Appendix – Regime and Sociology

I. Coding solution for asymmetrical directional expectations

II. R Script

I. Coding solution for asymmetrical directional expectations

In the current software package 'QCA' for R—as in any other, as far as I know—there is no way of coding different directional expectations for the presence and absence of a condition. When calculating the intermediate solution, an expectation can be defined for each condition as either '1', '0', or '-' (don't care). Assigning dir.exp=1 to a condition, automatically assumes the expectation '0' for the absences of the condition, and vice versa. Assigning '-' automatically assumes no expectations for both the presence and the absence of the conditions.

If one has asymmetrical directional expectations, this can lead to unwanted results. For example, if I would assign dir.exp=1 for the condition THAW for the minimization of OUT, ~THAW would be considered a difficult counterfactual and thus not be included in the minimization procedure for the intermediate solution term. However, because I do not have any expectations for ~THAW, it could be included. In this case, I therefore assigned a directional expectation "-" (don't care), because then both THAW and ~THAW can be included in the minimization of OUT. For the minimization of ~OUT, I would want THAW to be excluded and ~THAW included. Therefore I assigned a directional expectation of "0".

For the conditions NEIGH and CATH, the same reasoning applies, only in the reverse way. Here, I want NEIGH and CATH to be excluded from the minimization of OUT, but ~NEIGH and ~CATH should be included. This is achieved by assigning a directional expectation of "0".
For the minimization of ~OUT, I want both conditions in their presence and absence included. Therefore I assigned "-" to both.

The first table here below shows my directional expectations as formulated and explained in the manuscript (left column) and translates these into the decisions whether to include them in the minimization (right column). The second table shows how I coded the directional expectations in the calculation of the intermediate solutions in such a way that the same decisions on inclusion/exclusion follow.

This coding rule can also be expressed in words:

-- Where the presence of the condition is expected to lead to the outcome and the absence of the condition has no attached expectation, a 'don't care'-expectation ('-') shall be assigned;
-- Where the presence of the condition is expected to lead to the absence of outcome and the absence of the condition has no attached expectation, a negative expectation ('0') shall be assigned.

Asymmetrical expectations and intended decisions

```
              Decision
     OUT  out  OUT  out
```

```
THAW  1     1     0     incl  excl
      0     -     -     incl  incl
NEIGH 1     0     1     excl  incl
      0     -     -     incl  incl
CATH  1     0     1     excl  incl
      0     -     -     incl  incl
```

Symmetrical coding leading to the same intended decisions

```
                        Decision
            OUT   out   OUT   out
THAW  1     -     0     incl  excl
      0     -     1     incl  incl
NEIGH 1     0     -     excl  incl
      0     1     -     incl  incl
CATH  1     0     -     excl  incl
      0     1     -     incl  incl
```

II. R Script

1. Loading the package and the data

```
> library(QCA)

To cite this package in publications, please use:
  Dusa, Adrian (2019) QCA with R. A Comprehensive Resource.
  Springer International Publishing.
```

```
> DS <- read.csv("DS2019.csv")
> DS
   Country CON LIBDEM THAW NEIGH CATH OUT
1       AL   0      0    0     0    0   0
2       AT   0      1    0     1    1   0
3       BE   1      1    0     1    1   0
4       BG   0      0    0     0    0   0
5     CSSR   0      0    1     0    0   1
6       DK   0      1    0     0    0   1
7      FRG   1      1    0     0    0   1
8       FI   0      1    0     0    0   1
9       FR   1      1    0     0    0   1
10     GDR   0      0    0     0    0   0
11      GR   0      0    0     0    0   0
12      HU   0      0    0     0    0   0
13      IE   0      1    0     1    1   0
14      IT   1      1    0     0    1   0
15      NL   1      1    0     0    0   1
16      NO   0      1    0     0    0   1
17      PL   1      0    1     0    0   1
18      PT   0      0    0     0    1   0
19      RO   1      0    0     0    0   0
```

```
20    USSR   0       0     0      0     0    0
21      ES   0       0     0      0     1    0
22      SE   0       1     0      0     0    1
23      CH   0       1     0      1     0    0
24      GB   1       1     0      0     0    1
25      YU   0       0     1      0     0    1
```

2. Necessity analysis

2.1 Necessity analysis for the outcome

```
> superSubset(DS, outcome = "OUT", conditions = "CON, LIBDEM, THAW,
+         NEIGH, CATH", relation = "nec", incl.cut = 0.9, cov.cut = 0,
use.tilde
+             =
+                 FALSE,
+             use.letters = FALSE)

                inclN  RoN    covN
-----------------------------------
1  neigh        1.000  0.286  0.524
2  cath         1.000  0.429  0.579
3  neigh*cath   1.000  0.500  0.611
4  con+LIBDEM   0.909  0.133  0.435
5  con+thaw     0.909  0.067  0.417
6  libdem+thaw  1.000  0.000  0.440
7  LIBDEM+THAW  1.000  0.643  0.688
-----------------------------------
```

2.2 Necessity analysis for the negated outcome

```
> > superSubset(DS, outcome = "~OUT", conditions = "CON, LIBDEM, THAW,
+         NEIGH, CATH", relation = "nec", incl.cut = 0.9, cov.cut = 0,
use.tilde
+             =
+                 FALSE,
+             use.letters = FALSE)

                   inclN  RoN    covN
--------------------------------------
1  thaw            1.000  0.273  0.636
2  con+LIBDEM      0.929  0.167  0.565
3  con+neigh       0.929  0.083  0.542
4  con+CATH        0.929  0.500  0.684
5  libdem+NEIGH    0.929  0.750  0.812
6  LIBDEM+neigh    1.000  0.000  0.560
7  libdem+CATH     0.929  0.750  0.812
8  neigh+CATH      0.929  0.083  0.542
9  con+NEIGH+cath  0.929  0.083  0.542
--------------------------------------
```

3. Sufficiency analysis

3.1 Truth table

3.1.1 Constructing the truth table for the outcome

Note that row numbers in the output produced in R do not correspond with the row numbers in the manuscript.

```
> ttDS2019 <- truthTable(DS, outcome = "OUT", conditions = "CON,
LIBDEM, THAW, NEIGH, CATH", incl.cut = 0.7, complete = TRUE, show.cases
= TRUE, sort.by = "out, n")
> ttDS2019

  OUT: output value
    n: number of cases in configuration
 incl: sufficiency inclusion score
  PRI: proportional reduction in inconsistency

     CON LIBDEM THAW NEIGH CATH   OUT    n  incl  PRI   cases
 9    0    1     0     0    0      1     4  1.000 1.000 6,8,16,22
25    1    1     0     0    0      1     4  1.000 1.000 7,9,15,24
 5    0    0     1     0    0      1     2  1.000 1.000 5,25
21    1    0     1     0    0      1     1  1.000 1.000 17
 1    0    0     0     0    0      0     6  0.000 0.000 1,4,10,11,12,20
 2    0    0     0     0    1      0     2  0.000 0.000 18,21
12    0    1     0     1    1      0     2  0.000 0.000 2,13
11    0    1     0     1    0      0     1  0.000 0.000 23
17    1    0     0     0    0      0     1  0.000 0.000 19
26    1    1     0     0    1      0     1  0.000 0.000 14
28    1    1     0     1    1      0     1  0.000 0.000 3
 3    0    0     0     1    0      ?     0    -     -
 4    0    0     0     1    1      ?     0    -     -
 6    0    0     1     0    1      ?     0    -     -
 7    0    0     1     1    0      ?     0    -     -
 8    0    0     1     1    1      ?     0    -     -
10    0    1     0     0    1      ?     0    -     -
13    0    1     1     0    0      ?     0    -     -
14    0    1     1     0    1      ?     0    -     -
15    0    1     1     1    0      ?     0    -     -
16    0    1     1     1    1      ?     0    -     -
18    1    0     0     0    1      ?     0    -     -
19    1    0     0     1    0      ?     0    -     -
20    1    0     0     1    1      ?     0    -     -
22    1    0     1     0    1      ?     0    -     -
23    1    0     1     1    0      ?     0    -     -
24    1    0     1     1    1      ?     0    -     -
27    1    1     0     1    0      ?     0    -     -
29    1    1     1     0    0      ?     0    -     -
30    1    1     1     0    1      ?     0    -     -
31    1    1     1     1    0      ?     0    -     -
32    1    1     1     1    1      ?     0    -     -
```

3.1.2 Constructing the truth table for the negated outcome

```
> ttDS2019neg <- truthTable(DS, outcome = "~OUT", conditions = "CON,
LIBDEM, THAW, NEIGH, CATH", incl.cut = 0.7, complete = TRUE, show.cases
= TRUE, sort.by = "out, n")
> ttDS2019neg

  OUT: output value
    n: number of cases in configuration
 incl: sufficiency inclusion score
  PRI: proportional reduction in inconsistency

     CON LIBDEM THAW NEIGH CATH   OUT    n  incl  PRI   cases
 1    0     0     0     0    0     1     6  1.000 1.000 1,4,10,11,12,20
 2    0     0     0     0    1     1     2  1.000 1.000 18,21
12    0     1     0     1    1     1     2  1.000 1.000 2,13
11    0     1     0     1    0     1     1  1.000 1.000 23
17    1     0     0     0    0     1     1  1.000 1.000 19
26    1     1     0     0    1     1     1  1.000 1.000 14
28    1     1     0     1    1     1     1  1.000 1.000 3
 9    0     1     0     0    0     0     4  0.000 0.000 6,8,16,22
25    1     1     0     0    0     0     4  0.000 0.000 7,9,15,24
 5    0     0     1     0    0     0     2  0.000 0.000 5,25
21    1     0     1     0    0     0     1  0.000 0.000 17
 3    0     0     0     1    0     ?     0    -     -
 4    0     0     0     1    1     ?     0    -     -
 6    0     0     1     0    1     ?     0    -     -
 7    0     0     1     1    0     ?     0    -     -
 8    0     0     1     1    1     ?     0    -     -
10    0     1     0     0    1     ?     0    -     -
13    0     1     1     0    0     ?     0    -     -
14    0     1     1     0    1     ?     0    -     -
15    0     1     1     1    0     ?     0    -     -
16    0     1     1     1    1     ?     0    -     -
18    1     0     0     0    1     ?     0    -     -
19    1     0     0     1    0     ?     0    -     -
20    1     0     0     1    1     ?     0    -     -
22    1     0     1     0    1     ?     0    -     -
23    1     0     1     1    0     ?     0    -     -
24    1     0     1     1    1     ?     0    -     -
27    1     1     0     1    0     ?     0    -     -
29    1     1     1     0    0     ?     0    -     -
30    1     1     1     0    1     ?     0    -     -
31    1     1     1     1    0     ?     0    -     -
32    1     1     1     1    1     ?     0    -     -
```

3.2 Minimization

3.2.1 Complex solution, OUT=1

```
> consSOL <- minimize(ttDS2019, details=TRUE)
> consSOL

n OUT = 1/0/C: 11/14/0
  Total      : 25

Number of multiple-covered cases: 0

M1: LIBDEM*thaw*neigh*cath + libdem*THAW*neigh*cath <=> OUT

                           inclS  PRI    covS   covU   cases
-----------------------------------------------------------------------------
1  LIBDEM*thaw*neigh*cath  1.000  1.000  0.727  0.727  6,8,16,22; 7,9,15,24
2  libdem*THAW*neigh*cath  1.000  1.000  0.273  0.273  5,25; 17
-----------------------------------------------------------------------------
   M1                      1.000  1.000  1.000


> consSOL$PIchart

                         5  9  21 25
LIBDEM*thaw*neigh*cath   -  x  -  x
libdem*THAW*neigh*cath   x  -  x  -
```

3.2.2 Most parsimonious solution, OUT=1

```
> mps <- minimize(ttDS2019, include ="?", details = TRUE)
> mps

n OUT = 1/0/C: 11/14/0
  Total      : 25

Number of multiple-covered cases: 0

M1: THAW + LIBDEM*neigh*cath <=> OUT

                      inclS  PRI    covS   covU   cases
-----------------------------------------------------------------------
1  THAW               1.000  1.000  0.273  0.273  5,25; 17
2  LIBDEM*neigh*cath  1.000  1.000  0.727  0.727  6,8,16,22; 7,9,15,24
-----------------------------------------------------------------------
   M1                 1.000  1.000  1.000
```

3.2.2.1 Simplifying assumptions, mps, OUT=1

```
> mps$SA
$M1
   CON LIBDEM THAW NEIGH CATH
6    0      0    1     0    1
7    0      0    1     1    0
8    0      0    1     1    1
```

```
13   0       1    1     0    0
14   0       1    1     0    1
15   0       1    1     1    0
16   0       1    1     1    1
22   1       0    1     0    1
23   1       0    1     1    0
24   1       0    1     1    1
29   1       1    1     0    0
30   1       1    1     0    1
31   1       1    1     1    0
32   1       1    1     1    1
```

3.2.3 Enhanced parsimonious solution, OUT=1

```
> eps <- minimize(ttDS2019, include = "?", exclude =
c(3,4,13,14,15,16,18,19,20,29,30,31,32), details = TRUE)
> eps

n OUT = 1/0/C: 11/14/0
  Total      : 25

Number of multiple-covered cases: 0

M1: libdem*THAW + LIBDEM*thaw*neigh*cath <=> OUT

                           inclS  PRI    covS   covU   cases
---------------------------------------------------------------------------
1  libdem*THAW             1.000  1.000  0.273  0.273  5,25; 17
2  LIBDEM*thaw*neigh*cath  1.000  1.000  0.727  0.727  6,8,16,22; 7,9,15,24
---------------------------------------------------------------------------
   M1                      1.000  1.000  1.000
```

3.2.3.1 Simplifying assumptions, eps, OUT=1

```
> eps$SA
$M1
   CON LIBDEM THAW NEIGH CATH
6    0       0    1     0    1
7    0       0    1     1    0
8    0       0    1     1    1
22   1       0    1     0    1
23   1       0    1     1    0
24   1       0    1     1    1
```

3.2.4 Enhanced intermediate solution, OUT=1

```
> eSOL <- minimize(ttDS2019, include = "?", exclude =
c(3,4,13,14,15,16,18,19,20,29,30,31,32), dir.exp = "-,1,-,0,0",  details =
TRUE)
> eSOL

n OUT = 1/0/C: 11/14/0
  Total      : 25

From C1P1:
```

```
Number of multiple-covered cases: 0

M1:    LIBDEM*thaw*neigh*cath + libdem*THAW*neigh*cath <=> OUT

                           inclS  PRI    covS   covU   cases
---------------------------------------------------------------------------
1  LIBDEM*thaw*neigh*cath  1.000  1.000  0.727  0.727  6,8,16,22; 7,9,15,24
2  libdem*THAW*neigh*cath  1.000  1.000  0.273  0.273  5,25; 17
---------------------------------------------------------------------------
   M1                      1.000  1.000  1.000
```

3.2.4.1 Simplifying assumptions, easy and difficult counterfactuals, eis, OUT=1

Note: all simplifying assumptions are difficult counterfactuals. Therefore, no minimization was possible, and the enhanced intermediary solution is identical with the complex solution.

```
> eSOL$SA
$M1
   CON LIBDEM THAW NEIGH CATH
6    0      0    1     0    1
7    0      0    1     1    0
8    0      0    1     1    1
22   1      0    1     0    1
23   1      0    1     1    0
24   1      0    1     1    1

> eSOL$i.sol$C1P1$EC
[1] CON    LIBDEM THAW   NEIGH  CATH
<0 Zeilen> (oder row.names mit Länge 0)

> eSOL$i.sol$C1P1$DC
   CON LIBDEM THAW NEIGH CATH
6    0      0    1     0    1
7    0      0    1     1    0
8    0      0    1     1    1
22   1      0    1     0    1
23   1      0    1     1    0
24   1      0    1     1    1
```

3.2.5 Complex solution, OUT=0

```
> consSOLneg <- minimize(ttDS2019neg, details=TRUE)
> consSOLneg

n OUT = 1/0/C: 14/11/0
  Total      : 25

Number of multiple-covered cases: 6

M1: con*LIBDEM*thaw*NEIGH + con*libdem*thaw*neigh + CON*LIBDEM*thaw*CATH +
    libdem*thaw*neigh*cath <=> out

                           inclS  PRI    covS   covU   cases
----------------------------------------------------------------------------
--
1  con*LIBDEM*thaw*NEIGH   1.000  1.000  0.214  0.214  23; 2,13
2  con*libdem*thaw*neigh   1.000  1.000  0.571  0.143  1,4,10,11,12,20;
18,21
3  CON*LIBDEM*thaw*CATH    1.000  1.000  0.143  0.143  14; 3
4  libdem*thaw*neigh*cath  1.000  1.000  0.500  0.071  1,4,10,11,12,20; 19
----------------------------------------------------------------------------
--
   M1                      1.000  1.000  1.000


> consSOLneg$PIchart

                         1  2  11 12 17 26 28
con*LIBDEM*thaw*NEIGH    -  -  x  x  -  -  -
con*libdem*thaw*neigh    x  x  -  -  -  -  -
CON*LIBDEM*thaw*CATH     -  -  -  -  -  x  x
libdem*thaw*neigh*cath   x  -  -  -  x  -  -
LIBDEM*thaw*NEIGH*CATH   -  -  -  x  -  -  x
```

3.2.6 Most parsimonious solution, OUT=0

```
> mpsneg <- minimize(ttDS2019neg, include ="?", details = TRUE)
> mpsneg

n OUT = 1/0/C: 14/11/0
  Total      : 25

Number of multiple-covered cases: 5

M1: NEIGH + CATH + libdem*thaw <=> out

               inclS  PRI    covS   covU   cases
----------------------------------------------------------------------
1  NEIGH       1.000  1.000  0.286  0.071  23; 2,13; 3
2  CATH        1.000  1.000  0.429  0.071  18,21; 2,13; 14; 3
3  libdem*thaw 1.000  1.000  0.643  0.500  1,4,10,11,12,20; 18,21; 19
----------------------------------------------------------------------
   M1          1.000  1.000  1.000
```

3.2.6.1 Simplifying assumptions, mps, OUT=0

```
> mpsneg$SA
$M1
   CON LIBDEM THAW NEIGH CATH
3    0      0    0     1    0
4    0      0    0     1    1
6    0      0    1     0    1
7    0      0    1     1    0
8    0      0    1     1    1
10   0      1    0     0    1
14   0      1    1     0    1
15   0      1    1     1    0
16   0      1    1     1    1
18   1      0    0     0    1
19   1      0    0     1    0
20   1      0    0     1    1
22   1      0    1     0    1
23   1      0    1     1    0
24   1      0    1     1    1
27   1      1    0     1    0
30   1      1    1     0    1
31   1      1    1     1    0
32   1      1    1     1    1
```

3.2.7 Enhanced parsimonious solution, OUT=0

```
> epsneg <- minimize(ttDS2019neg, include = "?", exclude =
c(13,14,15,16,29,30,31,32), details = TRUE)
> epsneg

n OUT = 1/0/C: 14/11/0
  Total      : 25

Number of multiple-covered cases: 5

M1: libdem*thaw + thaw*NEIGH + thaw*CATH <=> out

                inclS  PRI    covS   covU   cases
------------------------------------------------------------------------
1  libdem*thaw  1.000  1.000  0.643  0.500  1,4,10,11,12,20; 18,21; 19
2  thaw*NEIGH   1.000  1.000  0.286  0.071  23; 2,13; 3
3  thaw*CATH    1.000  1.000  0.429  0.071  18,21; 2,13; 14; 3
------------------------------------------------------------------------
   M1           1.000  1.000  1.000
```

3.2.7.1 Simplifying assumptions, eps, OUT=0

```
> epsneg$SA
$M1
   CON LIBDEM THAW NEIGH CATH
3    0      0    0     1    0
4    0      0    0     1    1
10   0      1    0     0    1
18   1      0    0     0    1
19   1      0    0     1    0
20   1      0    0     1    1
27   1      1    0     1    0
```

3.2.8 Theory-guided enhanced intermediate solution, OUT=0

```
> teSOLneg <- minimize(ttDS2019neg, include = "?", dir.exp = "-,0,0,-,-",
exclude = c(13,14,15,16,23,27,29,30,31,32), details = TRUE)
> teSOLneg

n OUT = 1/0/C: 14/11/0
  Total      : 25

From C1P1:

Number of multiple-covered cases: 0

M1:    con*thaw*NEIGH + CON*thaw*CATH + libdem*thaw*neigh <=> out

                      inclS  PRI    covS   covU   cases
---------------------------------------------------------------------------
-
1  con*thaw*NEIGH     1.000  1.000  0.214  0.214  23; 2,13
2  CON*thaw*CATH      1.000  1.000  0.143  0.143  14; 3
3  libdem*thaw*neigh  1.000  1.000  0.643  0.643  1,4,10,11,12,20; 18,21;
19
---------------------------------------------------------------------------
-
   M1                 1.000  1.000  1.000
```

3.2.8.1 Simplifying assumptions, easy and difficult counterfactuals, teis, OUT=0

```
> teSOLneg$SA
$M1
   CON LIBDEM THAW NEIGH CATH
3    0      0    0     1    0
4    0      0    0     1    1
10   0      1    0     0    1
18   1      0    0     0    1
19   1      0    0     1    0
20   1      0    0     1    1

> teSOLneg$i.sol$C1P1$EC
   CON LIBDEM THAW NEIGH CATH
3    0      0    0     1    0
4    0      0    0     1    1
18   1      0    0     0    1
20   1      0    0     1    1

> teSOLneg$i.sol$C1P1$DC
   CON LIBDEM THAW NEIGH CATH
10   0      1    0     0    1
19   1      0    0     1    0
```

3.2.8.2 Robustness of conjunctural expectations, teis, OUT=0

To assess the robustness of the conjunctural directional expectations, I compare the enhanced intermediate solution (without conjunctural expectations) with the theory-guided enhanced intermediate solution.

```
> teSOLnegA <- minimize(ttDS2019neg, include = "?", dir.exp = "-,0,0,-,-",
exclude = c(13,14,15,16,29,30,31,32), details = TRUE)
> teSOLnegA

n OUT = 1/0/C: 14/11/0
  Total      : 25

From C1P1:

Number of multiple-covered cases: 0

M1:    con*thaw*NEIGH + CON*thaw*CATH + libdem*thaw*neigh <=> out

                      inclS  PRI    covS   covU   cases
---------------------------------------------------------------------------
-
1  con*thaw*NEIGH     1.000  1.000  0.214  0.214  23; 2,13
2  CON*thaw*CATH      1.000  1.000  0.143  0.143  14; 3
3  libdem*thaw*neigh  1.000  1.000  0.643  0.643  1,4,10,11,12,20; 18,21;
19
---------------------------------------------------------------------------
-
   M1                 1.000  1.000  1.000


> teSOLnegA$SA
$M1
   CON LIBDEM THAW NEIGH CATH
3    0      0    0     1    0
4    0      0    0     1    1
10   0      1    0     0    1
18   1      0    0     0    1
19   1      0    0     1    0
20   1      0    0     1    1
27   1      1    0     1    0

> teSOLnegA$i.sol$C1P1$EC
   CON LIBDEM THAW NEIGH CATH
3    0      0    0     1    0
4    0      0    0     1    1
18   1      0    0     0    1
20   1      0    0     1    1

> teSOLnegA$i.sol$C1P1$DC
   CON LIBDEM THAW NEIGH CATH
10   0      1    0     0    1
19   1      0    0     1    0
27   1      1    0     1    0
```

Note: The solutions with or without conjunctural expectations are the same. One of the remainders (27, corresponds to 28 in the manuscript) is a simplifying assumption, but a difficult one, thus not entering the minimization.

3.3 Testing for model ambiguity

Model ambiguity arises when different solutions are possible with the data at hand. Because I rely mostly on the (theory-guided) enhanced intermediary solution in my interpretations, I checked for model ambiguity for these solutions.

3.3.1 PI Charts

PI Charts identify non-essential prime implicants. A prime implicant is redundant if all primitive expressions (the columns) are covered even in its absence. Therefore, redundant prime implicants can be removed to arrive at a more parsimonious solution. A possible problem arises if alternative ways of removing prime implicants are possible.

The PI chart for the enhanced intermediate solution of the positive outcome shows that two alternative models are possible (lines 1 and 4; or lines 1,2,3). In the case of the complex solution, that is otherwise homonymous with the enhanced intermediate solution, no ambiguity arises. The reasons for choosing the model 1,4 and the implications this has for the analysis are explained in the manuscript.

The PI chart for the enhanced intermediate solution of the positive outcome is:

```
> eSOL$PIchart

                        5  9  21 25
libdem*THAW             x  -  x  -
con*LIBDEM*thaw*neigh   -  x  -  -
CON*LIBDEM*thaw*cath    -  -  -  x
LIBDEM*thaw*neigh*cath  -  x  -  x
```

PI chart for the complex solution

```
> consSOL$PIchart

                        5  9  21 25
LIBDEM*thaw*neigh*cath  -  x  -  x
libdem*THAW*neigh*cath  x  -  x  -
```

PI chart for the theory-guided enhanced intermediate solution of the negated outcome:

```
> teSOLneg$PIchart

                1  2  11 12 17 26 28
libdem*thaw     x  x  -  -  x  -  -
libdem*CATH     -  x  -  -  -  -  -
thaw*CATH       -  x  -  x  -  x  x
con*thaw*NEIGH  -  -  x  x  -  -  -
```

*Here, only the one prime implicant (libdem*CATH) is redundant, leaving no ambiguity.*

3.3.2 Row dominance

The second test tries the effects of using and non-using the option "row dominance" in the minimization procedure. Row dominance eliminates redundant PI charts before minimization. Therefore, I compare the solutions when row dominance is enabled with the solutions when it is disabled. (The default setting in the QCA package is row.dom = TRUE). As the output shows, the two solutions are identical.

```
> eSOLROWtrue <- minimize(ttDS2019, include = "?", exclude =
c(3,4,13,14,15,16,18,19,20,29,30,31,32), dir.exp = "-,1,-,0,0", row.dom =
TRUE, details = TRUE)

> eSOLROWtrue

n OUT = 1/0/C: 11/14/0
  Total      : 25

From C1P1:

Number of multiple-covered cases: 0

M1:    LIBDEM*thaw*neigh*cath + libdem*THAW*neigh*cath <=> OUT

                           inclS  PRI    covS   covU   cases
-----------------------------------------------------------------------------
1  LIBDEM*thaw*neigh*cath  1.000  1.000  0.727  0.727  6,8,16,22; 7,9,15,24
2  libdem*THAW*neigh*cath  1.000  1.000  0.273  0.273  5,25; 17
-----------------------------------------------------------------------------
   M1                      1.000  1.000  1.000


> eSOLROWFALSE <- minimize(ttDS2019, include = "?", exclude =
c(3,4,13,14,15,16,18,19,20,29,30,31,32), dir.exp = "-,1,-,0,0", row.dom =
FALSE, details = TRUE)
> eSOLROWFALSE

n OUT = 1/0/C: 11/14/0
  Total      : 25

From C1P1:

Number of multiple-covered cases: 0

M1:    LIBDEM*thaw*neigh*cath + libdem*THAW*neigh*cath <=> OUT

                           inclS  PRI    covS   covU   cases
-----------------------------------------------------------------------------
1  LIBDEM*thaw*neigh*cath  1.000  1.000  0.727  0.727  6,8,16,22; 7,9,15,24
2  libdem*THAW*neigh*cath  1.000  1.000  0.273  0.273  5,25; 17
-----------------------------------------------------------------------------
   M1                      1.000  1.000  1.000
```

```
> teSOLnegROWtrue <- minimize(ttDS2019neg, include = "?", dir.exp = "-
,0,0,-,-", exclude = c(13,14,15,16,23,27,29,30,31,32), row.dom = TRUE,
details = TRUE)
> teSOLnegROWtrue

n OUT = 1/0/C: 14/11/0
  Total      : 25

From C1P1:

Number of multiple-covered cases: 0

M1:    con*thaw*NEIGH + CON*thaw*CATH + libdem*thaw*neigh <=> out

                      inclS   PRI    covS   covU   cases
---------------------------------------------------------------------------
-
1  con*thaw*NEIGH     1.000  1.000  0.214  0.214  23; 2,13
2  CON*thaw*CATH      1.000  1.000  0.143  0.143  14; 3
3  libdem*thaw*neigh  1.000  1.000  0.643  0.643  1,4,10,11,12,20; 18,21;
19
---------------------------------------------------------------------------
-
   M1                 1.000  1.000  1.000


> teSOLnegROWFALSE <- minimize(ttDS2019neg, include = "?", dir.exp = "-
,0,0,-,-", exclude = c(13,14,15,16,23,27,29,30,31,32), row.dom = FALSE,
details = TRUE)

> teSOLnegROWFALSE

n OUT = 1/0/C: 14/11/0
  Total      : 25

From C1P1:

Number of multiple-covered cases: 0

M1:    con*thaw*NEIGH + CON*thaw*CATH + libdem*thaw*neigh <=> out

                      inclS   PRI    covS   covU   cases
---------------------------------------------------------------------------
-
1  con*thaw*NEIGH     1.000  1.000  0.214  0.214  23; 2,13
2  CON*thaw*CATH      1.000  1.000  0.143  0.143  14; 3
3  libdem*thaw*neigh  1.000  1.000  0.643  0.643  1,4,10,11,12,20; 18,21;
19
---------------------------------------------------------------------------
-
   M1                 1.000  1.000  1.000
```