
## class.1.certificate_UK                          2.1375e-01  3.2835e-01   0.6510  0.515052
## class.1.project_renewable                      -1.5500e-01  3.1028e-01  -0.4996  0.617388
## class.1.project_landfill                       -5.8410e-01  4.5701e-01  -1.2781  0.201215
## class.1.project_manure                         -4.6515e-01  3.6559e-01  -1.2723  0.203253
## class.1.price:co2_value                        -6.4195e-02  1.1018e-02  -5.8266 5.656e-09 ***
## class.1.price:framing_effectconsequence        -4.1486e-01  1.0495e-01  -3.9528 7.724e-05 ***
## class.1.price:framing_effectMetOffice           3.5668e-03  2.9495e-02   0.1209  0.903749
## class.1.price:framing_effectUN                  7.5184e-02  3.1682e-02   2.3731  0.017641 *
## class.1.location_EU:co2_value                  -5.1618e-01  1.2591e-01  -4.0995 4.141e-05 ***
## class.1.location_EU:framing_effectconsequence  -1.4785e+00  5.7819e-01  -2.5572  0.010553 *
## class.1.location_EU:framing_effectMetOffice    -1.7969e-02  3.1090e-01  -0.0578  0.953911
## class.1.location_EU:framing_effectUN            6.5970e-01  3.7485e-01   1.7599  0.078426 .
## class.1.location_UK:co2_value                   1.2103e-01  1.3127e-01   0.9220  0.356542
## class.1.location_UK:framing_effectconsequence   1.4041e+00  6.5843e-01   2.1324  0.032971 *
## class.1.location_UK:framing_effectMetOffice     5.9197e-01  3.1197e-01   1.8975  0.057760 .
## class.1.location_UK:framing_effectUN            5.2634e-01  3.3509e-01   1.5707  0.116242
## class.1.certificate_NGO:co2_value               1.1433e-01  1.0273e-01   1.1129  0.265733
## class.1.certificate_NGO:framing_effectconsequence  7.2350e-01  4.6665e-01   1.5504  0.121038
## class.1.certificate_NGO:framing_effectMetOffice    1.6847e-01  3.0499e-01   0.5524  0.580688
## class.1.certificate_NGO:framing_effectUN           2.4260e-01  3.3107e-01   0.7328  0.463687
## class.1.certificate_UK:co2_value                1.5870e-01  1.4649e-01   1.0834  0.278644
## class.1.certificate_UK:framing_effectconsequence   2.6371e+00  9.9760e-01   2.6434  0.008208 **
## class.1.certificate_UK:framing_effectMetOffice     9.3959e-02  3.3512e-01   0.2804  0.779189
## class.1.certificate_UK:framing_effectUN            2.6252e-02  3.8768e-01   0.0677  0.946013
## class.1.project_renewable:co2_value            -3.6505e-01  1.3133e-01  -2.7797  0.005441 **
## class.1.project_renewable:framing_effectconsequence -2.3363e+00  7.9826e-01  -2.9267  0.003426 **
## class.1.project_renewable:framing_effectMetOffice   -2.3689e-02  3.3737e-01  -0.0702  0.944021
## class.1.project_renewable:framing_effectUN          8.2095e-01  3.4592e-01   2.3732  0.017633 *
## class.1.project_landfill:co2_value             -7.7735e-02  2.1836e-01  -0.3560  0.721846
## class.1.project_landfill:framing_effectconsequence  -4.6354e-01  6.5379e-01  -0.7090  0.478322
## class.1.project_landfill:framing_effectMetOffice     2.2359e-01  4.6146e-01   0.4845  0.628018
## class.1.project_landfill:framing_effectUN            4.4343e-01  4.7500e-01   0.9335  0.350553
## class.1.project_manure:co2_value                1.8140e-01  1.2946e-01   1.4013  0.161134
## class.1.project_manure:framing_effectconsequence   -5.6272e-01  6.1190e-01  -0.9196  0.357769
## class.1.project_manure:framing_effectMetOffice      2.3315e-01  3.8354e-01   0.6079  0.543257
```

```
## class.1.project_manure:framing_effectUN              1.2914e-01  4.2719e-01   0.3023  0.762430
## class.2.I                                           -4.9159e-01  4.7498e-02 -10.3497 < 2.2e-16 ***
## class.2.price                                       -2.6927e-02  4.6463e-03  -5.7954 6.817e-09 ***
## class.2.location_EU                                  6.8386e-02  5.3860e-02   1.2697  0.204187
## class.2.location_UK                                  3.4737e-01  5.4544e-02   6.3686 1.908e-10 ***
## class.2.certificate_NGO                              6.0734e-02  5.5372e-02   1.0968  0.272716
## class.2.certificate_UK                               2.8855e-01  5.9639e-02   4.8382 1.310e-06 ***
## class.2.project_renewable                            2.8167e-01  6.2050e-02   4.5394 5.642e-06 ***
## class.2.project_landfill                            -3.2662e-01  7.2499e-02  -4.5051 6.634e-06 ***
## class.2.project_manure                              -2.9661e-01  6.7826e-02  -4.3731 1.225e-05 ***
## class.2.price:co2_value                             -4.2102e-05  1.2866e-03  -0.0327  0.973896
## class.2.price:framing_effectconsequence             -7.5795e-03  5.3534e-03  -1.4158  0.156826
## class.2.price:framing_effectMetOffice               -2.3168e-03  4.5017e-03  -0.5147  0.606794
## class.2.price:framing_effectUN                      -3.9420e-03  5.2792e-03  -0.7467  0.455246
## class.2.location_EU:co2_value                        1.5244e-02  1.5549e-02   0.9804  0.326892
## class.2.location_EU:framing_effectconsequence       -1.0652e-01  6.7123e-02  -1.5870  0.112518
## class.2.location_EU:framing_effectMetOffice         -1.6806e-01  5.6072e-02  -2.9973  0.002724 **
## class.2.location_EU:framing_effectUN                -1.0104e-01  6.5958e-02  -1.5320  0.125535
## class.2.location_UK:co2_value                       -7.2556e-02  1.5699e-02  -4.6217 3.806e-06 ***
## class.2.location_UK:framing_effectconsequence       -1.7722e-01  6.8571e-02  -2.5845  0.009753 **
## class.2.location_UK:framing_effectMetOffice         -5.0987e-02  5.7364e-02  -0.8888  0.374092
## class.2.location_UK:framing_effectUN                -6.5545e-02  6.6602e-02  -0.9841  0.325050
## class.2.certificate_NGO:co2_value                   -3.8290e-02  1.6393e-02  -2.3358  0.019503 *
## class.2.certificate_NGO:framing_effectconsequence    5.2684e-02  7.0825e-02   0.7439  0.456962
## class.2.certificate_NGO:framing_effectMetOffice      1.1083e-01  5.8297e-02   1.9012  0.057280 .
## class.2.certificate_NGO:framing_effectUN             1.1444e-01  6.8687e-02   1.6661  0.095703 .
## class.2.certificate_UK:co2_value                    -1.8145e-02  1.7014e-02  -1.0665  0.286205
## class.2.certificate_UK:framing_effectconsequence     9.0454e-02  7.4295e-02   1.2175  0.223415
## class.2.certificate_UK:framing_effectMetOffice       1.1649e-01  6.2208e-02   1.8725  0.061132 .
## class.2.certificate_UK:framing_effectUN              1.8892e-01  7.3257e-02   2.5789  0.009912 **
## class.2.project_renewable:co2_value                 -2.9870e-02  1.7588e-02  -1.6983  0.089446 .
## class.2.project_renewable:framing_effectconsequence  6.9914e-02  7.7210e-02   0.9055  0.365200
## class.2.project_renewable:framing_effectMetOffice   -7.8536e-02  6.3681e-02  -1.2333  0.217476
## class.2.project_renewable:framing_effectUN           1.4431e-02  7.5161e-02   0.1920  0.847742
## class.2.project_landfill:co2_value                   2.4840e-02  2.1069e-02   1.1790  0.238398
## class.2.project_landfill:framing_effectconsequence   1.1003e-01  9.0539e-02   1.2153  0.224267
## class.2.project_landfill:framing_effectMetOffice     2.2018e-02  7.5803e-02   0.2905  0.771459
## class.2.project_landfill:framing_effectUN            5.2984e-02  8.8231e-02   0.6005  0.548159
## class.2.project_manure:co2_value                     3.4390e-03  1.9824e-02   0.1735  0.862277
## class.2.project_manure:framing_effectconsequence     1.9544e-01  8.5460e-02   2.2869  0.022204 *
## class.2.project_manure:framing_effectMetOffice       1.5758e-01  7.1241e-02   2.2119  0.026976 *
## class.2.project_manure:framing_effectUN              2.5416e-01  8.3192e-02   3.0551  0.002250 **
## class.3.I                                           -3.8842e+00  1.0851e-01 -35.7948 < 2.2e-16 ***
## class.3.price                                       -2.2838e-02  9.3090e-03  -2.4533  0.014155 *
## class.3.location_EU                                  1.0964e-01  1.0398e-01   1.0544  0.291697
## class.3.location_UK                                  4.0228e-01  9.8569e-02   4.0812 4.481e-05 ***
## class.3.certificate_NGO                              5.4044e-01  9.8463e-02   5.4888 4.047e-08 ***
## class.3.certificate_UK                               7.4559e-01  1.1418e-01   6.5300 6.576e-11 ***
## class.3.project_renewable                            1.0558e-01  1.1194e-01   0.9432  0.345579
## class.3.project_landfill                            -6.2394e-01  1.3935e-01  -4.4774 7.555e-06 ***
## class.3.project_manure                              -3.6422e-01  1.2603e-01  -2.8898  0.003854 **
## class.3.price:co2_value                             -7.3738e-03  3.0899e-03  -2.3864  0.017014 *
## class.3.price:framing_effectconsequence             -7.1791e-03  1.0723e-02  -0.6695  0.503185
## class.3.price:framing_effectMetOffice                5.2119e-04  9.6674e-03   0.0539  0.957005
```

```
## class.3.price:framing_effectUN                      -1.1849e-02  1.0628e-02  -1.1148  0.264916
## class.3.location_EU:co2_value                       -3.6130e-02  3.6627e-02  -0.9864  0.323921
## class.3.location_EU:framing_effectconsequence        1.1301e-02  1.1936e-01   0.0947  0.924571
## class.3.location_EU:framing_effectMetOffice          4.6343e-02  1.0843e-01   0.4274  0.669092
## class.3.location_EU:framing_effectUN                -5.0398e-02  1.2002e-01  -0.4199  0.674550
## class.3.location_UK:co2_value                        1.2403e-02  3.6049e-02   0.3441  0.730801
## class.3.location_UK:framing_effectconsequence        4.6445e-02  1.1725e-01   0.3961  0.692025
## class.3.location_UK:framing_effectMetOffice         -5.3508e-02  1.0416e-01  -0.5137  0.607460
## class.3.location_UK:framing_effectUN                 1.0064e-02  1.2013e-01   0.0838  0.933234
## class.3.certificate_NGO:co2_value                   -8.1317e-02  3.5599e-02  -2.2843  0.022356 *
## class.3.certificate_NGO:framing_effectconsequence   -4.1883e-02  1.1523e-01  -0.3635  0.716252
## class.3.certificate_NGO:framing_effectMetOffice     -1.6773e-01  1.0415e-01  -1.6105  0.107286
## class.3.certificate_NGO:framing_effectUN            -1.5476e-01  1.1946e-01  -1.2954  0.195167
## class.3.certificate_UK:co2_value                    -4.7332e-02  4.1912e-02  -1.1293  0.258763
## class.3.certificate_UK:framing_effectconsequence    -1.9442e-01  1.3232e-01  -1.4693  0.141760
## class.3.certificate_UK:framing_effectMetOffice      -1.0071e-01  1.1990e-01  -0.8400  0.400912
## class.3.certificate_UK:framing_effectUN             -2.6999e-01  1.3483e-01  -2.0025  0.045233 *
## class.3.project_renewable:co2_value                  2.9007e-02  4.0387e-02   0.7182  0.472612
## class.3.project_renewable:framing_effectconsequence -8.5450e-03  1.2904e-01  -0.0662  0.947204
## class.3.project_renewable:framing_effectMetOffice   -1.1759e-01  1.1710e-01  -1.0042  0.315305
## class.3.project_renewable:framing_effectUN           1.3785e-01  1.3311e-01   1.0356  0.300375
## class.3.project_landfill:co2_value                   9.0391e-02  4.9439e-02   1.8283  0.067500 .
## class.3.project_landfill:framing_effectconsequence  -1.2499e-01  1.5964e-01  -0.7829  0.433667
## class.3.project_landfill:framing_effectMetOffice    -2.2470e-01  1.4255e-01  -1.5763  0.114953
## class.3.project_landfill:framing_effectUN           -2.8256e-02  1.6306e-01  -0.1733  0.862426
## class.3.project_manure:co2_value                     5.1839e-02  4.4595e-02   1.1624  0.245055
## class.3.project_manure:framing_effectconsequence    -7.1217e-02  1.4704e-01  -0.4843  0.628148
## class.3.project_manure:framing_effectMetOffice       1.4519e-05  1.3354e-01   0.0001  0.999913
## class.3.project_manure:framing_effectUN             -1.6684e-01  1.4920e-01  -1.1182  0.263475
## (class)2                                             1.6297e+00  3.2013e-02  50.9085 < 2.2e-16 ***
## (class)3                                             1.5476e+00  3.2200e-02  48.0636 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -16556
## Number of observations: 12760
## Number of iterations: 25
## Exit of MLE: successive function values within relative tolerance limit (reltol)

##      AIC      BIC
## 33362.41 34294.16
```

The class membership probabilities are:

```
##    Class_1    Class_2    Class_3
## 0.09256792 0.47232955 0.43510253
```

The effects of demographics are:

```
## $Class_2
##                                  coef        se           z       p_val
## (Intercept)                1.42033718 0.4901568  2.89771992 0.003758861
```

```
## age_group35_54               0.11413038 0.2583437  0.44177730 0.658650369
## age_group55_                -0.02728599 0.2845539 -0.09589043 0.923607597
## is_women                     0.13761868 0.2099346  0.65553128 0.512125752
## diet_typeFlexitarian         0.14294429 0.2815017  0.50779199 0.611599229
## diet_typeVegan_Vegetarian    0.36951400 0.4095747  0.90218940 0.366956263
## education_levelDegree       -0.23355034 0.2348208 -0.99458983 0.319935797
## education_levelPostgraduate -0.21926346 0.3041742 -0.72084831 0.471002847
## hh_size                      0.05996884 0.1182586  0.50709904 0.612085325
## income_level30_50k           0.42410286 0.2503298  1.69417639 0.090231769
## income_level50_              0.10943850 0.2717746  0.40268110 0.687182841
## n_children                  -0.02812311 0.1659385 -0.16947910 0.865419813
## is_shopper                   0.29530823 0.2494918  1.18363886 0.236556050
## where_liveRuralarea         -0.27292285 0.3581150 -0.76210960 0.445994593
## where_liveTownorsuburb      -0.49091146 0.2804028 -1.75073649 0.079991311
##
## $Class_3
##                                    coef        se          z      p_val
## (Intercept)                  1.23982900 0.4936895  2.5113539 0.01202691
## age_group35_54               0.10524975 0.2614839  0.4025095 0.68730910
## age_group55_                 0.23870679 0.2856290  0.8357232 0.40331066
## is_women                     0.04658651 0.2110631  0.2207232 0.82530800
## diet_typeFlexitarian        -0.11556784 0.2870557 -0.4025973 0.68724452
## diet_typeVegan_Vegetarian    0.20181526 0.4150824  0.4862052 0.62682165
## education_levelDegree       -0.17302596 0.2359466 -0.7333267 0.46335921
## education_levelPostgraduate -0.17146327 0.3059652 -0.5604012 0.57520580
## hh_size                      0.10242903 0.1187729  0.8623939 0.38847079
## income_level30_50k           0.41480235 0.2519150  1.6465965 0.09964102
## income_level50_              0.23050778 0.2723096  0.8464916 0.39727854
## n_children                  -0.06707639 0.1671427 -0.4013122 0.68819030
## is_shopper                   0.20504090 0.2491996  0.8227979 0.41062294
## where_liveRuralarea         -0.33795452 0.3621879 -0.9330917 0.35077261
## where_liveTownorsuburb      -0.38035762 0.2832444 -1.3428601 0.17931729
```

Latent Class interact with co2 consumption + framing effect + PCA, 4 classes

The marginal utility coefficients are:

```
##
## Model estimated on: Mon Nov 11 08:34:24 PM 2024
##
## Call:
## gmnl(formula = f1, data = dt, model = "lc", Q = q, panel = TRUE,
##     method = "bhhh", iterlim = 5000)
##
## Frequencies of categories:
##
##        1        2        3        4        5        6
## 0.192868 0.272962 0.158307 0.243260 0.060815 0.071787
##
## The estimation took: 0h:2m:15s
##
## Coefficients:
##                                                    Estimate  Std. Error  z-value  Pr(>|z|)
```

```
## class.1.I                                            0.93491282  0.29950199   3.1216 0.0017990 **
## class.1.price                                       -0.13301316  0.02812733  -4.7290 2.257e-06 ***
## class.1.location_EU                                 -0.26789962  0.30160634  -0.8882 0.3744102
## class.1.location_UK                                 -0.13757511  0.30802181  -0.4466 0.6551344
## class.1.certificate_NGO                             -0.52626124  0.29546792  -1.7811 0.0748943 .
## class.1.certificate_UK                               0.22597339  0.33375718   0.6771 0.4983683
## class.1.project_renewable                           -0.18084439  0.31575655  -0.5727 0.5668251
## class.1.project_landfill                            -0.60072841  0.46240724  -1.2991 0.1938984
## class.1.project_manure                              -0.47129605  0.37074828  -1.2712 0.2036567
## class.1.price:co2_value                             -0.06197079  0.01103819  -5.6142 1.975e-08 ***
## class.1.price:framing_effectconsequence             -0.41421570  0.10503356  -3.9437 8.025e-05 ***
## class.1.price:framing_effectMetOffice                0.00820898  0.02978220   0.2756 0.7828294
## class.1.price:framing_effectUN                       0.07759499  0.03200208   2.4247 0.0153216 *
## class.1.location_EU:co2_value                       -0.50197199  0.12607206  -3.9816 6.844e-05 ***
## class.1.location_EU:framing_effectconsequence       -1.46765008  0.58029861  -2.5291 0.0114346 *
## class.1.location_EU:framing_effectMetOffice         -0.00245198  0.31285898  -0.0078 0.9937468
## class.1.location_EU:framing_effectUN                 0.67170779  0.37626769   1.7852 0.0742312 .
## class.1.location_UK:co2_value                        0.11179022  0.13104250   0.8531 0.3936129
## class.1.location_UK:framing_effectconsequence        1.41364758  0.65989897   2.1422 0.0321759 *
## class.1.location_UK:framing_effectMetOffice          0.58078003  0.31414304   1.8488 0.0644902 .
## class.1.location_UK:framing_effectUN                 0.53462603  0.33626351   1.5899 0.1118569
## class.1.certificate_NGO:co2_value                    0.11076307  0.10279841   1.0775 0.2812666
## class.1.certificate_NGO:framing_effectconsequence    0.73096268  0.46881158   1.5592 0.1189533
## class.1.certificate_NGO:framing_effectMetOffice      0.16831937  0.30808470   0.5463 0.5848314
## class.1.certificate_NGO:framing_effectUN             0.25631533  0.33237047   0.7712 0.4406041
## class.1.certificate_UK:co2_value                     0.15549474  0.14620484   1.0635 0.2875370
## class.1.certificate_UK:framing_effectconsequence     2.64095067  0.99853229   2.6448 0.0081731 **
## class.1.certificate_UK:framing_effectMetOffice       0.08767646  0.33704333   0.2601 0.7947603
## class.1.certificate_UK:framing_effectUN              0.01474483  0.38819659   0.0380 0.9697013
## class.1.project_renewable:co2_value                 -0.34748220  0.13167445  -2.6389 0.0083163 **
## class.1.project_renewable:framing_effectconsequence -2.34183888  0.80008053  -2.9270 0.0034224 **
## class.1.project_renewable:framing_effectMetOffice    0.00048447  0.34042585   0.0014 0.9988645
## class.1.project_renewable:framing_effectUN           0.84817405  0.34909027   2.4297 0.0151126 *
## class.1.project_landfill:co2_value                  -0.06490451  0.21742185  -0.2985 0.7653072
## class.1.project_landfill:framing_effectconsequence  -0.47033812  0.65649764  -0.7164 0.4737226
## class.1.project_landfill:framing_effectMetOffice     0.24578345  0.46252383   0.5314 0.5951442
## class.1.project_landfill:framing_effectUN            0.42166512  0.47540490   0.8870 0.3751004
## class.1.project_manure:co2_value                     0.18562217  0.12930848   1.4355 0.1511450
## class.1.project_manure:framing_effectconsequence    -0.57002009  0.61457709  -0.9275 0.3536671
## class.1.project_manure:framing_effectMetOffice       0.24229893  0.38725424   0.6257 0.5315220
## class.1.project_manure:framing_effectUN              0.12770044  0.42925533   0.2975 0.7660902
## class.2.I                                           -2.44343672  0.13502879 -18.0957 < 2.2e-16 ***
## class.2.price                                       -0.17001480  0.01631934 -10.4180 < 2.2e-16 ***
## class.2.location_EU                                  0.00411192  0.14786648   0.0278 0.9778150
## class.2.location_UK                                 -0.76101005  0.13647254  -5.5763 2.457e-08 ***
## class.2.certificate_NGO                              0.44521879  0.18953590   2.3490 0.0188242 *
## class.2.certificate_UK                               0.99754422  0.20017246   4.9834 6.247e-07 ***
## class.2.project_renewable                            0.95981443  0.20366037   4.7128 2.443e-06 ***
## class.2.project_landfill                            -0.07199254  0.18403067  -0.3912 0.6956504
## class.2.project_manure                              -0.61913265  0.18630902  -3.3231 0.0008901 ***
## class.2.price:co2_value                              0.00681815  0.00323897   2.1050 0.0352885 *
## class.2.price:framing_effectconsequence             -0.03203964  0.02106695  -1.5208 0.1282978
## class.2.price:framing_effectMetOffice                0.07374143  0.01520333   4.8503 1.232e-06 ***
## class.2.price:framing_effectUN                       0.02124769  0.01784582   1.1906 0.2338005
```

```
## class.2.location_EU:co2_value                          -0.10385518  0.03828943  -2.7124 0.0066803 **
## class.2.location_EU:framing_effectconsequence           0.15060570  0.19773340   0.7617 0.4462627
## class.2.location_EU:framing_effectMetOffice            -0.65948526  0.15142058  -4.3553 1.329e-05 ***
## class.2.location_EU:framing_effectUN                   -0.74511870  0.18599427  -4.0061 6.172e-05 ***
## class.2.location_UK:co2_value                          -0.11926238  0.03731753  -3.1959 0.0013940 **
## class.2.location_UK:framing_effectconsequence           0.91980992  0.17151947   5.3627 8.198e-08 ***
## class.2.location_UK:framing_effectMetOffice             0.01148416  0.14155518   0.0811 0.9353397
## class.2.location_UK:framing_effectUN                    0.13648422  0.16501821   0.8271 0.4081884
## class.2.certificate_NGO:co2_value                      -0.12523153  0.04881946  -2.5652 0.0103117 *
## class.2.certificate_NGO:framing_effectconsequence       0.46393518  0.24029764   1.9307 0.0535240 .
## class.2.certificate_NGO:framing_effectMetOffice        -0.87216367  0.19800859  -4.4047 1.059e-05 ***
## class.2.certificate_NGO:framing_effectUN               -0.39394530  0.24325191  -1.6195 0.1053408
## class.2.certificate_UK:co2_value                       -0.05101603  0.03893106  -1.3104 0.1900539
## class.2.certificate_UK:framing_effectconsequence        0.61884645  0.28707070   2.1557 0.0311049 *
## class.2.certificate_UK:framing_effectMetOffice         -0.61669362  0.19859699  -3.1053 0.0019012 **
## class.2.certificate_UK:framing_effectUN                -0.32899817  0.22976397  -1.4319 0.1521735
## class.2.project_renewable:co2_value                     0.06398402  0.04531591   1.4120 0.1579632
## class.2.project_renewable:framing_effectconsequence    -0.18128845  0.27915812  -0.6494 0.5160725
## class.2.project_renewable:framing_effectMetOffice      -1.09244643  0.20668077  -5.2857 1.252e-07 ***
## class.2.project_renewable:framing_effectUN             -0.40674477  0.25436883  -1.5990 0.1098127
## class.2.project_landfill:co2_value                      0.03034245  0.04502547   0.6739 0.5003779
## class.2.project_landfill:framing_effectconsequence     -0.38777745  0.23151451  -1.6750 0.0939422 .
## class.2.project_landfill:framing_effectMetOffice       -0.56757497  0.18973484  -2.9914 0.0027769 **
## class.2.project_landfill:framing_effectUN               0.31108269  0.23708786   1.3121 0.1894868
## class.2.project_manure:co2_value                       -0.12415808  0.05116767  -2.4265 0.0152455 *
## class.2.project_manure:framing_effectconsequence        0.39251102  0.22111336   1.7752 0.0758719 .
## class.2.project_manure:framing_effectMetOffice         -0.28734360  0.19610194  -1.4653 0.1428454
## class.2.project_manure:framing_effectUN                 0.40761864  0.22876390   1.7818 0.0747768 .
## class.3.I                                               0.03489706  0.05956543   0.5859 0.5579689
## class.3.price                                           0.00337758  0.00568987   0.5936 0.5527715
## class.3.location_EU                                     0.11711902  0.06576252   1.7809 0.0749224 .
## class.3.location_UK                                     0.63999952  0.06852087   9.3402 < 2.2e-16 ***
## class.3.certificate_NGO                                 0.06467655  0.07008464   0.9228 0.3560933
## class.3.certificate_UK                                  0.25603530  0.07275109   3.5193 0.0004326 ***
## class.3.project_renewable                               0.25531176  0.07785290   3.2794 0.0010402 **
## class.3.project_landfill                               -0.34558864  0.08948905  -3.8618 0.0001126 ***
## class.3.project_manure                                 -0.21932096  0.08503452  -2.5792 0.0099030 **
## class.3.price:co2_value                                -0.00128335  0.00156926  -0.8178 0.4134665
## class.3.price:framing_effectconsequence                 0.00103962  0.00660980   0.1573 0.8750208
## class.3.price:framing_effectMetOffice                  -0.01523893  0.00554028  -2.7506 0.0059492 **
## class.3.price:framing_effectUN                         -0.00587870  0.00635099  -0.9256 0.3546357
## class.3.location_EU:co2_value                           0.05744765  0.02037925   2.8189 0.0048184 **
## class.3.location_EU:framing_effectconsequence          -0.11702320  0.08374969  -1.3973 0.1623242
## class.3.location_EU:framing_effectMetOffice            -0.05006687  0.06862186  -0.7296 0.4656315
## class.3.location_EU:framing_effectUN                    0.02117966  0.08032398   0.2637 0.7920281
## class.3.location_UK:co2_value                          -0.07380883  0.02023556  -3.6475 0.0002648 ***
## class.3.location_UK:framing_effectconsequence          -0.46288496  0.08665611  -5.3416 9.211e-08 ***
## class.3.location_UK:framing_effectMetOffice             0.01304941  0.07334704   0.1779 0.8587911
## class.3.location_UK:framing_effectUN                   -0.13071717  0.08294268  -1.5760 0.1150272
## class.3.certificate_NGO:co2_value                      -0.04253414  0.02163486  -1.9660 0.0492986 *
## class.3.certificate_NGO:framing_effectconsequence      -0.07261584  0.09004715  -0.8064 0.4200006
## class.3.certificate_NGO:framing_effectMetOffice         0.27754591  0.07478347   3.7113 0.0002062 ***
## class.3.certificate_NGO:framing_effectUN                0.18687931  0.08613028   2.1697 0.0300274 *
## class.3.certificate_UK:co2_value                       -0.01970934  0.02202853  -0.8947 0.3709374
```

```
## class.3.certificate_UK:framing_effectconsequence    -0.12913475  0.09217252  -1.4010 0.1612107
## class.3.certificate_UK:framing_effectMetOffice       0.17894306  0.07653210   2.3381 0.0193798 *
## class.3.certificate_UK:framing_effectUN              0.24614985  0.08936606   2.7544 0.0058800 **
## class.3.project_renewable:co2_value                 -0.07470769  0.02235010  -3.3426 0.0008299 ***
## class.3.project_renewable:framing_effectconsequence  0.05549296  0.09762365   0.5684 0.5697378
## class.3.project_renewable:framing_effectMetOffice    0.06547472  0.08009311   0.8175 0.4136527
## class.3.project_renewable:framing_effectUN           0.09094448  0.09196528   0.9889 0.3227120
## class.3.project_landfill:co2_value                   0.01029564  0.02663912   0.3865 0.6991369
## class.3.project_landfill:framing_effectconsequence   0.24488636  0.11394096   2.1492 0.0316155 *
## class.3.project_landfill:framing_effectMetOffice     0.10546358  0.09452303   1.1157 0.2645314
## class.3.project_landfill:framing_effectUN           -0.03763644  0.10808894  -0.3482 0.7276909
## class.3.project_manure:co2_value                     0.05233896  0.02578545   2.0298 0.0423782 *
## class.3.project_manure:framing_effectconsequence     0.14339547  0.10803896   1.3273 0.1844237
## class.3.project_manure:framing_effectMetOffice       0.29754609  0.09074768   3.2788 0.0010424 **
## class.3.project_manure:framing_effectUN              0.24790486  0.10380416   2.3882 0.0169312 *
## class.4.I                                           -3.86197929  0.10750149 -35.9249 < 2.2e-16 ***
## class.4.price                                       -0.02268608  0.00926321  -2.4491 0.0143233 *
## class.4.location_EU                                  0.10705932  0.10349180   1.0345 0.3009158
## class.4.location_UK                                  0.39607308  0.09833092   4.0280 5.626e-05 ***
## class.4.certificate_NGO                              0.53933524  0.09822232   5.4910 3.997e-08 ***
## class.4.certificate_UK                               0.73211690  0.11390229   6.4276 1.296e-10 ***
## class.4.project_renewable                            0.10265946  0.11168833   0.9192 0.3580118
## class.4.project_landfill                            -0.63063714  0.13882817  -4.5426 5.557e-06 ***
## class.4.project_manure                              -0.37683191  0.12547149  -3.0033 0.0026705 **
## class.4.price:co2_value                             -0.00764752  0.00306660  -2.4938 0.0126379 *
## class.4.price:framing_effectconsequence             -0.00712198  0.01062107  -0.6706 0.5025059
## class.4.price:framing_effectMetOffice                0.00115340  0.00957836   0.1204 0.9041524
## class.4.price:framing_effectUN                      -0.01383465  0.01043882  -1.3253 0.1850692
## class.4.location_EU:co2_value                       -0.03677785  0.03636723  -1.0113 0.3118772
## class.4.location_EU:framing_effectconsequence        0.01511458  0.11875803   0.1273 0.8987250
## class.4.location_EU:framing_effectMetOffice          0.04798024  0.10788603   0.4447 0.6565143
## class.4.location_EU:framing_effectUN                -0.05617214  0.11885485  -0.4726 0.6364906
## class.4.location_UK:co2_value                        0.01134849  0.03599215   0.3153 0.7525305
## class.4.location_UK:framing_effectconsequence        0.05674605  0.11687227   0.4855 0.6272940
## class.4.location_UK:framing_effectMetOffice         -0.05057450  0.10374814  -0.4875 0.6259226
## class.4.location_UK:framing_effectUN                 0.01428942  0.11924078   0.1198 0.9046126
## class.4.certificate_NGO:co2_value                   -0.08167483  0.03547650  -2.3022 0.0213226 *
## class.4.certificate_NGO:framing_effectconsequence   -0.03326725  0.11496389  -0.2894 0.7722972
## class.4.certificate_NGO:framing_effectMetOffice     -0.16516494  0.10389199  -1.5898 0.1118854
## class.4.certificate_NGO:framing_effectUN            -0.15858245  0.11874001  -1.3355 0.1816985
## class.4.certificate_UK:co2_value                    -0.04599070  0.04183172  -1.0994 0.2715841
## class.4.certificate_UK:framing_effectconsequence    -0.18368780  0.13167757  -1.3950 0.1630213
## class.4.certificate_UK:framing_effectMetOffice      -0.09021296  0.11929826  -0.7562 0.4495312
## class.4.certificate_UK:framing_effectUN             -0.25885996  0.13360316  -1.9375 0.0526808 .
## class.4.project_renewable:co2_value                  0.02761830  0.04034589   0.6845 0.4936353
## class.4.project_renewable:framing_effectconsequence -0.00136319  0.12845506  -0.0106 0.9915329
## class.4.project_renewable:framing_effectMetOffice   -0.11048382  0.11646802  -0.9486 0.3428142
## class.4.project_renewable:framing_effectUN           0.14002259  0.13203958   1.0605 0.2889357
## class.4.project_landfill:co2_value                   0.09072550  0.04911887   1.8471 0.0647385 .
## class.4.project_landfill:framing_effectconsequence  -0.12342370  0.15860970  -0.7782 0.4364748
## class.4.project_landfill:framing_effectMetOffice    -0.21850955  0.14170483  -1.5420 0.1230724
## class.4.project_landfill:framing_effectUN           -0.02583993  0.16129189  -0.1602 0.8727188
## class.4.project_manure:co2_value                     0.05187437  0.04431592   1.1706 0.2417763
## class.4.project_manure:framing_effectconsequence    -0.06362698  0.14619326  -0.4352 0.6633990
```

```
## class.4.project_manure:framing_effectMetOffice       0.00969077  0.13279813   0.0730 0.9418271
## class.4.project_manure:framing_effectUN             -0.14273028  0.14764287  -0.9667 0.3336808
## (class)2                                             0.40326138  0.03892915  10.3589 < 2.2e-16 ***
## (class)3                                             1.27127005  0.03335901  38.1087 < 2.2e-16 ***
## (class)4                                             1.55010850  0.03213413  48.2387 < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Optimization of log-likelihood by BHHH maximisation
## Log Likelihood: -16296
## Number of observations: 12760
## Number of iterations: 113
## Exit of MLE: successive function values within relative tolerance limit (reltol)

##      AIC      BIC
## 32926.45 34171.28
```

The class membership probabilities are:

```
##    Class_1    Class_2    Class_3    Class_4
## 0.09281554 0.13891684 0.33092249 0.43734512
```

The effects of demographics are:

```
## $Class_2
##                                 coef        se           z      p_val
## (Intercept)                  0.18961199 0.5777249  0.32820465 0.74275693
## age_group35_54               0.08982129 0.3011930  0.29821834 0.76553653
## age_group55_                -0.20755904 0.3381053 -0.61388867 0.53928890
## is_women                     0.11357565 0.2476398  0.45863238 0.64649818
## diet_typeFlexitarian        -0.08472921 0.3366959 -0.25164907 0.80131233
## diet_typeVegan_Vegetarian    0.25879796 0.4663583  0.55493379 0.57893995
## education_levelDegree       -0.13561100 0.2780009 -0.48780778 0.62568600
## education_levelPostgraduate  0.02813733 0.3541981  0.07943954 0.93668302
## hh_size                      0.03493024 0.1387731  0.25170762 0.80126707
## income_level30_50k           0.25311800 0.2911211  0.86945950 0.38459585
## income_level50_             -0.18657428 0.3283436 -0.56822872 0.56987967
## n_children                  -0.05636437 0.1955410 -0.28824834 0.77315665
## is_shopper                   0.52282270 0.3073336  1.70115673 0.08891356
## where_liveRuralarea         -0.02684468 0.4094247 -0.06556684 0.94772269
## where_liveTownorsuburb      -0.46631408 0.3234287 -1.44178318 0.14936355
##
## $Class_3
##                                 coef        se           z      p_val
## (Intercept)                  1.01254944 0.5053865  2.00351520 0.04512202
## age_group35_54               0.13347585 0.2667834  0.50031539 0.61685302
## age_group55_                 0.06326645 0.2945461  0.21479302 0.82992870
## is_women                     0.13753404 0.2170218  0.63373361 0.52625469
## diet_typeFlexitarian         0.22370593 0.2888025  0.77459845 0.43857697
## diet_typeVegan_Vegetarian    0.37556575 0.4178818  0.89873677 0.36879289
## education_levelDegree       -0.27207858 0.2426838 -1.12112387 0.26223514
## education_levelPostgraduate -0.31432279 0.3164033 -0.99342450 0.32050313
## hh_size                      0.07955556 0.1220602  0.65177296 0.51454765
```

```
## income_level30_50k           0.48765094 0.2578450  1.89125596 0.05859018
## income_level50_              0.23072792 0.2810215  0.82103306 0.41162744
## n_children                  -0.01210209 0.1709181 -0.07080635 0.94355188
## is_shopper                   0.20907560 0.2575477  0.81179357 0.41691009
## where_liveRuralarea         -0.36117513 0.3696592 -0.97704894 0.32854493
## where_liveTownorsuburb      -0.49192081 0.2876992 -1.70984397 0.08729473
##
## $Class_4
##                                    coef        se          z      p_val
## (Intercept)                   1.22662184 0.4926588  2.4897998 0.01278151
## age_group35_54                0.11683214 0.2608767  0.4478443 0.65426556
## age_group55_                  0.24822526 0.2850002  0.8709653 0.38377308
## is_women                      0.04018989 0.2107522  0.1906974 0.84876271
## diet_typeFlexitarian         -0.11841969 0.2862535 -0.4136882 0.67910245
## diet_typeVegan_Vegetarian     0.19630185 0.4116360  0.4768822 0.63344604
## education_levelDegree        -0.17665350 0.2354536 -0.7502689 0.45309279
## education_levelPostgraduate -0.16190327 0.3061758 -0.5287918 0.59694990
## hh_size                       0.10758422 0.1188829  0.9049596 0.36548681
## income_level30_50k            0.40740149 0.2512431  1.6215433 0.10490118
## income_level50_               0.23352192 0.2723584  0.8574066 0.39122019
## n_children                   -0.07196474 0.1673134 -0.4301193 0.66710886
## is_shopper                    0.20576885 0.2489528  0.8265377 0.40849914
## where_liveRuralarea          -0.33366663 0.3616905 -0.9225198 0.35625752
## where_liveTownorsuburb       -0.37794358 0.2822510 -1.3390335 0.18055976
```

Based on BIC, the optimal number of classes is 3. Also, we could not estiamte a model with more than 4 classes due to lack of variation, i.e., singular hessian matrix.