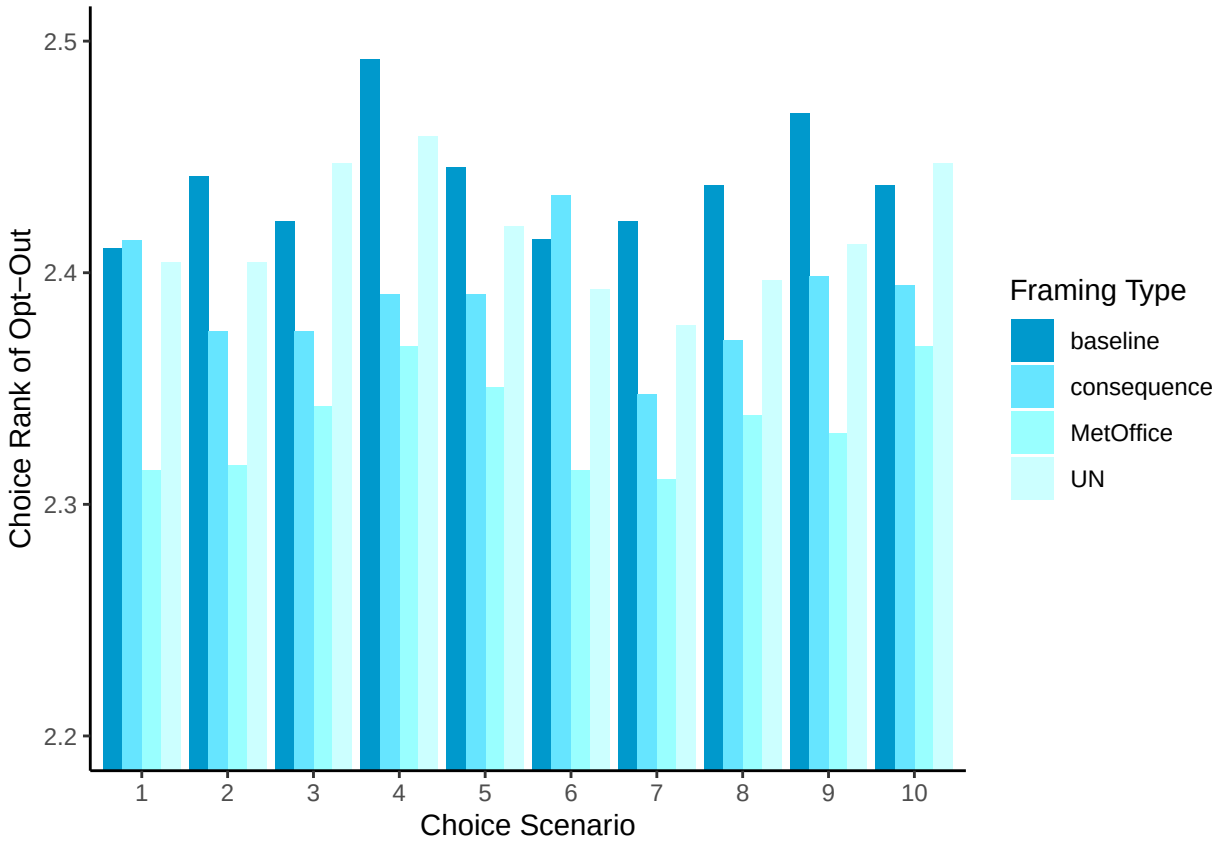
Consumer WTP for Carbon Offsets

Choice Probaility by Information Treatment

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



The above table presents the choice probability of the opt-out option being the best option by information treatment. The probability differences between different information treatments does not appear to be large. Evan when the probaiblity of selecting opt out is larger with consequence framing, the difference at about 0.01 percentage points.

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: Fri Oct 11 06:08:57 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: Fri Oct 11 06:08:57 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: Fri Oct 11 06:08:57 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
```

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: Fri Oct 11 06:08:57 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: Fri Oct 11 06:08:57 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
```

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: Fri Oct 11 06:08:57 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: Fri Oct 11 06:08:58 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: Fri Oct 11 06:09:01 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: Fri Oct 11 06:09:02 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: Fri Oct 11 06:09:02 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: Fri Oct 11 06:09:02 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: Fri Oct 11 06:09:02 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: Fri Oct 11 06:09:03 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.