IDS 702 Team Project

Part II: Model and Variable Selection

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Model 1

```
ten_countries
```

```
##    year National_income_USA GDP_USA  CO2_USA National_income_China GDP_China
## 1  2000             64578.1 74362.4 6243.512              6259.370  7532.649
## 2  2001             64349.0 74251.9 6158.156              6544.980  7877.060
## 3  2002             64323.1 74689.2 6278.259              7181.381  8582.114
## 4  2003             65074.4 75835.9 6356.811              7721.759  9194.614
## 5  2004             67017.0 77806.5 6548.128              8489.616 10066.976
## 6  2005             68544.1 79563.2 6585.853              9138.108 10892.963
## 7  2006             70148.4 80832.0 6584.979             10119.452 11987.739
## 8  2007             69569.5 81404.6 6607.977             11243.391 13223.011
## 9  2008             67699.5 80418.9 6321.091             11696.728 13600.195
## 10 2009             64505.5 77516.5 5798.996             12309.536 14454.701
## 11 2010             66668.3 78613.8 6009.014             13274.508 15617.514
## 12 2011             68056.3 79306.2 5950.137             14064.083 16558.948
## 13 2012             69614.1 80106.3 5727.855             14949.991 17432.122
## 14 2013             70077.3 81210.1 5818.528             16231.302 19043.346
## 15 2014             71621.3 82404.0 5854.312             17531.952 20368.709
## 16 2015             73544.6 84920.5 5728.896             18482.566 21570.536
## 17 2016             73137.1 85306.5 5609.857             19566.483 22872.949
## 18 2017             74230.4 86750.5 5591.527             20682.222 24283.701
## 19 2018             75376.1 88520.5 5767.385             21738.991 25744.047
## 20 2019             76074.7 89639.3 5618.349             22778.129 27102.295
## 21 2020             72530.5 85889.4 5056.514             23087.360 27578.189
##    CO2_China National_income_India GDP_India CO2_India National_income_Germany
## 1   2966.438              4552.485  5052.384  947.9181                48311.96
## 2   3111.275              4597.144  5136.486  973.3258                48683.11
## 3   3349.532              4708.538  5262.935  992.7863                48259.49
## 4   3756.494              4768.670  5312.647 1045.8105                48167.90
## 5   4247.222              5027.720  5609.233 1112.0221                49489.77
## 6   4671.877              5282.856  5913.055 1157.0825                49847.43
## 7   4966.312              5615.163  6315.307 1244.4029                52205.85
## 8   5394.594              5966.624  6726.242 1348.2947                53369.37
## 9   5888.035              6428.904  7194.478 1438.7902                53449.48
## 10  6623.902              6461.402  7299.937 1538.6289                50191.62
## 11  7202.213              6854.784  7737.486 1584.6096                51843.24
## 12  7953.535              7364.190  8320.766 1649.3192                53089.67
```

```
## 13  8254.039             7660.195  8659.019 1804.3167               53318.50
## 14  8466.827             7808.042  8932.345 1820.7281               53352.82
## 15  8514.369             8121.890  9378.188 1979.7384               54239.58
## 16  8507.310             8647.252  9914.606 2067.3493               54956.91
## 17  8555.539             9298.896 10517.834 2180.2446               56090.13
## 18  8724.594             9793.632 11059.116 2252.4839               57266.73
## 19  8959.962            10236.769 11576.406 2354.7946               57716.25
## 20  9156.242            10503.325 11895.422 2377.0559               57433.75
## 21  9229.492             9805.317 11146.120 2210.6620               54640.23
##    GDP_Germany CO2_Germany National_income_United_Kingdom GDP_United_Kingdom
## 1     57016.27   1092.6729                       43075.56           48107.78
## 2     57549.24   1087.2233                       44484.70           49649.08
## 3     57363.53   1057.6714                       45294.19           50359.84
## 4     56905.06   1064.0225                       46503.02           51590.29
## 5     57425.47   1068.8797                       47626.35           52741.93
## 6     57632.14   1048.3137                       48223.86           53601.64
## 7     59604.86   1076.8192                       48806.44           53939.66
## 8     61380.64   1020.1647                       49268.38           55036.39
## 9     61846.99   1010.5018                       50648.49           56009.63
## 10    58265.11    930.0541                       50901.30           55578.85
## 11    60192.29    976.3896                       46733.21           51887.34
## 12    61601.47    976.1004                       47234.27           52531.09
## 13    61687.18    920.5091                       45829.82           52836.54
## 14    61728.83    920.9907                       46521.52           53726.41
## 15    62827.34    888.6082                       46997.54           54469.18
## 16    63461.50    875.8379                       48152.87           55454.08
## 17    64618.88    872.7670                       48638.00           56294.16
## 18    66053.95    870.9329                       49583.21           57085.30
## 19    66489.19    861.5927                       50150.14           57629.75
## 20    66972.62    800.6746                       49596.16           58217.73
## 21    63789.39    728.6139                       44407.02           52440.47
##    CO2_United_Kingdom National_income_Canada GDP_Canada CO2_Canada
## 1            696.0880               50550.55   59203.12   567.7579
## 2            705.2561               50202.63   59295.21   547.2713
## 3            698.3926               51102.66   60102.49   570.1219
## 4            713.6533               51481.95   60437.15   548.4005
## 5            736.3135               52746.58   61486.91   565.2194
## 6            726.5763               53778.74   62510.64   576.6702
## 7            741.9619               55097.93   63416.60   566.1175
## 8            749.2371               55281.52   63820.98   599.0809
## 9            710.9267               54533.72   63320.09   581.7258
## 10           656.4940               51616.66   60567.60   558.7508
## 11           681.8591               52507.60   61558.47   595.0749
## 12           628.7591               52836.67   62144.62   563.5060
## 13           640.3765               53749.96   62380.18   603.6116
## 14           616.4803               54370.56   62942.97   608.2582
## 15           589.7714               55199.02   63860.11   600.0063
## 16           569.8455               54431.28   63435.45   581.2418
## 17           541.5390               54332.94   63252.60   564.4867
## 18           536.2167               55753.06   64412.22   575.3884
## 19           540.1666               56410.94   65470.15   588.4063
## 20           525.5872               56243.78   65976.72   578.5203
## 21           462.5168               52203.72   61846.17   520.6682
##    National_income_Australia GDP_Australia CO2_Australia National_income_Brazil
```

```
## 1                  49196.72      59361.10      290.0058              19398.26
## 2                  49264.47      59556.09      296.0152              19130.62
## 3                  50641.77      60954.64      316.9795              19197.78
## 4                  51354.31      61823.26      331.1009              18858.95
## 5                  52952.24      63377.03      344.4134              19573.88
## 6                  53336.22      64499.39      341.2755              19711.19
## 7                  53764.03      65201.06      357.6028              20035.42
## 8                  54378.31      66334.08      370.4580              20879.32
## 9                  55362.23      67397.08      364.0607              21553.71
## 10                 54883.99      66753.23      388.0428              21024.08
## 11                 54885.92      67019.50      383.2160              22101.93
## 12                 55097.63      66982.52      390.9302              22667.99
## 13                 55321.40      67113.89      411.9872              22825.91
## 14                 56134.66      68250.37      389.4520              23410.83
## 15                 55739.82      67929.35      392.2972              22971.87
## 16                 54580.75      66947.42      395.8695              21701.24
## 17                 55411.53      67743.49      385.2692              20611.64
## 18                 55754.61      68608.97      388.6341              20662.18
## 19                 56478.93      69495.37      378.9225              20576.88
## 20                 56174.23      69410.57      374.4238              20551.79
## 21                 56154.24      69020.93      336.9815              19421.20
##    GDP_Brazil CO2_Brazil National_income_Nigeria GDP_Nigeria CO2_Nigeria
## 1    22578.43   336.8040                6474.840    7025.409    46.75644
## 2    22352.55   332.5702                6728.206    7251.252    64.49740
## 3    22480.10   315.9631                7639.961    8144.340    72.02371
## 4    22190.73   304.2479                7957.967    8511.187    77.80638
## 5    22924.43   316.5276                8334.339    9050.305    84.41149
## 6    23136.16   334.4246                8751.912    9374.453    92.17793
## 7    23534.97   343.8018                9087.660    9692.325    72.20950
## 8    24455.98   370.0410                9111.175   10064.754    86.35525
## 9    25203.66   416.0265                9492.785   10465.193    88.48206
## 10   24699.07   381.4825                9939.175   11010.768    81.08125
## 11   26071.36   459.4822               10449.586   11581.925    94.15883
## 12   26625.68   484.8448               10652.660   11889.566    99.37846
## 13   26675.81   509.7443               10844.451   12079.069    83.58206
## 14   27024.49   541.5421               11328.784   12556.556   118.39379
## 15   26719.49   569.2059               11939.575   13003.272   121.24401
## 16   25356.16   520.5365               12032.302   12995.640   124.26436
## 17   24149.99   502.8934               11703.372   12458.698   128.22008
## 18   24093.54   511.0102               11422.023   12228.112   131.76394
## 19   24152.82   488.8707               11323.754   12127.006   129.86198
## 20   24138.30   487.8927               11376.982   12054.961   133.62974
## 21   22840.16   463.4981               10889.509   11509.348   130.28899
##    National_income_South_Africa GDP_South_Africa CO2_South_Africa
## 1                      18131.60         21448.80         278.0964
## 2                      18492.86         21914.33         260.8040
## 3                      19144.58         22474.12         245.8759
## 4                      19592.42         23018.91         279.7352
## 5                      20313.80         23616.64         322.6100
## 6                      21168.80         24517.85         301.6430
## 7                      21954.06         25586.41         326.1320
## 8                      22319.79         26458.62         328.7444
## 9                      22336.04         26661.83         328.2835
## 10                     22021.05         26330.78         349.8212
```

```
## 11                    22611.55         26826.65         329.5887
## 12                    22939.50         27120.81         331.0373
## 13                    22578.18         26843.58         331.9544
## 14                    22179.29         26496.03         325.9381
## 15                    21796.20         26082.81         337.3161
## 16                    21735.35         25902.97         321.9626
## 17                    21277.78         25576.71         320.8881
## 18                    21114.80         25413.43         331.0132
## 19                    21051.32         25363.42         335.3028
## 20                    20561.55         24989.32         339.9962
## 21                    18960.69         23019.92         331.4963
```

```
population_ten_countries
```

```
##    Percentile Year
## 1        pall 2000
## 2        pall 2001
## 3        pall 2002
## 4        pall 2003
## 5        pall 2004
## 6        pall 2005
## 7        pall 2006
## 8        pall 2007
## 9        pall 2008
## 10       pall 2009
## 11       pall 2010
## 12       pall 2011
## 13       pall 2012
## 14       pall 2013
## 15       pall 2014
## 16       pall 2015
## 17       pall 2016
## 18       pall 2017
## 19       pall 2018
## 20       pall 2019
## 21       pall 2020
##    npopul_999_i_US\r\nPopulation\r\nTotal population | units | all ages | individual\r\nUSA
## 1                                                                                282398000
## 2                                                                                285225000
## 3                                                                                287955000
## 4                                                                                290626000
## 5                                                                                293262000
## 6                                                                                295993000
## 7                                                                                298818000
## 8                                                                                301696000
## 9                                                                                304543000
## 10                                                                               307240000
## 11                                                                               309774000
## 12                                                                               312010000
## 13                                                                               314212000
## 14                                                                               316357000
## 15                                                                               318631000
## 16                                                                               320918000
## 17                                                                               323186000
```

```
## 18                                                                                                  325220000
## 19                                                                                                  326949000
## 20                                                                                                  328527000
## 21                                                                                                  330152000
##    npopul_999_i_CN\r\nPopulation\r\nTotal population | units | all ages | individual\r\nChina
## 1                                                                                                  1267430000
## 2                                                                                                  1276270000
## 3                                                                                                  1284530000
## 4                                                                                                  1292270000
## 5                                                                                                  1299880000
## 6                                                                                                  1307560000
## 7                                                                                                  1314480000
## 8                                                                                                  1321290000
## 9                                                                                                  1328020000
## 10                                                                                                 1334500000
## 11                                                                                                 1340910000
## 12                                                                                                 1347350000
## 13                                                                                                 1354040000
## 14                                                                                                 1360720000
## 15                                                                                                 1367820000
## 16                                                                                                 1374620000
## 17                                                                                                 1381656576
## 18                                                                                                 1388469248
## 19                                                                                                 1394943360
## 20                                                                                                 1400938752
## 21                                                                                                 1406351872
##    npopul_999_i_IN\r\nPopulation\r\nTotal population | units | all ages | individual\r\nIndia
## 1                                                                                                  1056575552
## 2                                                                                                  1075000064
## 3                                                                                                  1093317248
## 4                                                                                                  1111523200
## 5                                                                                                  1129623424
## 6                                                                                                  1147609984
## 7                                                                                                  1165486336
## 8                                                                                                  1183209472
## 9                                                                                                  1200669824
## 10                                                                                                 1217726208
## 11                                                                                                 1234281216
## 12                                                                                                 1250288000
## 13                                                                                                 1265780224
## 14                                                                                                 1280842112
## 15                                                                                                 1295600768
## 16                                                                                                 1310152448
## 17                                                                                                 1324517248
## 18                                                                                                 1338676736
## 19                                                                                                 1352642304
## 20                                                                                                 1366417792
## 21                                                                                                 1380004352
##    npopul_999_i_DE\r\nPopulation\r\nTotal population | units | all ages | individual\r\nGermany
## 1                                                                                                    82211503
## 2                                                                                                    82349915
## 3                                                                                                    82488490
## 4                                                                                                    82534176
## 5                                                                                                    82516260
```

```
## 6                                                                                   82469422
## 7                                                                                   82376451
## 8                                                                                   82266372
## 9                                                                                   82110097
## 10                                                                                  81902328
## 11                                                                                  81776951
## 12                                                                                  81797673
## 13                                                                                  81818399
## 14                                                                                  81839131
## 15                                                                                  82117400
## 16                                                                                  82457192
## 17                                                                                  82866880
## 18                                                                                  83335328
## 19                                                                                  83805152
## 20                                                                                  84201000
## 21                                                                                  84470080
##    npopul_999_i_GB\r\nPopulation\r\nTotal population | units | all ages | individual\r\nUnited Kingdo
## 1                                                                                          5888600
## 2                                                                                          5911300
## 3                                                                                          5936600
## 4                                                                                          5963700
## 5                                                                                          5995000
## 6                                                                                          6041300
## 7                                                                                          6082700
## 8                                                                                          6131900
## 9                                                                                          6182400
## 10                                                                                         6226000
## 11                                                                                         6275900
## 12                                                                                         6328500
## 13                                                                                         6370500
## 14                                                                                         6410600
## 15                                                                                         6453910
## 16                                                                                         6497029
## 17                                                                                         6540217
## 18                                                                                         6582588
## 19                                                                                         6623450
## 20                                                                                         6661775
## 21                                                                                         6696878
##    npopul_999_i_CA\r\nPopulation\r\nTotal population | units | all ages | individual\r\nCanada
## 1                                                                                  30685730
## 2                                                                                  31019020
## 3                                                                                  31353656
## 4                                                                                  31639670
## 5                                                                                  31940676
## 6                                                                                  32245209
## 7                                                                                  32576074
## 8                                                                                  32929733
## 9                                                                                  33319098
## 10                                                                                 33729690
## 11                                                                                 34126181
## 12                                                                                 34482779
## 13                                                                                 34865028
## 14                                                                                 35238912
## 15                                                                                 35606120
```

```
## 16                                                                                                  35967868
## 17                                                                                                  36323556
## 18                                                                                                  36672136
## 19                                                                                                  37014040
## 20                                                                                                  37349980
## 21                                                                                                  37680540
##    npopul_999_i_QG\r\nPopulation\r\nTotal population | units | all ages | individual\r\nAustralia an
## 1
## 2
## 3
## 4
## 5
## 6
## 7
## 8
## 9
## 10
## 11
## 12
## 13
## 14
## 15
## 16
## 17
## 18
## 19
## 20
## 21
##    npopul_999_i_QQ\r\nPopulation\r\nTotal population | units | all ages | individual\r\nOceania (exc
## 1
## 2
## 3
## 4
## 5
## 6
## 7
## 8
## 9
## 10
## 11
## 12
## 13
## 14
## 15
## 16
## 17
## 18
## 19
## 20
## 21
##    npopul_999_i_AU\r\nPopulation\r\nTotal population | units | all ages | individual\r\nAustralia
## 1                                                                                                     19028802
## 2                                                                                                     19274701
## 3                                                                                                     19495210
```

```
## 4                                                                               19720737
## 5                                                                               19932722
## 6                                                                               20176844
## 7                                                                               20450966
## 8                                                                               20827622
## 9                                                                               21249199
## 10                                                                              21691653
## 11                                                                              22031750
## 12                                                                              22340024
## 13                                                                              22728254
## 14                                                                              23117400
## 15                                                                              23475300
## 16                                                                              23809652
## 17                                                                              24138170
## 18                                                                              24458424
## 19                                                                              24770346
## 20                                                                              25073828
## 21                                                                              25368990
##    npopul_999_i_BR\r\nPopulation\r\nTotal population | units | all ages | individual\r\nBrazil
## 1                                                                              174790336
## 2                                                                              177196048
## 3                                                                              179537520
## 4                                                                              181809248
## 5                                                                              184006480
## 6                                                                              186127104
## 7                                                                              188167360
## 8                                                                              190130448
## 9                                                                              192030368
## 10                                                                             193886512
## 11                                                                             195713632
## 12                                                                             197514528
## 13                                                                             199287296
## 14                                                                             201035904
## 15                                                                             202763744
## 16                                                                             204471776
## 17                                                                             206163056
## 18                                                                             207833824
## 19                                                                             209469328
## 20                                                                             211049520
## 21                                                                             212559424
##    npopul_999_i_NG\r\nPopulation\r\nTotal population | units | all ages | individual\r\nNigeria
## 1                                                                               122283848
## 2                                                                               125394048
## 3                                                                               128596080
## 4                                                                               131900632
## 5                                                                               135320416
## 6                                                                               138865024
## 7                                                                               142538304
## 8                                                                               146339984
## 9                                                                               150269616
## 10                                                                              154324928
## 11                                                                              158503200
## 12                                                                              162805072
## 13                                                                              167228800
```

```
## 14                                                                                            171765824
## 15                                                                                            176404928
## 16                                                                                            181137440
## 17                                                                                            185960240
## 18                                                                                            190873248
## 19                                                                                            195874688
## 20                                                                                            200963600
## 21                                                                                            206139584
##    npopul_999_i_ZA\r\nPopulation\r\nTotal population | units | all ages | individual\r\nSouth Africa
## 1                                                                                               43695928
## 2                                                                                               44552396
## 3                                                                                               45456336
## 4                                                                                               46303560
## 5                                                                                               47071708
## 6                                                                                               47817896
## 7                                                                                               48533604
## 8                                                                                               49215800
## 9                                                                                               49861788
## 10                                                                                              50473912
## 11                                                                                              51056648
## 12                                                                                              51634728
## 13                                                                                              52221984
## 14                                                                                              52875980
## 15                                                                                              53608552
## 16                                                                                              54436288
## 17                                                                                              55243480
## 18                                                                                              56031828
## 19                                                                                              56801168
## 20                                                                                              57553784
## 21                                                                                              58291328
```

```
co2_wealth_ten_countries
```

```
##     co2_usa co2_china co2_india co2_germany   co2_uk co2_canada co2_australia
## 1  6243.512  2966.438  947.9181   1092.6729 696.0880   567.7579      290.0058
## 2  6158.156  3111.275  973.3258   1087.2233 705.2561   547.2713      296.0152
## 3  6278.259  3349.532  992.7863   1057.6714 698.3926   570.1219      316.9795
## 4  6356.811  3756.494 1045.8105   1064.0225 713.6533   548.4005      331.1009
## 5  6548.128  4247.222 1112.0221   1068.8797 736.3135   565.2194      344.4134
## 6  6585.853  4671.877 1157.0825   1048.3137 726.5763   576.6702      341.2755
## 7  6584.979  4966.312 1244.4029   1076.8192 741.9619   566.1175      357.6028
## 8  6607.977  5394.594 1348.2947   1020.1647 749.2371   599.0809      370.4580
## 9  6321.091  5888.035 1438.7902   1010.5018 710.9267   581.7258      364.0607
## 10 5798.996  6623.902 1538.6289    930.0541 656.4940   558.7508      388.0428
## 11 6009.014  7202.213 1584.6096    976.3896 681.8591   595.0749      383.2160
## 12 5950.137  7953.535 1649.3192    976.1004 628.7591   563.5060      390.9302
## 13 5727.855  8254.039 1804.3167    920.5091 640.3765   603.6116      411.9872
## 14 5818.528  8466.827 1820.7281    920.9907 616.4803   608.2582      389.4520
## 15 5854.312  8514.369 1979.7384    888.6082 589.7714   600.0063      392.2972
## 16 5728.896  8507.310 2067.3493    875.8379 569.8455   581.2418      395.8695
## 17 5609.857  8555.539 2180.2446    872.7670 541.5390   564.4867      385.2692
## 18 5591.527  8724.594 2252.4839    870.9329 536.2167   575.3884      388.6341
## 19 5767.385  8959.962 2354.7946    861.5927 540.1666   588.4063      378.9225
## 20 5618.349  9156.242 2377.0559    800.6746 525.5872   578.5203      374.4238
```

```
## 21 5056.514  9229.492 2210.6620    728.6139 462.5168   520.6682      336.9815
##    co2_brazil co2_nigira co2_south africa wealth_usa wealth_china wealth_india
## 1    336.8040   46.75644         278.0964   306733.0     37379.01     18120.92
## 2    332.5702   64.49740         260.8040   303177.4     38938.06     18374.40
## 3    315.9631   72.02371         245.8759   294610.2     42336.16     18883.00
## 4    304.2479   77.80638         279.7352   300247.8     45347.28     19715.74
## 5    316.5276   84.41149         322.6100   327274.8     49844.96     21355.34
## 6    334.4246   92.17793         301.6430   351245.4     55433.03     23034.77
## 7    343.8018   72.20950         326.1320   369410.2     61219.75     25036.09
## 8    370.0410   86.35525         328.7444   374904.3     71338.67     27117.88
## 9    416.0265   88.48206         328.2835   331209.7     72466.92     30012.09
## 10   381.4825   81.08125         349.8212   285842.0     78054.68     30811.66
## 11   459.4822   94.15883         329.5887   285324.0     88372.76     33206.79
## 12   484.8448   99.37846         331.0373   283604.5     92081.52     36511.52
## 13   509.7443   83.58206         331.9544   284190.3     99858.58     38686.20
## 14   541.5421  118.39379         325.9381   308147.6    111329.84     39810.32
## 15   569.2059  121.24401         337.3161   330596.7    121060.89     42422.08
## 16   520.5365  124.26436         321.9626   344401.7    130738.92     44968.12
## 17   502.8934  128.22008         320.8881   351970.0    140193.88     47670.41
## 18   511.0102  131.76394         331.0132   374711.8    146572.84     49571.23
## 19   488.8707  129.86198         335.3028   380433.6    154389.36     51046.34
## 20   487.8927  133.62974         339.9962   394437.5    165082.77     51906.35
## 21   463.4981  130.28899         331.4963   435500.7    167898.90     48818.63
##    wealth_germany wealth_uk wealth_canada wealth_australia wealth_brazil
## 1         213548.4  224227.6      175542.5         258389.0      50439.44
## 2         212377.1  231185.1      175526.7         265419.3      51825.35
## 3         208078.8  236191.2      169034.7         278433.0      50988.20
## 4         205238.4  248911.5      172188.8         295593.6      50675.09
## 5         206856.2  262375.2      182508.8         319410.5      54321.95
## 6         210510.9  275032.7      197483.7         339880.3      56035.48
## 7         215374.8  284992.1      216042.9         353010.3      57147.53
## 8         221775.7  291658.3      228888.4         372691.7      61837.34
## 9         226326.1  270516.9      217958.4         379099.4      65621.70
## 10        224584.4  250220.2      220745.9         358257.7      69899.30
## 11        227977.4  247868.4      232661.6         367272.2      76061.49
## 12        229758.5  245341.3      235620.5         362716.8      81115.90
## 13        236535.0  243128.8      237776.7         350881.3      84170.63
## 14        247880.2  244642.8      249331.5         355584.2      86745.99
## 15        260320.1  254202.6      265139.2         372273.5      87176.34
## 16        275193.4  268953.3      278465.5         394787.1      82862.85
## 17        293030.2  276354.2      290485.6         409807.3      76795.06
## 18        313133.1  283868.8      303848.3         423287.6      74022.48
## 19        332035.5  283466.1      308984.9         438983.1      71041.45
## 20        348798.0  281459.8      319379.7         434488.0      71638.46
## 21        341320.5  255742.1      339001.8         435620.1      68393.73
##    wealth_nigeria wealth_south africa
## 1        25247.13            56071.84
## 2        27205.46            58176.98
## 3        32232.88            59349.12
## 4        33985.51            62104.35
## 5        36434.64            66732.86
## 6        39471.59            72234.20
## 7        42248.35            77641.68
## 8        43417.67            80382.15
```

```
## 9        45975.06           79721.35
## 10       48789.65           78733.64
## 11       51295.11           80548.15
## 12       52558.42           81122.95
## 13       53790.52           80698.02
## 14       56269.71           81312.14
## 15       59383.44           81792.65
## 16       59948.06           82485.29
## 17       58411.23           80752.95
## 18       57196.79           80151.81
## 19       56963.32           79842.16
## 20       57446.58           77519.38
## 21       55203.29           73176.29
```

```
# meanC02 <- mean(as.matrix(only_co2_ten_countries))
# meanC02
```

```
colnames(population_ten_countries) <- c(
  "Percentile","Year","pop_usa","pop_china","pop_india","pop_germany","pop_uk","pop_canada","pop_aus_nz
population_ten_countries <- subset(population_ten_countries, select=-c(pop_aus_nz, pop_oceania))
population_ten_countries
```

```
##    Percentile Year   pop_usa  pop_china  pop_india pop_germany   pop_uk
## 1        pall 2000 282398000 1267430000 1056575552    82211503 58886000
## 2        pall 2001 285225000 1276270000 1075000064    82349915 59113000
## 3        pall 2002 287955000 1284530000 1093317248    82488490 59366000
## 4        pall 2003 290626000 1292270000 1111523200    82534176 59637000
## 5        pall 2004 293262000 1299880000 1129623424    82516260 59950000
## 6        pall 2005 295993000 1307560000 1147609984    82469422 60413000
## 7        pall 2006 298818000 1314480000 1165486336    82376451 60827000
## 8        pall 2007 301696000 1321290000 1183209472    82266372 61319000
## 9        pall 2008 304543000 1328020000 1200669824    82110097 61824000
## 10       pall 2009 307240000 1334500000 1217726208    81902328 62260000
## 11       pall 2010 309774000 1340910000 1234281216    81776951 62759000
## 12       pall 2011 312010000 1347350000 1250288000    81797673 63285000
## 13       pall 2012 314212000 1354040000 1265780224    81818399 63705000
## 14       pall 2013 316357000 1360720000 1280842112    81839131 64106000
## 15       pall 2014 318631000 1367820000 1295600768    82117400 64539100
## 16       pall 2015 320918000 1374620000 1310152448    82457192 64970292
## 17       pall 2016 323186000 1381656576 1324517248    82866880 65402176
## 18       pall 2017 325220000 1388469248 1338676736    83335328 65825884
## 19       pall 2018 326949000 1394943360 1352642304    83805152 66234508
## 20       pall 2019 328527000 1400938752 1366417792    84201000 66617756
## 21       pall 2020 330152000 1406351872 1380004352    84470080 66968780
##    pop_canada pop_australia pop_brazil pop_nigeria pop_southafrica
## 1    30685730      19028802  174790336   122283848        43695928
## 2    31019020      19274701  177196048   125394048        44552396
## 3    31353656      19495210  179537520   128596080        45456336
## 4    31639670      19720737  181809248   131900632        46303560
## 5    31940676      19932722  184006480   135320416        47071708
## 6    32245209      20176844  186127104   138865024        47817896
## 7    32576074      20450966  188167360   142538304        48533604
## 8    32929733      20827622  190130448   146339984        49215800
```

```
## 9    33319098      21249199  192030368   150269616        49861788
## 10   33729690      21691653  193886512   154324928        50473912
## 11   34126181      22031750  195713632   158503200        51056648
## 12   34482779      22340024  197514528   162805072        51634728
## 13   34865028      22728254  199287296   167228800        52221984
## 14   35238912      23117400  201035904   171765824        52875980
## 15   35606120      23475300  202763744   176404928        53608552
## 16   35967868      23809652  204471776   181137440        54436288
## 17   36323556      24138170  206163056   185960240        55243480
## 18   36672136      24458424  207833824   190873248        56031828
## 19   37014040      24770346  209469328   195874688        56801168
## 20   37349980      25073828  211049520   200963600        57553784
## 21   37680540      25368990  212559424   206139584        58291328
```

```
nat_inc <- ten_countries[ , grepl("National_income", names( ten_countries ) ) ]
nat_inc$Year <- 2000:2020
co2 <- ten_countries[ , grepl("CO2", names( ten_countries ) ) ]
co2$Year <- 2000:2020
pop <- population_ten_countries[ , grepl("pop", names( population_ten_countries ) ) ]
pop$Year <- 2000:2020
wealth <- co2_wealth_ten_countries[ , grepl("wealth", names( co2_wealth_ten_countries ) ) ]
wealth$Year <- 2000:2020
co2
```

```
##     CO2_USA CO2_China CO2_India CO2_Germany CO2_United_Kingdom CO2_Canada
## 1  6243.512  2966.438  947.9181   1092.6729           696.0880   567.7579
## 2  6158.156  3111.275  973.3258   1087.2233           705.2561   547.2713
## 3  6278.259  3349.532  992.7863   1057.6714           698.3926   570.1219
## 4  6356.811  3756.494 1045.8105   1064.0225           713.6533   548.4005
## 5  6548.128  4247.222 1112.0221   1068.8797           736.3135   565.2194
## 6  6585.853  4671.877 1157.0825   1048.3137           726.5763   576.6702
## 7  6584.979  4966.312 1244.4029   1076.8192           741.9619   566.1175
## 8  6607.977  5394.594 1348.2947   1020.1647           749.2371   599.0809
## 9  6321.091  5888.035 1438.7902   1010.5018           710.9267   581.7258
## 10 5798.996  6623.902 1538.6289    930.0541           656.4940   558.7508
## 11 6009.014  7202.213 1584.6096    976.3896           681.8591   595.0749
## 12 5950.137  7953.535 1649.3192    976.1004           628.7591   563.5060
## 13 5727.855  8254.039 1804.3167    920.5091           640.3765   603.6116
## 14 5818.528  8466.827 1820.7281    920.9907           616.4803   608.2582
## 15 5854.312  8514.369 1979.7384    888.6082           589.7714   600.0063
## 16 5728.896  8507.310 2067.3493    875.8379           569.8455   581.2418
## 17 5609.857  8555.539 2180.2446    872.7670           541.5390   564.4867
## 18 5591.527  8724.594 2252.4839    870.9329           536.2167   575.3884
## 19 5767.385  8959.962 2354.7946    861.5927           540.1666   588.4063
## 20 5618.349  9156.242 2377.0559    800.6746           525.5872   578.5203
## 21 5056.514  9229.492 2210.6620    728.6139           462.5168   520.6682
##    CO2_Australia CO2_Brazil CO2_Nigeria CO2_South_Africa Year
## 1       290.0058   336.8040    46.75644         278.0964 2000
## 2       296.0152   332.5702    64.49740         260.8040 2001
## 3       316.9795   315.9631    72.02371         245.8759 2002
## 4       331.1009   304.2479    77.80638         279.7352 2003
## 5       344.4134   316.5276    84.41149         322.6100 2004
## 6       341.2755   334.4246    92.17793         301.6430 2005
## 7       357.6028   343.8018    72.20950         326.1320 2006
```

```
## 8       370.4580   370.0410    86.35525         328.7444 2007
## 9       364.0607   416.0265    88.48206         328.2835 2008
## 10      388.0428   381.4825    81.08125         349.8212 2009
## 11      383.2160   459.4822    94.15883         329.5887 2010
## 12      390.9302   484.8448    99.37846         331.0373 2011
## 13      411.9872   509.7443    83.58206         331.9544 2012
## 14      389.4520   541.5421   118.39379         325.9381 2013
## 15      392.2972   569.2059   121.24401         337.3161 2014
## 16      395.8695   520.5365   124.26436         321.9626 2015
## 17      385.2692   502.8934   128.22008         320.8881 2016
## 18      388.6341   511.0102   131.76394         331.0132 2017
## 19      378.9225   488.8707   129.86198         335.3028 2018
## 20      374.4238   487.8927   133.62974         339.9962 2019
## 21      336.9815   463.4981   130.28899         331.4963 2020
```

```
wealth_stack <- reshape2::melt(wealth, id.vars = "Year", variable.name = 'country_wealth', value.name='
wealth_stack$Country <- toupper(sub(".*_", "", wealth_stack$country_wealth))
pop_stack <- reshape2::melt(pop, id.vars = "Year", variable.name='country_pop', value.name='National_Po
pop_stack$Country <- toupper(sub(".*_", "", pop_stack$country_pop))
pop_stack$Country[pop_stack$Country == "SOUTHAFRICA"] <- "SOUTH AFRICA"
co2_stack <- reshape2::melt(co2, id.vars = "Year", variable.name='country_co2', value.name='National_Ca
co2_stack$Country <- toupper(sub(".*_", "", co2_stack$country_co2))
co2_stack$Country[co2_stack$Country == "KINGDOM"] <- "UK"
co2_stack$Country[co2_stack$Country == "AFRICA"] <- "SOUTH AFRICA"
nat_inc_stack <- reshape2::melt(nat_inc, id.vars = "Year", variable.name='country_income', value.name='
nat_inc_stack$Country <- toupper(sub(".*_", "", nat_inc_stack$country_income))
nat_inc_stack$Country[nat_inc_stack$Country == "KINGDOM"] <- "UK"
nat_inc_stack$Country[nat_inc_stack$Country == "AFRICA"] <- "SOUTH AFRICA"
complete_model_2_df <- wealth_stack[, c("Year", "Country", "National_Wealth")]
complete_model_2_df <- merge(complete_model_2_df, pop_stack, by=c("Year", "Country"))
complete_model_2_df <- merge(complete_model_2_df, co2_stack, by=c("Year", "Country"))
complete_model_2_df <- merge(complete_model_2_df, nat_inc_stack, by=c("Year", "Country"))
dropcolFromCompleteModel <- c("country_pop", "country_co2", "country_income")
complete_model_2_df = complete_model_2_df[, !(names(complete_model_2_df) %in% dropcolFromCompleteModel)]
complete_model_2_df <- complete_model_2_df[order(complete_model_2_df[,2], complete_model_2_df[,1]), ]
```

```
mean_co2 <- mean(co2_stack$National.carbon.emissions)
```

```
## Start:  AIC=2775.72
## stacking_co2 ~ top10 + middle40 + bottom50 + country_code
##
##                Df Sum of Sq        RSS    AIC
## - bottom50      1    568503  102621102 2774.9
## - middle40      1    669066  102721665 2775.1
## - top10         1    676398  102728997 2775.1
## <none>                       102052599 2775.7
## - country_code  9 997560299 1099612898 3256.9
##
## Step:  AIC=2774.88
## stacking_co2 ~ top10 + middle40 + country_code
##
##                Df  Sum of Sq        RSS    AIC
## - middle40      1     672450  103293552 2774.3
```

```
## <none>                          102621102 2774.9
## - top10         1    1880869  104501971 2776.7
## - country_code  9 1038698605 1141319707 3262.8
##
## Step:  AIC=2774.26
## stacking_co2 ~ top10 + country_code
##
##                Df  Sum of Sq        RSS    AIC
## <none>                         103293552 2774.3
## - top10         1    6561411  109854963 2785.2
## - country_code  9 1114784349 1218077901 3274.4


##
## Call:
## lm(formula = stacking_co2 ~ top10 + country_code, data = dataset_for_model1)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -3258.4  -112.2   -20.9   106.5  2611.8
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)      3023.5      854.7   3.538 0.000502 ***
## top10            6783.8     1908.0   3.555 0.000472 ***
## country_code2     768.0      228.2   3.365 0.000918 ***
## country_code3   -4895.8      264.4 -18.520  < 2e-16 ***
## country_code4   -4499.7      271.0 -16.602  < 2e-16 ***
## country_code5   -4869.8      263.0 -18.519  < 2e-16 ***
## country_code6   -5175.1      234.1 -22.103  < 2e-16 ***
## country_code7   -4803.5      325.2 -14.773  < 2e-16 ***
## country_code8   -6676.9      379.8 -17.580  < 2e-16 ***
## country_code9   -6069.1      226.7 -26.774  < 2e-16 ***
## country_code10  -6882.0      401.5 -17.140  < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 720.5 on 199 degrees of freedom
## Multiple R-squared:  0.916,  Adjusted R-squared:  0.9118
## F-statistic:   217 on 10 and 199 DF,  p-value: < 2.2e-16
```

The baseline of country is USA. Top 10% income bracket and country are statistically significant.

\begin{table}

\caption{95% Confidence Interval}

Table 1: MLR Model Regressing Carbon Footprint on Income Inequality

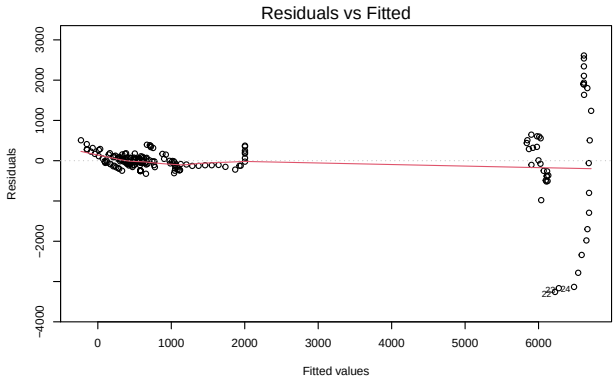
Predictor	Estimate	SE	t	p-value
(Intercept)	3023.49	854.66	3.54	0
top10	6783.79	1908.02	3.56	0
country_code2	768.03	228.23	3.37	0
country_code3	-4895.81	264.35	-18.52	0
country_code4	-4499.73	271.03	-16.60	0
country_code5	-4869.77	262.96	-18.52	0
country_code6	-5175.08	234.14	-22.10	0
country_code7	-4803.51	325.16	-14.77	0
country_code8	-6676.87	379.79	-17.58	0
country_code9	-6069.10	226.68	-26.77	0
country_code10	-6881.98	401.53	-17.14	0

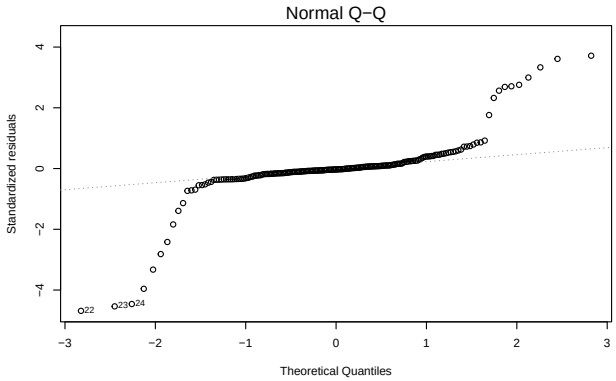
[a] Multiple R-squared: 0.9160

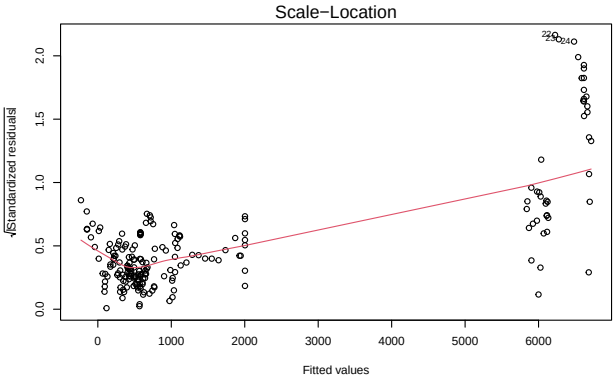
[b] Adjusted R-squared: 0.9118

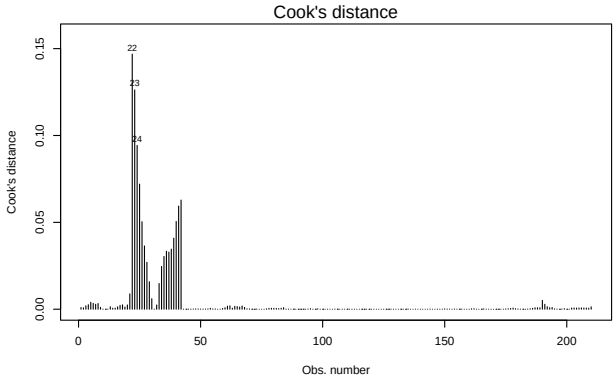
	2.5 %	97.5 %
(Intercept)	1338.13	4708.84
top10	3021.25	10546.33
country_code2	317.98	1218.08
country_code3	-5417.10	-4374.53
country_code4	-5034.19	-3965.27
country_code5	-5388.31	-4351.22
country_code6	-5636.78	-4713.37
country_code7	-5444.70	-4162.32
country_code8	-7425.81	-5927.94
country_code9	-6516.10	-5622.10
country_code10	-7673.77	-6090.19

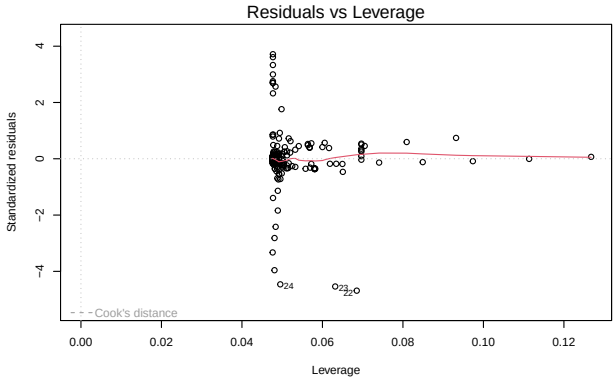
\end{table}











Model 2

```
## [1] "Year"                      "Country"
## [3] "National_Carbon_Emissions" "National_Wealth"
## [5] "National_Income"           "National_Population"
```

```
## [1] 1761.01
```

```
## 'data.frame':    210 obs. of  7 variables:
##  $ Year           : num  2000 2001 2002 2003 2004 ...
##  $ Country        : Factor w/ 10 levels "AUSTRALIA","BRAZIL",..: 10 10 10 10 10 10 10 10 10 10 ...
##  $ CO2            : num  6244 6158 6278 6357 6548 ...
##  $ National_Wealth: num  306733 303177 294610 300248 327275 ...
```

```
##  $ National_Income: num  64578 64349 64323 65074 67017 ...
##  $ Population     : num  2.82e+08 2.85e+08 2.88e+08 2.91e+08 2.93e+08 ...
##  $ CO2_C          : Ord.factor w/ 3 levels "low"<"med"<"high": 3 3 3 3 3 3 3 3 3 3 ...
```

	Year	Country	CO2	National_Wealth	National_Income	Population
1	2000	USA	6243.51155	306733.00	64578.100	282398000
2	2001	USA	6158.15648	303177.40	64349.000	285225000
3	2002	USA	6278.25894	294610.20	64323.100	287955000
4	2003	USA	6356.81134	300247.80	65074.400	290626000
5	2004	USA	6548.12797	327274.80	67017.000	293262000
6	2005	USA	6585.85281	351245.40	68544.100	295993000
7	2006	USA	6584.97941	369410.20	70148.400	298818000
8	2007	USA	6607.97739	374904.30	69569.500	301696000
9	2008	USA	6321.09090	331209.70	67699.500	304543000
10	2009	USA	5798.99596	285842.00	64505.500	307240000
11	2010	USA	6009.01357	285324.00	66668.300	309774000
12	2011	USA	5950.13695	283604.50	68056.300	312010000
13	2012	USA	5727.85528	284190.30	69614.100	314212000
14	2013	USA	5818.52831	308147.60	70077.300	316357000
15	2014	USA	5854.31222	330596.70	71621.300	318631000
16	2015	USA	5728.89559	344401.70	73544.600	320918000
17	2016	USA	5609.85715	351970.00	73137.100	323186000
18	2017	USA	5591.52706	374711.80	74230.400	325220000
19	2018	USA	5767.38466	380433.60	75376.100	326949000
20	2019	USA	5618.34916	394437.50	76074.700	328527000
21	2020	USA	5056.51425	435500.70	72530.500	330152000
22	2000	CHINA	2966.43794	37379.01	6259.370	1267430000
23	2001	CHINA	3111.27545	38938.06	6544.980	1276270000
24	2002	CHINA	3349.53177	42336.16	7181.381	1284530000
25	2003	CHINA	3756.49381	45347.28	7721.759	1292270000
26	2004	CHINA	4247.22240	49844.96	8489.616	1299880000
27	2005	CHINA	4671.87694	55433.03	9138.108	1307560000
28	2006	CHINA	4966.31174	61219.75	10119.452	1314480000
29	2007	CHINA	5394.59413	71338.67	11243.391	1321290000
30	2008	CHINA	5888.03489	72466.92	11696.728	1328020000
31	2009	CHINA	6623.90213	78054.68	12309.536	1334500000
32	2010	CHINA	7202.21252	88372.76	13274.508	1340910000
33	2011	CHINA	7953.53483	92081.52	14064.083	1347350000
34	2012	CHINA	8254.03900	99858.58	14949.991	1354040000
35	2013	CHINA	8466.82728	111329.84	16231.302	1360720000
36	2014	CHINA	8514.36874	121060.89	17531.952	1367820000
37	2015	CHINA	8507.30992	130738.92	18482.566	1374620000
38	2016	CHINA	8555.53899	140193.88	19566.483	1381656576
39	2017	CHINA	8724.59387	146572.84	20682.222	1388469248
40	2018	CHINA	8959.96155	154389.36	21738.991	1394943360
41	2019	CHINA	9156.24206	165082.77	22778.129	1400938752
42	2020	CHINA	9229.49200	167898.90	23087.360	1406351872
43	2000	INDIA	947.91810	18120.92	4552.485	1056575552
44	2001	INDIA	973.32583	18374.40	4597.144	1075000064
45	2002	INDIA	992.78627	18883.00	4708.538	1093317248
46	2003	INDIA	1045.81046	19715.74	4768.670	1111523200
47	2004	INDIA	1112.02207	21355.34	5027.720	1129623424
48	2005	INDIA	1157.08253	23034.77	5282.856	1147609984
49	2006	INDIA	1244.40292	25036.09	5615.163	1165486336

```
## 50  2007        INDIA 1348.29468        27117.88        5966.624 1183209472
## 51  2008        INDIA 1438.79016        30012.09        6428.904 1200669824
## 52  2009        INDIA 1538.62890        30811.66        6461.402 1217726208
## 53  2010        INDIA 1584.60956        33206.79        6854.784 1234281216
## 54  2011        INDIA 1649.31925        36511.52        7364.190 1250288000
## 55  2012        INDIA 1804.31667        38686.20        7660.195 1265780224
## 56  2013        INDIA 1820.72811        39810.32        7808.042 1280842112
## 57  2014        INDIA 1979.73836        42422.08        8121.890 1295600768
## 58  2015        INDIA 2067.34933        44968.12        8647.252 1310152448
## 59  2016        INDIA 2180.24464        47670.41        9298.896 1324517248
## 60  2017        INDIA 2252.48385        49571.23        9793.632 1338676736
## 61  2018        INDIA 2354.79461        51046.34       10236.769 1352642304
## 62  2019        INDIA 2377.05587        51906.35       10503.325 1366417792
## 63  2020        INDIA 2210.66196        48818.63        9805.317 1380004352
## 64  2000      GERMANY 1092.67290       213548.38       48311.960   82211503
## 65  2001      GERMANY 1087.22330       212377.11       48683.111   82349915
## 66  2002      GERMANY 1057.67141       208078.83       48259.491   82488490
## 67  2003      GERMANY 1064.02252       205238.45       48167.905   82534176
## 68  2004      GERMANY 1068.87969       206856.16       49489.766   82516260
## 69  2005      GERMANY 1048.31369       210510.94       49847.434   82469422
## 70  2006      GERMANY 1076.81924       215374.77       52205.850   82376451
## 71  2007      GERMANY 1020.16471       221775.67       53369.371   82266372
## 72  2008      GERMANY 1010.50178       226326.15       53449.476   82110097
## 73  2009      GERMANY  930.05410       224584.41       50191.617   81902328
## 74  2010      GERMANY  976.38962       227977.37       51843.243   81776951
## 75  2011      GERMANY  976.10044       229758.50       53089.672   81797673
## 76  2012      GERMANY  920.50914       236534.96       53318.505   81818399
## 77  2013      GERMANY  920.99074       247880.19       53352.816   81839131
## 78  2014      GERMANY  888.60820       260320.06       54239.576   82117400
## 79  2015      GERMANY  875.83791       275193.37       54956.913   82457192
## 80  2016      GERMANY  872.76705       293030.15       56090.128   82866880
## 81  2017      GERMANY  870.93288       313133.10       57266.733   83335328
## 82  2018      GERMANY  861.59273       332035.55       57716.254   83805152
## 83  2019      GERMANY  800.67457       348797.99       57433.751   84201000
## 84  2020      GERMANY  728.61385       341320.48       54640.233   84470080
## 85  2000           UK  696.08799       224227.57       43075.562   58886000
## 86  2001           UK  705.25608       231185.07       44484.701   59113000
## 87  2002           UK  698.39256       236191.25       45294.192   59366000
## 88  2003           UK  713.65332       248911.49       46503.021   59637000
## 89  2004           UK  736.31346       262375.20       47626.349   59950000
## 90  2005           UK  726.57628       275032.70       48223.864   60413000
## 91  2006           UK  741.96187       284992.14       48806.441   60827000
## 92  2007           UK  749.23708       291658.27       49268.377   61319000
## 93  2008           UK  710.92674       270516.91       50648.495   61824000
## 94  2009           UK  656.49401       250220.19       50901.300   62260000
## 95  2010           UK  681.85912       247868.39       46733.207   62759000
## 96  2011           UK  628.75915       245341.33       47234.266   63285000
## 97  2012           UK  640.37652       243128.82       45829.821   63705000
## 98  2013           UK  616.48025       244642.81       46521.516   64106000
## 99  2014           UK  589.77141       254202.62       46997.536   64539100
## 100 2015           UK  569.84551       268953.27       48152.874   64970292
## 101 2016           UK  541.53902       276354.21       48637.999   65402176
## 102 2017           UK  536.21669       283868.81       49583.211   65825884
## 103 2018           UK  540.16664       283466.06       50150.139   66234508
```

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## 104 2019          UK  525.58722       281459.83       49596.157   66617756
## 105 2020          UK  462.51676       255742.08       44407.024   66968780
## 106 2000      CANADA  567.75790       175542.47       50550.550   30685730
## 107 2001      CANADA  547.27128       175526.70       50202.632   31019020
## 108 2002      CANADA  570.12195       169034.71       51102.665   31353656
## 109 2003      CANADA  548.40047       172188.83       51481.946   31639670
## 110 2004      CANADA  565.21937       182508.75       52746.580   31940676
## 111 2005      CANADA  576.67023       197483.74       53778.739   32245209
## 112 2006      CANADA  566.11750       216042.85       55097.925   32576074
## 113 2007      CANADA  599.08089       228888.38       55281.518   32929733
## 114 2008      CANADA  581.72580       217958.44       54533.716   33319098
## 115 2009      CANADA  558.75080       220745.87       51616.659   33729690
## 116 2010      CANADA  595.07495       232661.59       52507.600   34126181
## 117 2011      CANADA  563.50597       235620.52       52836.666   34482779
## 118 2012      CANADA  603.61164       237776.68       53749.962   34865028
## 119 2013      CANADA  608.25821       249331.46       54370.559   35238912
## 120 2014      CANADA  600.00632       265139.17       55199.022   35606120
## 121 2015      CANADA  581.24184       278465.49       54431.284   35967868
## 122 2016      CANADA  564.48669       290485.55       54332.939   36323556
## 123 2017      CANADA  575.38844       303848.33       55753.056   36672136
## 124 2018      CANADA  588.40633       308984.85       56410.938   37014040
## 125 2019      CANADA  578.52025       319379.68       56243.778   37349980
## 126 2020      CANADA  520.66823       339001.81       52203.724   37680540
## 127 2000   AUSTRALIA  290.00579       258389.05       49196.723   19028802
## 128 2001   AUSTRALIA  296.01516       265419.31       49264.472   19274701
## 129 2002   AUSTRALIA  316.97948       278433.02       50641.773   19495210
## 130 2003   AUSTRALIA  331.10087       295593.63       51354.305   19720737
## 131 2004   AUSTRALIA  344.41339       319410.51       52952.241   19932722
## 132 2005   AUSTRALIA  341.27551       339880.30       53336.220   20176844
## 133 2006   AUSTRALIA  357.60276       353010.25       53764.033   20450966
## 134 2007   AUSTRALIA  370.45804       372691.70       54378.305   20827622
## 135 2008   AUSTRALIA  364.06073       379099.43       55362.234   21249199
## 136 2009   AUSTRALIA  388.04278       358257.65       54883.993   21691653
## 137 2010   AUSTRALIA  383.21599       367272.23       54885.925   22031750
## 138 2011   AUSTRALIA  390.93022       362716.78       55097.633   22340024
## 139 2012   AUSTRALIA  411.98715       350881.25       55321.398   22728254
## 140 2013   AUSTRALIA  389.45198       355584.19       56134.656   23117400
## 141 2014   AUSTRALIA  392.29716       372273.48       55739.818   23475300
## 142 2015   AUSTRALIA  395.86949       394787.14       54580.754   23809652
## 143 2016   AUSTRALIA  385.26915       409807.28       55411.531   24138170
## 144 2017   AUSTRALIA  388.63414       423287.58       55754.607   24458424
## 145 2018   AUSTRALIA  378.92248       438983.08       56478.931   24770346
## 146 2019   AUSTRALIA  374.42385       434488.05       56174.226   25073828
## 147 2020   AUSTRALIA  336.98146       435620.06       56154.241   25368990
## 148 2000      BRAZIL  336.80399        50439.44       19398.261  174790336
## 149 2001      BRAZIL  332.57024        51825.35       19130.623  177196048
## 150 2002      BRAZIL  315.96305        50988.20       19197.779  179537520
## 151 2003      BRAZIL  304.24792        50675.09       18858.952  181809248
## 152 2004      BRAZIL  316.52757        54321.95       19573.880  184006480
## 153 2005      BRAZIL  334.42462        56035.48       19711.194  186127104
## 154 2006      BRAZIL  343.80179        57147.53       20035.416  188167360
## 155 2007      BRAZIL  370.04096        61837.34       20879.325  190130448
## 156 2008      BRAZIL  416.02650        65621.70       21553.708  192030368
## 157 2009      BRAZIL  381.48250        69899.30       21024.076  193886512
```

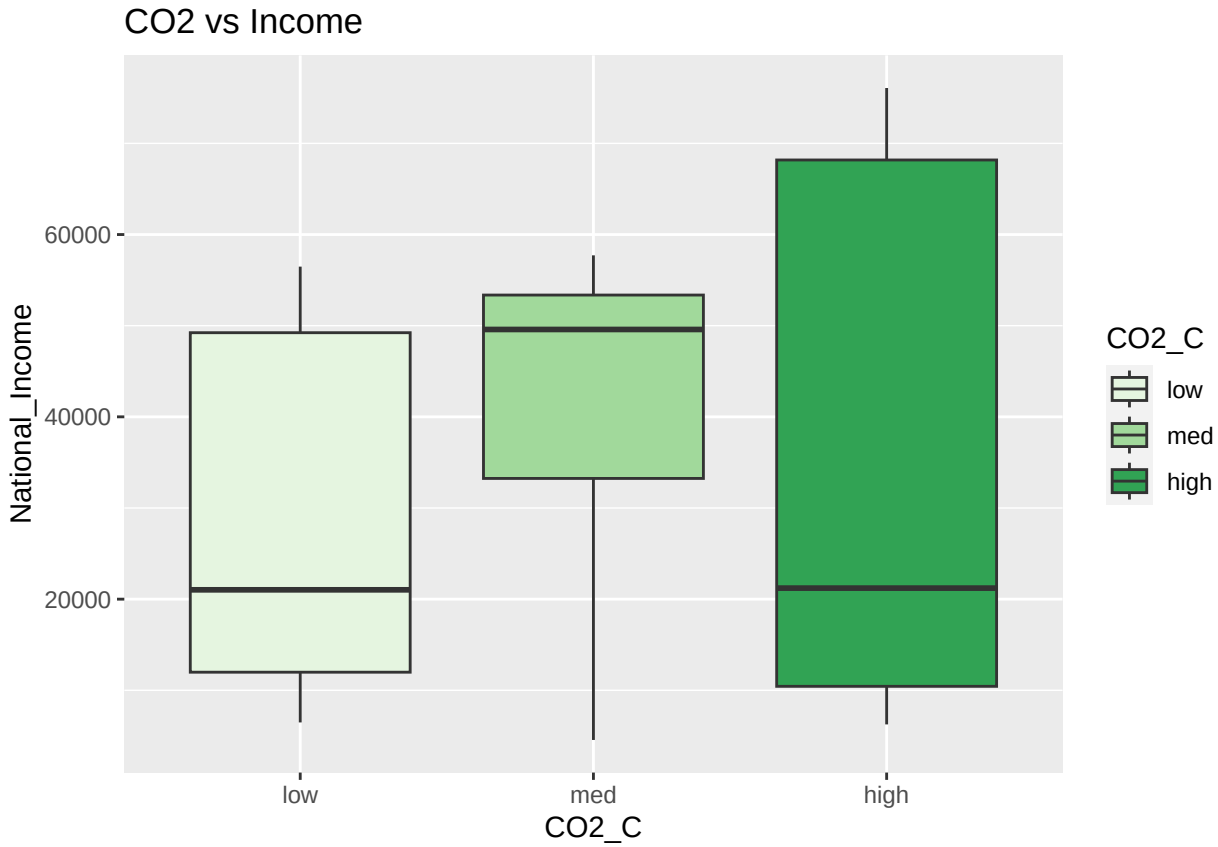
```
## 158 2010       BRAZIL  459.48223       76061.49       22101.933  195713632
## 159 2011       BRAZIL  484.84479       81115.90       22667.989  197514528
## 160 2012       BRAZIL  509.74425       84170.63       22825.911  199287296
## 161 2013       BRAZIL  541.54205       86745.99       23410.828  201035904
## 162 2014       BRAZIL  569.20591       87176.34       22971.872  202763744
## 163 2015       BRAZIL  520.53649       82862.85       21701.237  204471776
## 164 2016       BRAZIL  502.89339       76795.06       20611.641  206163056
## 165 2017       BRAZIL  511.01017       74022.48       20662.176  207833824
## 166 2018       BRAZIL  488.87072       71041.45       20576.876  209469328
## 167 2019       BRAZIL  487.89273       71638.46       20551.788  211049520
## 168 2020       BRAZIL  463.49809       68393.73       19421.199  212559424
## 169 2000      NIGERIA   46.75644       25247.13        6474.840  122283848
## 170 2001      NIGERIA   64.49740       27205.46        6728.206  125394048
## 171 2002      NIGERIA   72.02371       32232.88        7639.961  128596080
## 172 2003      NIGERIA   77.80638       33985.51        7957.967  131900632
## 173 2004      NIGERIA   84.41149       36434.64        8334.339  135320416
## 174 2005      NIGERIA   92.17793       39471.59        8751.912  138865024
## 175 2006      NIGERIA   72.20950       42248.35        9087.660  142538304
## 176 2007      NIGERIA   86.35525       43417.67        9111.175  146339984
## 177 2008      NIGERIA   88.48206       45975.06        9492.785  150269616
## 178 2009      NIGERIA   81.08125       48789.65        9939.175  154324928
## 179 2010      NIGERIA   94.15883       51295.11       10449.586  158503200
## 180 2011      NIGERIA   99.37846       52558.42       10652.660  162805072
## 181 2012      NIGERIA   83.58206       53790.52       10844.451  167228800
## 182 2013      NIGERIA  118.39379       56269.71       11328.784  171765824
## 183 2014      NIGERIA  121.24401       59383.44       11939.575  176404928
## 184 2015      NIGERIA  124.26436       59948.06       12032.302  181137440
## 185 2016      NIGERIA  128.22008       58411.23       11703.372  185960240
## 186 2017      NIGERIA  131.76394       57196.79       11422.023  190873248
## 187 2018      NIGERIA  129.86198       56963.32       11323.754  195874688
## 188 2019      NIGERIA  133.62974       57446.58       11376.982  200963600
## 189 2020      NIGERIA  130.28899       55203.29       10889.509  206139584
## 190 2000 SOUTH AFRICA  278.09643       56071.84       18131.601   43695928
## 191 2001 SOUTH AFRICA  260.80398       58176.98       18492.862   44552396
## 192 2002 SOUTH AFRICA  245.87588       59349.12       19144.583   45456336
## 193 2003 SOUTH AFRICA  279.73522       62104.35       19592.415   46303560
## 194 2004 SOUTH AFRICA  322.60998       66732.86       20313.804   47071708
## 195 2005 SOUTH AFRICA  301.64299       72234.20       21168.801   47817896
## 196 2006 SOUTH AFRICA  326.13196       77641.68       21954.055   48533604
## 197 2007 SOUTH AFRICA  328.74438       80382.15       22319.792   49215800
## 198 2008 SOUTH AFRICA  328.28353       79721.35       22336.038   49861788
## 199 2009 SOUTH AFRICA  349.82117       78733.64       22021.053   50473912
## 200 2010 SOUTH AFRICA  329.58867       80548.15       22611.549   51056648
## 201 2011 SOUTH AFRICA  331.03732       81122.95       22939.498   51634728
## 202 2012 SOUTH AFRICA  331.95444       80698.02       22578.177   52221984
## 203 2013 SOUTH AFRICA  325.93809       81312.14       22179.291   52875980
## 204 2014 SOUTH AFRICA  337.31614       81792.65       21796.205   53608552
## 205 2015 SOUTH AFRICA  321.96256       82485.29       21735.353   54436288
## 206 2016 SOUTH AFRICA  320.88808       80752.95       21277.779   55243480
## 207 2017 SOUTH AFRICA  331.01317       80151.81       21114.797   56031828
## 208 2018 SOUTH AFRICA  335.30276       79842.16       21051.319   56801168
## 209 2019 SOUTH AFRICA  339.99618       77519.38       20561.552   57553784
## 210 2020 SOUTH AFRICA  331.49627       73176.29       18960.685   58291328
##     CO2_C
```

```
## 1    high
## 2    high
## 3    high
## 4    high
## 5    high
## 6    high
## 7    high
## 8    high
## 9    high
## 10   high
## 11   high
## 12   high
## 13   high
## 14   high
## 15   high
## 16   high
## 17   high
## 18   high
## 19   high
## 20   high
## 21   high
## 22   high
## 23   high
## 24   high
## 25   high
## 26   high
## 27   high
## 28   high
## 29   high
## 30   high
## 31   high
## 32   high
## 33   high
## 34   high
## 35   high
## 36   high
## 37   high
## 38   high
## 39   high
## 40   high
## 41   high
## 42   high
## 43    med
## 44    med
## 45    med
## 46    med
## 47    med
## 48    med
## 49    med
## 50    med
## 51    med
## 52    med
## 53    med
## 54    med
```

```
## 55    med
## 56    med
## 57    med
## 58   high
## 59   high
## 60   high
## 61   high
## 62   high
## 63   high
## 64    med
## 65    med
## 66    med
## 67    med
## 68    med
## 69    med
## 70    med
## 71    med
## 72    med
## 73    med
## 74    med
## 75    med
## 76    med
## 77    med
## 78    med
## 79    med
## 80    med
## 81    med
## 82    med
## 83    med
## 84    med
## 85    med
## 86    med
## 87    med
## 88    med
## 89    med
## 90    med
## 91    med
## 92    med
## 93    med
## 94    med
## 95    med
## 96    med
## 97    med
## 98    med
## 99    med
## 100   med
## 101   med
## 102   med
## 103   med
## 104   med
## 105   low
## 106   med
## 107   med
## 108   med
```

```
## 109   med
## 110   med
## 111   med
## 112   med
## 113   med
## 114   med
## 115   med
## 116   med
## 117   med
## 118   med
## 119   med
## 120   med
## 121   med
## 122   med
## 123   med
## 124   med
## 125   med
## 126   med
## 127   low
## 128   low
## 129   low
## 130   low
## 131   low
## 132   low
## 133   low
## 134   low
## 135   low
## 136   low
## 137   low
## 138   low
## 139   low
## 140   low
## 141   low
## 142   low
## 143   low
## 144   low
## 145   low
## 146   low
## 147   low
## 148   low
## 149   low
## 150   low
## 151   low
## 152   low
## 153   low
## 154   low
## 155   low
## 156   low
## 157   low
## 158   low
## 159   low
## 160   med
## 161   med
## 162   med
```

```
## 163   med
## 164   med
## 165   med
## 166   low
## 167   low
## 168   low
## 169   low
## 170   low
## 171   low
## 172   low
## 173   low
## 174   low
## 175   low
## 176   low
## 177   low
## 178   low
## 179   low
## 180   low
## 181   low
## 182   low
## 183   low
## 184   low
## 185   low
## 186   low
## 187   low
## 188   low
## 189   low
## 190   low
## 191   low
## 192   low
## 193   low
## 194   low
## 195   low
## 196   low
## 197   low
## 198   low
## 199   low
## 200   low
## 201   low
## 202   low
## 203   low
## 204   low
## 205   low
## 206   low
## 207   low
## 208   low
## 209   low
## 210   low
```




```
## List of 94
##  $ line                       :List of 6
##   ..$ colour       : chr "black"
##   ..$ linewidth    : num 0.5
##   ..$ linetype     : num 1
##   ..$ lineend      : chr "butt"
##   ..$ arrow        : logi FALSE
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_line" "element"
##  $ rect                       :List of 5
##   ..$ fill         : chr "white"
##   ..$ colour       : chr "black"
##   ..$ linewidth    : num 0.5
##   ..$ linetype     : num 1
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_rect" "element"
##  $ text                       :List of 11
##   ..$ family       : chr ""
##   ..$ face         : chr "plain"
##   ..$ colour       : chr "black"
##   ..$ size         : num 11
##   ..$ hjust        : num 0.5
##   ..$ vjust        : num 0.5
##   ..$ angle        : num 0
##   ..$ lineheight   : num 0.9
##   ..$ margin       : 'margin' num [1:4] 0points 0points 0points 0points
##   .. ..- attr(*, "unit")= int 8
```

```
##   ..$ debug        : logi FALSE
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ title                     : NULL
##  $ aspect.ratio              : NULL
##  $ axis.title                : NULL
##  $ axis.title.x              :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : NULL
##   ..$ vjust        : num 1
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 2.75points 0points 0points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.title.x.top          :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : NULL
##   ..$ vjust        : num 0
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 0points 2.75points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.title.x.bottom       : NULL
##  $ axis.title.y              :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : NULL
##   ..$ vjust        : num 1
##   ..$ angle        : num 90
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 2.75points 0points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.title.y.left         : NULL
##  $ axis.title.y.right        :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
```

```
##   ..$ size         : NULL
##   ..$ hjust        : NULL
##   ..$ vjust        : num 0
##   ..$ angle        : num -90
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 0points 0points 2.75points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.text                 :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : chr "grey30"
##   ..$ size         : 'rel' num 0.8
##   ..$ hjust        : NULL
##   ..$ vjust        : NULL
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : NULL
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.text.x               :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : NULL
##   ..$ vjust        : num 1
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 2.2points 0points 0points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.text.x.top           :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : NULL
##   ..$ vjust        : num 0
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 0points 2.2points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.text.x.bottom        : NULL
##  $ axis.text.y               :List of 11
##   ..$ family       : NULL
```

```
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : num 1
##   ..$ vjust        : NULL
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 2.2points 0points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.text.y.left          : NULL
##  $ axis.text.y.right         :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : num 0
##   ..$ vjust        : NULL
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 0points 0points 2.2points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ axis.ticks                :List of 6
##   ..$ colour       : chr "grey20"
##   ..$ linewidth    : NULL
##   ..$ linetype     : NULL
##   ..$ lineend      : NULL
##   ..$ arrow        : logi FALSE
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_line" "element"
##  $ axis.ticks.x              : NULL
##  $ axis.ticks.x.top          : NULL
##  $ axis.ticks.x.bottom       : NULL
##  $ axis.ticks.y              : NULL
##  $ axis.ticks.y.left         : NULL
##  $ axis.ticks.y.right        : NULL
##  $ axis.ticks.length         : 'simpleUnit' num 2.75points
##   ..- attr(*, "unit")= int 8
##  $ axis.ticks.length.x       : NULL
##  $ axis.ticks.length.x.top   : NULL
##  $ axis.ticks.length.x.bottom: NULL
##  $ axis.ticks.length.y       : NULL
##  $ axis.ticks.length.y.left  : NULL
##  $ axis.ticks.length.y.right : NULL
##  $ axis.line                 :List of 6
##   ..$ colour       : chr "black"
##   ..$ linewidth    : 'rel' num 1
##   ..$ linetype     : NULL
##   ..$ lineend      : NULL
```

```
##   ..$ arrow        : logi FALSE
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_line" "element"
##  $ axis.line.x               : NULL
##  $ axis.line.x.top           : NULL
##  $ axis.line.x.bottom        : NULL
##  $ axis.line.y               : NULL
##  $ axis.line.y.left          : NULL
##  $ axis.line.y.right         : NULL
##  $ legend.background         :List of 5
##   ..$ fill         : NULL
##   ..$ colour       : logi NA
##   ..$ linewidth    : NULL
##   ..$ linetype     : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_rect" "element"
##  $ legend.margin             : 'margin' num [1:4] 5.5points 5.5points 5.5points 5.5points
##   ..- attr(*, "unit")= int 8
##  $ legend.spacing            : 'simpleUnit' num 11points
##   ..- attr(*, "unit")= int 8
##  $ legend.spacing.x          : NULL
##  $ legend.spacing.y          : NULL
##  $ legend.key                : list()
##   ..- attr(*, "class")= chr [1:2] "element_blank" "element"
##  $ legend.key.size           : 'simpleUnit' num 1.2lines
##   ..- attr(*, "unit")= int 3
##  $ legend.key.height         : NULL
##  $ legend.key.width          : NULL
##  $ legend.text               :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : 'rel' num 0.8
##   ..$ hjust        : NULL
##   ..$ vjust        : NULL
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : NULL
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ legend.text.align         : NULL
##  $ legend.title              :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : num 0
##   ..$ vjust        : NULL
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : NULL
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
```

```
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ legend.title.align        : NULL
##  $ legend.position           : chr "none"
##  $ legend.direction          : NULL
##  $ legend.justification      : chr "center"
##  $ legend.box                : NULL
##  $ legend.box.just           : NULL
##  $ legend.box.margin         : 'margin' num [1:4] 0cm 0cm 0cm 0cm
##   ..- attr(*, "unit")= int 1
##  $ legend.box.background     : list()
##   ..- attr(*, "class")= chr [1:2] "element_blank" "element"
##  $ legend.box.spacing        : 'simpleUnit' num 11points
##   ..- attr(*, "unit")= int 8
##  $ panel.background          :List of 5
##   ..$ fill         : chr "white"
##   ..$ colour       : logi NA
##   ..$ linewidth    : NULL
##   ..$ linetype     : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_rect" "element"
##  $ panel.border              : list()
##   ..- attr(*, "class")= chr [1:2] "element_blank" "element"
##  $ panel.spacing             : 'simpleUnit' num 5.5points
##   ..- attr(*, "unit")= int 8
##  $ panel.spacing.x           : NULL
##  $ panel.spacing.y           : NULL
##  $ panel.grid                :List of 6
##   ..$ colour       : chr "grey92"
##   ..$ linewidth    : NULL
##   ..$ linetype     : NULL
##   ..$ lineend      : NULL
##   ..$ arrow        : logi FALSE
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_line" "element"
##  $ panel.grid.major          : list()
##   ..- attr(*, "class")= chr [1:2] "element_blank" "element"
##  $ panel.grid.minor          : list()
##   ..- attr(*, "class")= chr [1:2] "element_blank" "element"
##  $ panel.grid.major.x        : NULL
##  $ panel.grid.major.y        : NULL
##  $ panel.grid.minor.x        : NULL
##  $ panel.grid.minor.y        : NULL
##  $ panel.ontop               : logi FALSE
##  $ plot.background           :List of 5
##   ..$ fill         : NULL
##   ..$ colour       : chr "white"
##   ..$ linewidth    : NULL
##   ..$ linetype     : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_rect" "element"
##  $ plot.title                :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
```

```
##   ..$ size         : 'rel' num 1.2
##   ..$ hjust        : num 0
##   ..$ vjust        : num 1
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 0points 5.5points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ plot.title.position       : chr "panel"
##  $ plot.subtitle             :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : num 0
##   ..$ vjust        : num 1
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 0points 0points 5.5points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ plot.caption              :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : 'rel' num 0.8
##   ..$ hjust        : num 1
##   ..$ vjust        : num 1
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 5.5points 0points 0points 0points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ plot.caption.position     : chr "panel"
##  $ plot.tag                  :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : 'rel' num 1.2
##   ..$ hjust        : num 0.5
##   ..$ vjust        : num 0.5
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : NULL
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ plot.tag.position         : chr "topleft"
```

```
##  $ plot.margin               : 'margin' num [1:4] 5.5points 5.5points 5.5points 5.5points
##   ..- attr(*, "unit")= int 8
##  $ strip.background          :List of 5
##   ..$ fill         : chr "white"
##   ..$ colour       : chr "black"
##   ..$ linewidth    : 'rel' num 2
##   ..$ linetype     : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_rect" "element"
##  $ strip.background.x        : NULL
##  $ strip.background.y        : NULL
##  $ strip.clip                : chr "inherit"
##  $ strip.placement           : chr "inside"
##  $ strip.text                :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : chr "grey10"
##   ..$ size         : 'rel' num 0.8
##   ..$ hjust        : NULL
##   ..$ vjust        : NULL
##   ..$ angle        : NULL
##   ..$ lineheight   : NULL
##   ..$ margin       : 'margin' num [1:4] 4.4points 4.4points 4.4points 4.4points
##   .. ..- attr(*, "unit")= int 8
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ strip.text.x              : NULL
##  $ strip.text.y              :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : NULL
##   ..$ vjust        : NULL
##   ..$ angle        : num -90
##   ..$ lineheight   : NULL
##   ..$ margin       : NULL
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  $ strip.switch.pad.grid     : 'simpleUnit' num 2.75points
##   ..- attr(*, "unit")= int 8
##  $ strip.switch.pad.wrap     : 'simpleUnit' num 2.75points
##   ..- attr(*, "unit")= int 8
##  $ strip.text.y.left         :List of 11
##   ..$ family       : NULL
##   ..$ face         : NULL
##   ..$ colour       : NULL
##   ..$ size         : NULL
##   ..$ hjust        : NULL
##   ..$ vjust        : NULL
##   ..$ angle        : num 90
##   ..$ lineheight   : NULL
```

```
##   ..$ margin       : NULL
##   ..$ debug        : NULL
##   ..$ inherit.blank: logi TRUE
##   ..- attr(*, "class")= chr [1:2] "element_text" "element"
##  - attr(*, "class")= chr [1:2] "theme" "gg"
##  - attr(*, "complete")= logi TRUE
##  - attr(*, "validate")= logi TRUE
```

```
## # weights:  42 (26 variable)
## initial  value 230.708581
## iter  10 value 205.627776
## iter  20 value 141.382973
## iter  30 value 138.465579
## iter  40 value 53.268040
## iter  50 value 21.990203
## iter  60 value 14.525303
## iter  70 value 9.821259
## iter  80 value 9.809613
## iter  90 value 9.722262
## iter 100 value 9.715952
## final  value 9.715952
## stopped after 100 iterations
```

```
## Call:
## multinom(formula = CO2_C ~ Country + National_Wealth + National_Income +
##     Population, data = m2_data1, Hess = TRUE)
##
## Coefficients:
##      (Intercept) CountryBRAZIL CountryCANADA CountryCHINA CountryGERMANY
## med    -173.3309      80.89588    229.150381     6.227514     204.198402
## high   -429.9688     -71.31341     -6.626446   -36.171521      -9.348818
##      CountryINDIA CountryNIGERIA CountrySOUTH AFRICA CountryUK CountryUSA
## med      169.3066      -105.9449           -75.39969  91.34829  -30.36680
## high    -187.2393       -47.1139           -23.96826 -10.33851   28.60204
##      National_Wealth National_Income   Population
## med    -0.0001539016     0.002346892 2.637126e-07
## high   -0.0009447068     0.012261076 6.970602e-07
##
## Std. Errors:
##       (Intercept) CountryBRAZIL CountryCANADA  CountryCHINA CountryGERMANY
## med  1.784849e-11  7.829885e-12           NaN           NaN   3.605414e-46
## high 1.755962e-17  2.767806e-80  1.793776e-54 1.703831e-135   3.605227e-46
##      CountryINDIA CountryNIGERIA CountrySOUTH AFRICA    CountryUK    CountryUSA
## med  1.756059e-17  6.861489e-102        2.457417e-95 2.567839e-11 8.506141e-150
## high 1.756059e-17  1.354071e-120       1.004857e-104 1.006353e-21 1.554362e-140
##      National_Wealth National_Income  Population
## med     5.636985e-06    9.728059e-07 4.09036e-09
## high    3.540255e-12    7.402542e-13 7.09603e-09
##
## Residual Deviance: 19.4319
## AIC: 71.4319
```

```
##        (Intercept) CountryBRAZIL CountryCANADA CountryCHINA CountryGERMANY
```

```
## med   5.288569e-76  1.357169e+35  3.301762e+99 5.064948e+02   4.811042e+88
## high 1.848887e-187  1.069001e-31  1.324863e-03 1.953927e-16   8.706823e-05
##      CountryINDIA CountryNIGERIA CountrySOUTH AFRICA    CountryUK   CountryUSA
## med  3.380060e+73   9.743921e-47        1.796108e-33 4.699560e+39 6.484360e-14
## high 4.819542e-82   3.456935e-21        3.896869e-11 3.236241e-05 2.640629e+12
##      National_Wealth National_Income Population
## med        0.9998461        1.002350   1.000000
## high       0.9990557        1.012337   1.000001

## , , med
##
##                              2.5 %        97.5 %
## (Intercept)         -1.733309e+02 -1.733309e+02
## CountryBRAZIL        8.089588e+01  8.089588e+01
## CountryCANADA                 NaN           NaN
## CountryCHINA                  NaN           NaN
## CountryGERMANY       2.041984e+02  2.041984e+02
## CountryINDIA         1.693066e+02  1.693066e+02
## CountryNIGERIA      -1.059449e+02 -1.059449e+02
## CountrySOUTH AFRICA -7.539969e+01 -7.539969e+01
## CountryUK            9.134829e+01  9.134829e+01
## CountryUSA          -3.036680e+01 -3.036680e+01
## National_Wealth     -1.649499e-04 -1.428533e-04
## National_Income      2.344985e-03  2.348798e-03
## Population           2.556956e-07  2.717296e-07
##
## , , high
##
##                              2.5 %        97.5 %
## (Intercept)         -4.299688e+02 -4.299688e+02
## CountryBRAZIL       -7.131341e+01 -7.131341e+01
## CountryCANADA       -6.626446e+00 -6.626446e+00
## CountryCHINA        -3.617152e+01 -3.617152e+01
## CountryGERMANY      -9.348818e+00 -9.348818e+00
## CountryINDIA        -1.872393e+02 -1.872393e+02
## CountryNIGERIA      -4.711390e+01 -4.711390e+01
## CountrySOUTH AFRICA -2.396826e+01 -2.396826e+01
## CountryUK           -1.033851e+01 -1.033851e+01
## CountryUSA           2.860204e+01  2.860204e+01
## National_Wealth     -9.447069e-04 -9.447068e-04
## National_Income      1.226108e-02  1.226108e-02
## Population           6.831522e-07  7.109682e-07
```

	(Intercept)	CountryBRAZIL	CountryCANADA	CountryCHINA	CountryGERMANY	CountryI
Coefficient	-1.733309e+02	8.089588e+01	229.1504	6.227514	2.041984e+02	1.69306
Std.Errors	0.000000e+00	0.000000e+00	NaN	NaN	0.000000e+00	0.00000
z-value	-9.711236e+12	1.033168e+13	NaN	NaN	5.663660e+47	9.64128
p-value	0.000000e+00	0.000000e+00	NaN	NaN	0.000000e+00	0.00000
	(Intercept)	CountryBRAZIL	CountryCANADA	CountryCHINA	CountryGERMANY	CountryI
Coefficient	-4.299688e+02	-7.131341e+01	-6.626446e+00	-3.617152e+01	-9.348818e+00	-1.87239
Std.Errors	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	0.00000
z-value	-2.448622e+19	-2.576532e+81	-3.694132e+54	-2.122952e+136	-2.593129e+46	-1.06624
p-value	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00	0.00000

	2.5 %.med	97.5 %.med	2.5 %.high	97.5 %.high
(Intercept)	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00
CountryBRAZIL	1.357169e+35	1.357169e+35	0.000000e+00	0.000000e+00
CountryCANADA	NaN	NaN	1.324900e-03	1.324900e-03
CountryCHINA	NaN	NaN	0.000000e+00	0.000000e+00
CountryGERMANY	4.811042e+88	4.811042e+88	8.710000e-05	8.710000e-05
CountryINDIA	3.380060e+73	3.380060e+73	0.000000e+00	0.000000e+00
CountryNIGERIA	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00
CountrySOUTH AFRICA	0.000000e+00	0.000000e+00	0.000000e+00	0.000000e+00
CountryUK	4.699560e+39	4.699560e+39	3.240000e-05	3.240000e-05
CountryUSA	0.000000e+00	0.000000e+00	2.640629e+12	2.640629e+12
National_Wealth	9.998351e-01	9.998572e-01	9.990557e-01	9.990557e-01
National_Income	1.002348e+00	1.002352e+00	1.012337e+00	1.012337e+00
Population	1.000000e+00	1.000000e+00	1.000001e+00	1.000001e+00

This is a TEST

```
## Call:
## multinom(formula = CO2_C ~ Country + National_Wealth + National_Income +
##     Population, data = m2_data1, Hess = TRUE)
##
## Coefficients:
##      (Intercept) CountryBRAZIL CountryCANADA CountryCHINA CountryGERMANY
## med    -173.3309      80.89588    229.150381     6.227514     204.198402
## high   -429.9688     -71.31341     -6.626446   -36.171521      -9.348818
##      CountryINDIA CountryNIGERIA CountrySOUTH AFRICA CountryUK CountryUSA
## med      169.3066      -105.9449           -75.39969  91.34829  -30.36680
## high    -187.2393       -47.1139           -23.96826 -10.33851   28.60204
##      National_Wealth National_Income   Population
## med    -0.0001539016     0.002346892 2.637126e-07
## high   -0.0009447068     0.012261076 6.970602e-07
##
## Std. Errors:
##       (Intercept) CountryBRAZIL CountryCANADA  CountryCHINA CountryGERMANY
## med  1.784849e-11  7.829885e-12           NaN           NaN   3.605414e-46
## high 1.755962e-17  2.767806e-80  1.793776e-54 1.703831e-135   3.605227e-46
##      CountryINDIA CountryNIGERIA CountrySOUTH AFRICA    CountryUK    CountryUSA
## med  1.756059e-17  6.861489e-102        2.457417e-95 2.567839e-11 8.506141e-150
## high 1.756059e-17  1.354071e-120       1.004857e-104 1.006353e-21 1.554362e-140
##      National_Wealth National_Income  Population
## med     5.636985e-06    9.728059e-07 4.09036e-09
## high    3.540255e-12    7.402542e-13 7.09603e-09
```

```
##
## Residual Deviance: 19.4319
## AIC: 71.4319
```

From the p-value table below, it shows that every variable in the model are significant. So let's do a deviance test.

```
## # weights:  15 (8 variable)
## initial  value 230.708581
## iter  10 value 205.627777
## iter  20 value 203.862022
## iter  30 value 90.284285
## iter  40 value 34.005375
## iter  50 value 31.459952
## iter  60 value 27.267922
## iter  70 value 26.862888
## iter  80 value 26.862535
## iter  90 value 25.767598
## iter 100 value 25.231279
## final  value 25.231279
## stopped after 100 iterations

## Likelihood ratio tests of Multinomial Models
##
## Response: CO2_C
##                                                          Model Resid. df Resid. Dev
## 1           National_Wealth + National_Income + Population       412   50.46256
## 2 Country + National_Wealth + National_Income + Population       394   19.43190
##     Test    Df LR stat.    Pr(Chi)
## 1
## 2 1 vs 2    18 31.03065 0.02855308

## # weights:  39 (24 variable)
## initial  value 230.708581
## iter  10 value 208.274778
## iter  10 value 208.274778
## iter  20 value 59.661479
## iter  30 value 20.871895
## iter  40 value 20.650791
## iter  50 value 20.624533
## iter  50 value 20.624533
## iter  60 value 20.577779
## iter  70 value 20.566096
## iter  70 value 20.566096
## iter  70 value 20.566096
## final  value 20.566096
## converged

## Likelihood ratio tests of Multinomial Models
##
## Response: CO2_C
##                                                          Model Resid. df Resid. Dev
## 1                   Country + National_Income + Population       396   41.13219
```

```
## 2 Country + National_Wealth + National_Income + Population       394   19.43190
##     Test    Df LR stat.      Pr(Chi)
## 1
## 2 1 vs 2     2 21.70029 1.940181e-05

## # weights:  69 (44 variable)
## initial  value 230.708581
## iter  10 value 65.006494
## iter  20 value 40.670258
## iter  30 value 31.601029
## iter  40 value 27.104159
## iter  50 value 23.210390
## iter  60 value 18.035538
## iter  70 value 15.335899
## iter  80 value 12.676175
## iter  90 value 11.673928
## iter 100 value 10.974403
## final  value 10.974403
## stopped after 100 iterations

## Likelihood ratio tests of Multinomial Models
##
## Response: CO2_C
##                                                          Model Resid. df Resid. Dev
## 1 Country + National_Wealth + National_Income + Population       394   19.43190
## 2 Country * National_Wealth + National_Income + Population       376   21.94881
##     Test    Df  LR stat. Pr(Chi)
## 1
## 2 1 vs 2    18 -2.516902       1

## # weights:  39 (24 variable)
## initial  value 230.708581
## iter  10 value 209.619088
## iter  20 value 22.184391
## iter  30 value 13.208850
## iter  40 value 12.416135
## iter  50 value 12.214388
## iter  60 value 12.194671
## iter  60 value 12.194671
## iter  70 value 12.153277
## iter  80 value 12.133020
## iter  90 value 12.072068
## iter 100 value 12.015779
## final  value 12.015779
## stopped after 100 iterations

## Likelihood ratio tests of Multinomial Models
##
## Response: CO2_C
##                                                          Model Resid. df Resid. Dev
## 1                   Country + National_Wealth + Population       396   24.03156
## 2 Country + National_Wealth + National_Income + Population       394   19.43190
##     Test    Df LR stat.   Pr(Chi)
```

```
## 1
## 2 1 vs 2     2 4.599654 0.1002762

## # weights:  69 (44 variable)
## initial  value 230.708581
## iter  10 value 56.464587
## iter  20 value 45.331746
## iter  30 value 33.384534
## iter  40 value 28.178482
## iter  50 value 27.209242
## iter  60 value 22.435185
## iter  70 value 22.055858
## iter  80 value 17.033209
## iter  90 value 16.290074
## iter 100 value 15.199012
## final  value 15.199012
## stopped after 100 iterations

## Likelihood ratio tests of Multinomial Models
##
## Response: CO2_C
##                                                          Model Resid. df Resid. Dev
## 1 Country + National_Wealth + National_Income + Population       394   19.43190
## 2 National_Wealth + Country * National_Income + Population       376   30.39802
##     Test    Df  LR stat. Pr(Chi)
## 1
## 2 1 vs 2    18 -10.96612       1

## # weights:  39 (24 variable)
## initial  value 230.708581
## iter  10 value 38.583611
## iter  20 value 27.008099
## iter  30 value 24.313483
## iter  40 value 15.634044
## iter  50 value 11.868021
## iter  60 value 11.794991
## iter  70 value 11.780383
## iter  80 value 11.776885
## iter  90 value 11.727156
## iter 100 value 11.691017
## final  value 11.691017
## stopped after 100 iterations

## Likelihood ratio tests of Multinomial Models
##
## Response: CO2_C
##                                                          Model Resid. df Resid. Dev
## 1              Country + National_Wealth + National_Income       396   23.38203
## 2 Country + National_Wealth + National_Income + Population       394   19.43190
##     Test    Df LR stat.   Pr(Chi)
## 1
## 2 1 vs 2     2 3.950129 0.1387523
```

```
## # weights:  69 (44 variable)
## initial  value 230.708581
## iter  10 value 116.504323
## iter  20 value 96.951761
## iter  30 value 53.493962
## iter  40 value 45.423767
## iter  50 value 41.241348
## iter  50 value 41.241348
## iter  60 value 30.316304
## iter  70 value 26.933724
## iter  80 value 20.189075
## iter  90 value 19.528394
## iter 100 value 13.081014
## final  value 13.081014
## stopped after 100 iterations

## Likelihood ratio tests of Multinomial Models
##
## Response: CO2_C
##                                                                    Model Resid. df
## 1           Country + National_Wealth + National_Income + Population       394
## 2 Country + National_Wealth + National_Income + Population * Country       376
##   Resid. Dev   Test    Df  LR stat. Pr(Chi)
## 1   19.43190
## 2   26.16203 1 vs 2    18 -6.730124       1
```

so it shows only and country are significant after deviance test.