South Africa

```
## [1] "Census Females"
```

```
## # A tibble: 87 x 7
##      age  `1970`  `1985`  `1991`  `1996`  `2001`  `2011`
##    <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>
##  1     0 347577  265629  334664  434223. 454482  575028
##  2     1 327004. 260708. 364874. 434296. 440667  567032.
##  3     2 325266  271447. 381647. 449406. 442266. 564236.
##  4     3 321094. 268910. 377053. 461697. 449032. 556210.
##  5     4 317607  268605. 379364. 474658. 459546. 544576.
##  6     5 313946. 270473. 375903. 480788. 469845. 526048.
##  7     6 308134. 271848. 368341. 479310. 477704. 502114.
##  8     7 302909. 272745. 360249. 473457. 482862. 478502.
##  9     8 298338. 273427. 354368. 467138. 492895. 460004.
## 10     9 292232. 273185. 348572. 464657. 503893. 451534.
## # ... with 77 more rows
```

```
## [1] "Census Males"
```

```
## # A tibble: 87 x 7
##      age  `1970`  `1985`  `1991`  `1996`  `2001`  `2011`
##    <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>   <dbl>
##  1     0 353187  266840  332158  432514. 453924  584097
##  2     1 328995. 262455  371515  433911. 441106. 577574.
##  3     2 322879  272988. 389101. 448461. 441893  574048.
##  4     3 318908. 271081. 384583. 461203. 448540. 565571.
##  5     4 316325. 270742. 387601. 475238. 459394. 553093.
##  6     5 313168. 272325. 383920. 482371. 470590. 534653
##  7     6 306989. 273540. 375467. 481068. 478769. 510001.
##  8     7 302124. 274341. 366494. 473935. 482864. 485063.
##  9     8 298292. 274877  360549. 465731. 491967. 465714.
## 10     9 292348. 274215. 354626. 461874. 503328. 457150.
## # ... with 77 more rows
```

Thiele log-Normal Hump Spline

```
## [1] "relative convergence (4)"
```

```
##           log_tau2_logpop_f           log_tau2_logpop_f           log_tau2_logpop_m           log_tau2_l
##                  7.02131490                  5.48684742                  7.02015487                  5.5
##               log_tau2_gx_m         log_lambda_gx_age_f         log_lambda_gx_age_m        log_lambda_g
##                  3.42259394                  7.81422922                  7.87640796                  4.9
##     log_lambda_gx_agetime_m              log_lambda_tp log_lambda_tp_0_inflated_sd           log_dispe
##                  6.90775171                  6.19697640                  0.03114965                  0.3
##     log_marginal_prec_psi_f       log_marginal_prec_A_f       log_marginal_prec_B_f     log_marginal_pre
##                  4.30570645                  6.81069046                  6.84609344                  4.1
##       log_marginal_prec_B_m           log_lambda_phi_f            log_lambda_psi_f         log_lambda_l
##                  6.85476341                  4.32782461                  4.31883594                  1.8
##              log_lambda_A_f              log_lambda_B_f           log_lambda_phi_m           log_lambd
##                  4.30677987                  4.29529794                  4.33064844                  4.3
##        log_lambda_epsilon_m             log_lambda_A_m              log_lambda_B_m
##                  4.63333457                  4.30813553                  4.31508409
```

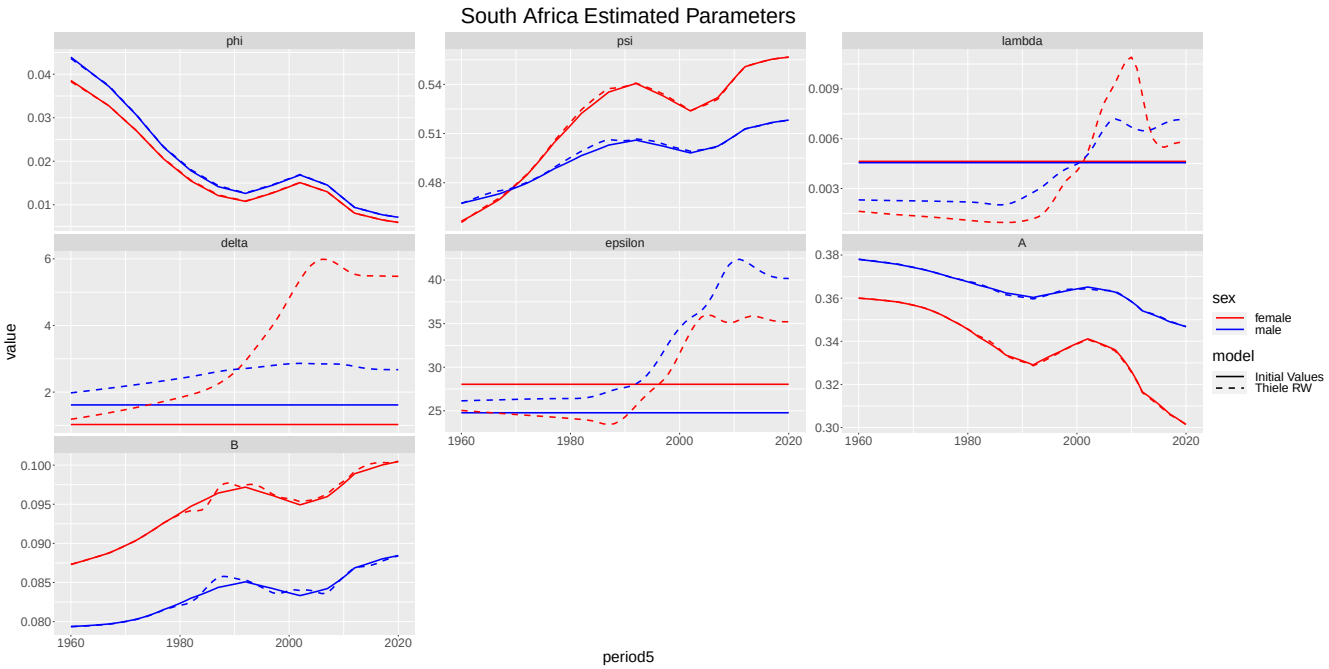

Figure 1: Estimated parameters

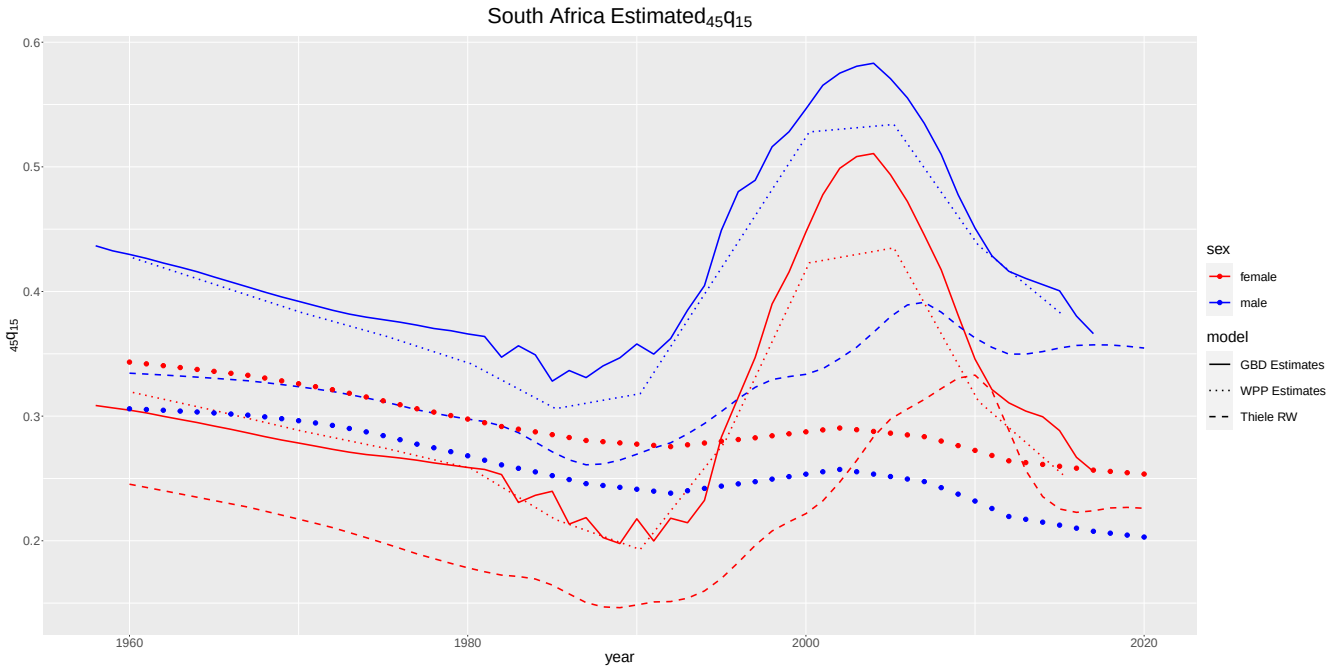

Figure 2: Estimated $_{45}q_{15}$

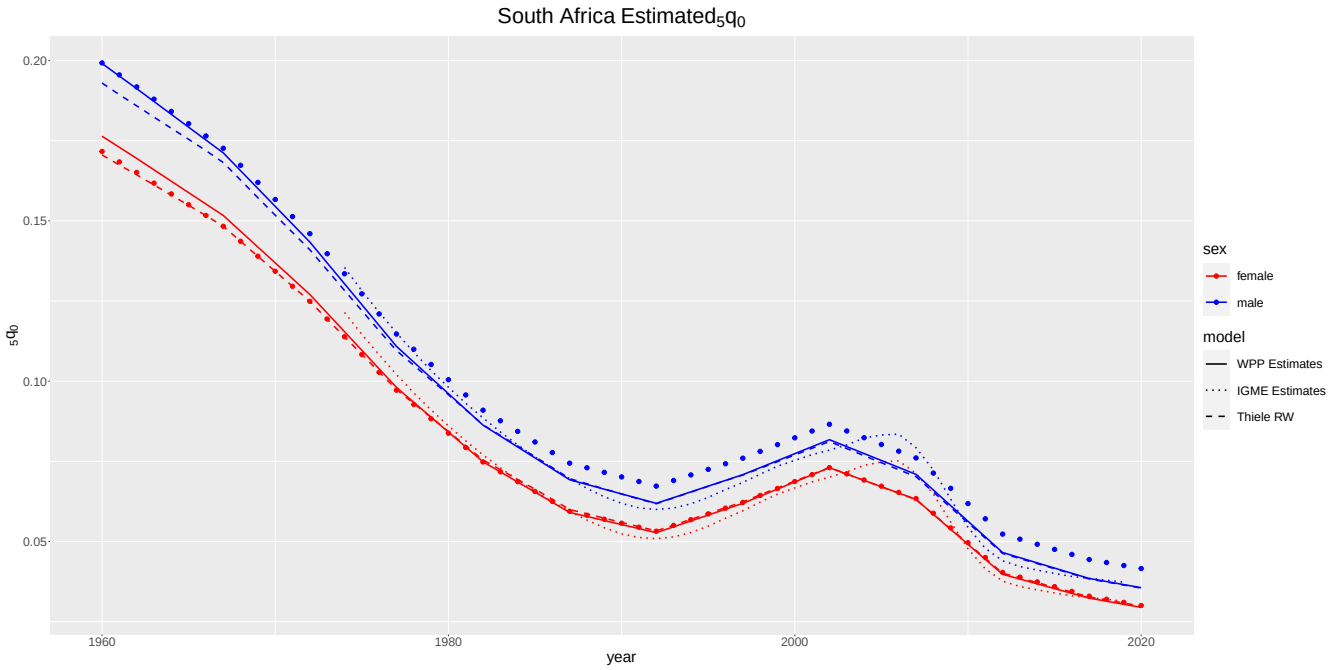

Figure 3: Estimated $_5q_0$

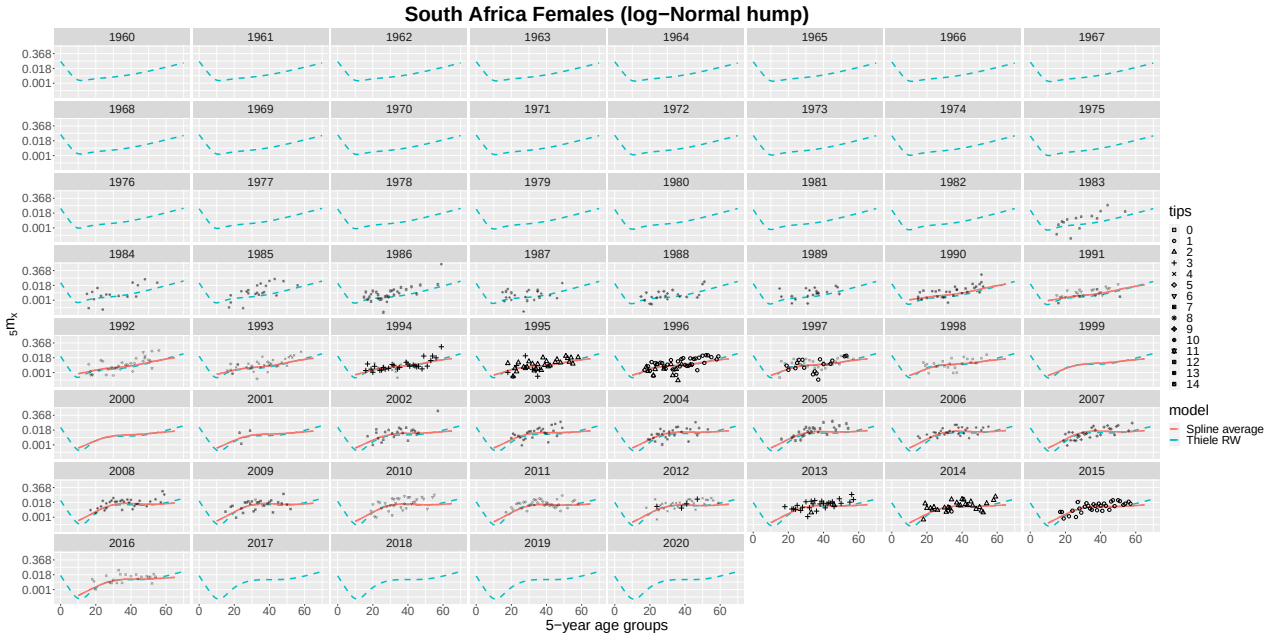

Figure 4: Mortality Schedules

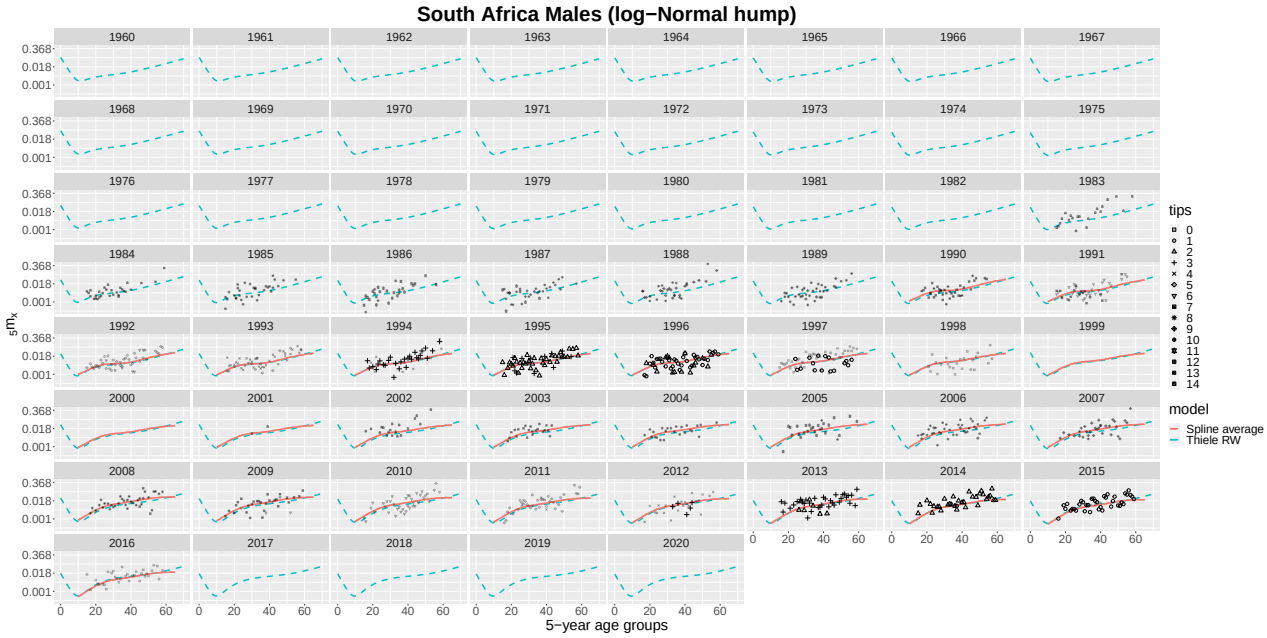

Figure 5: Mortality Schedules

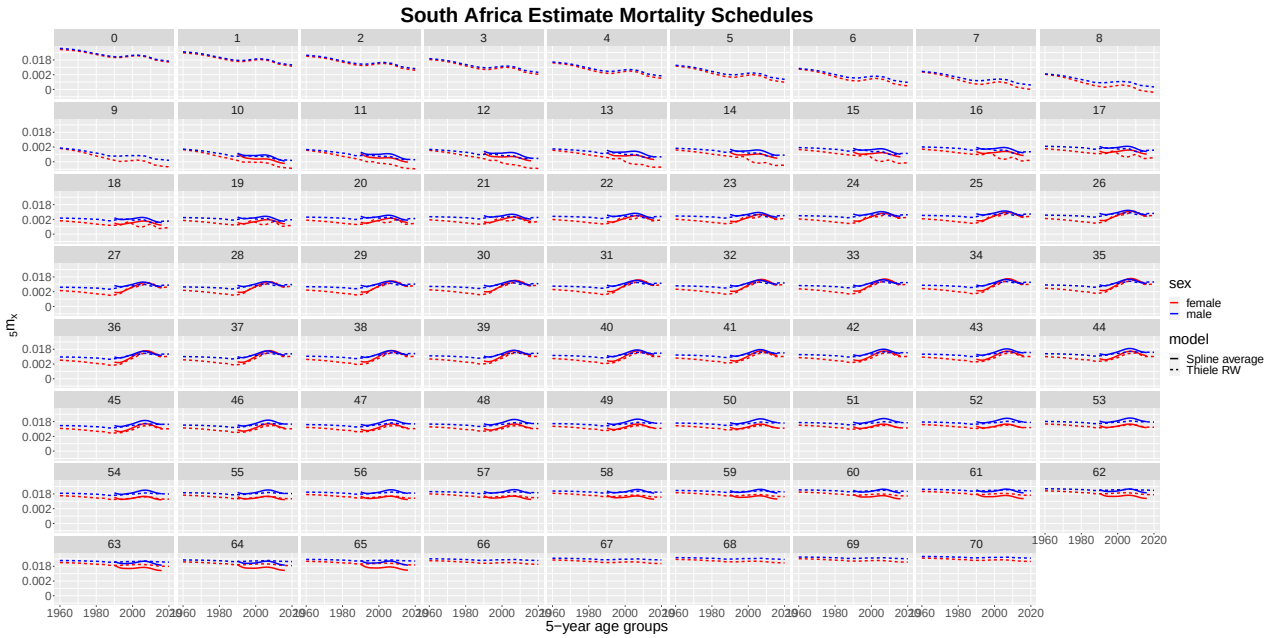

Figure 6: Mortality Schedules

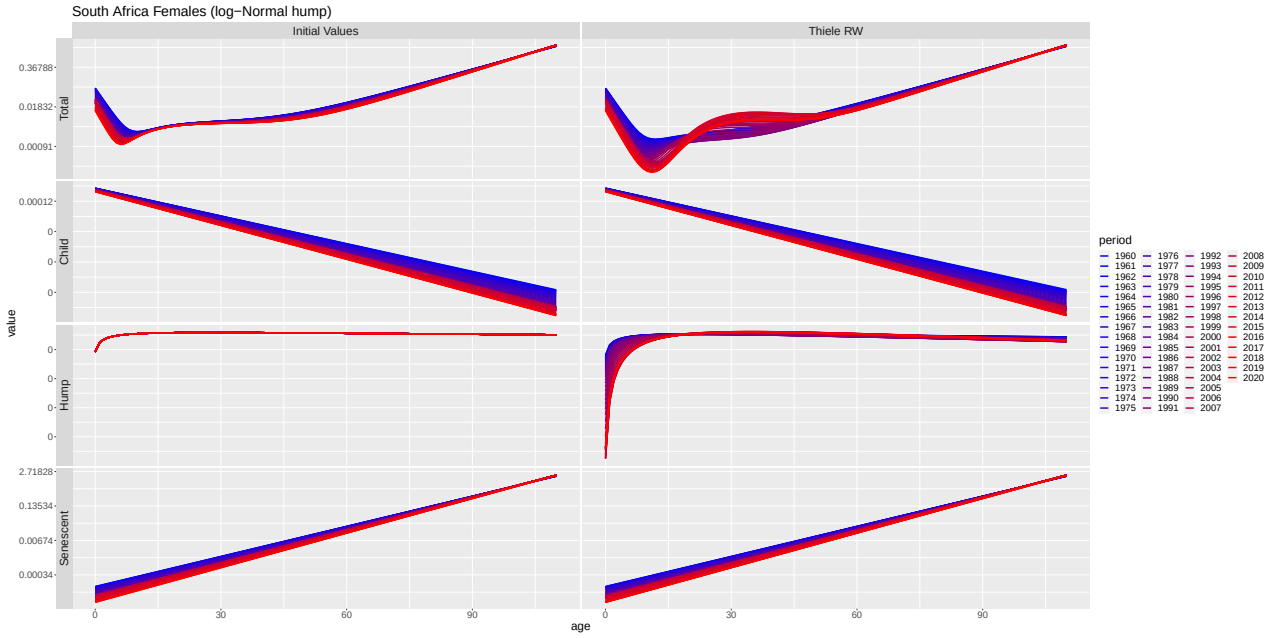

Figure 7: Thiele Decomposed

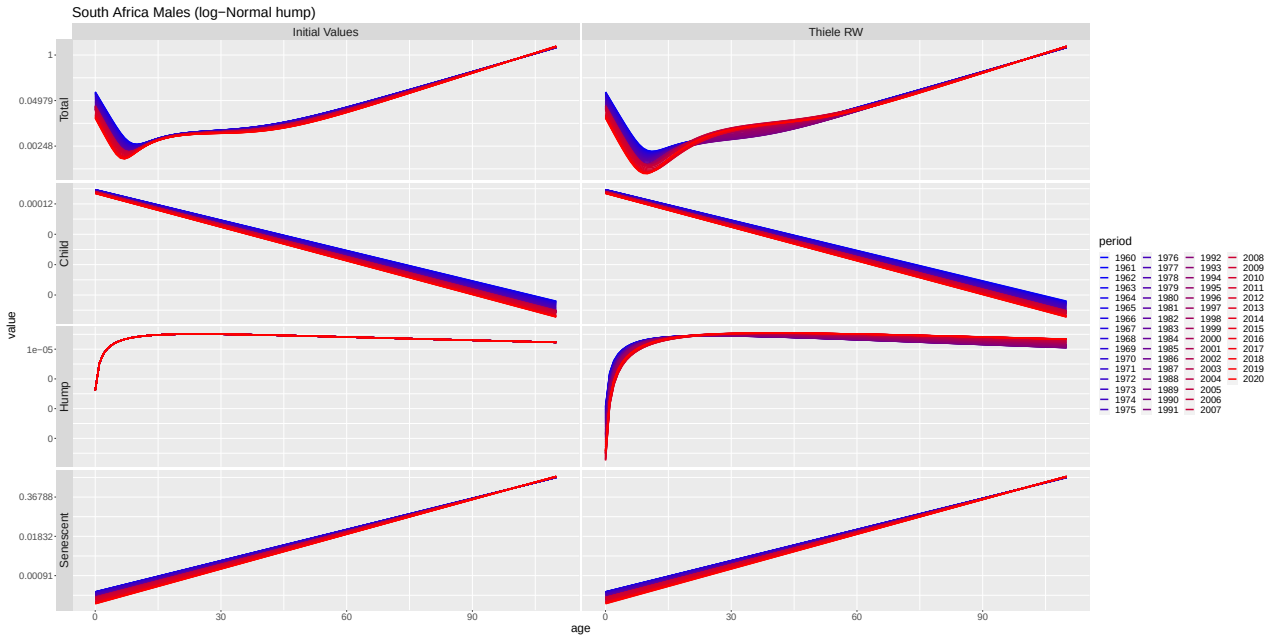

Figure 8: Thiele Decomposed

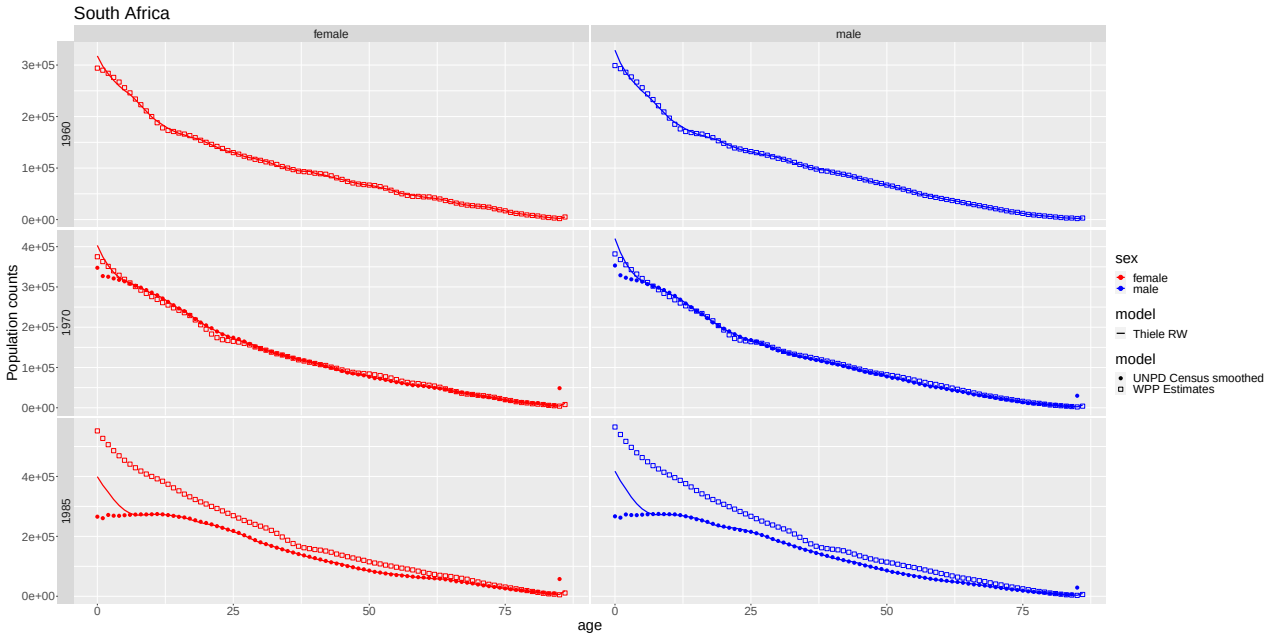

Figure 9: Population

Figure 10: Population

Figure 11: Population

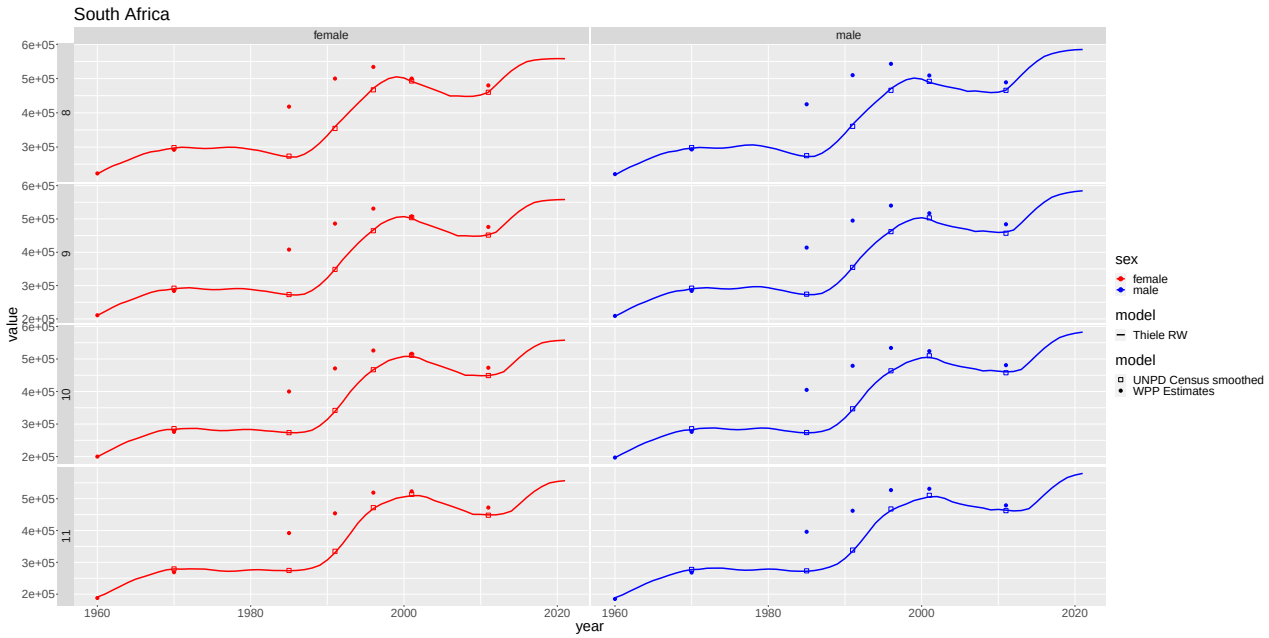

Figure 12: Population

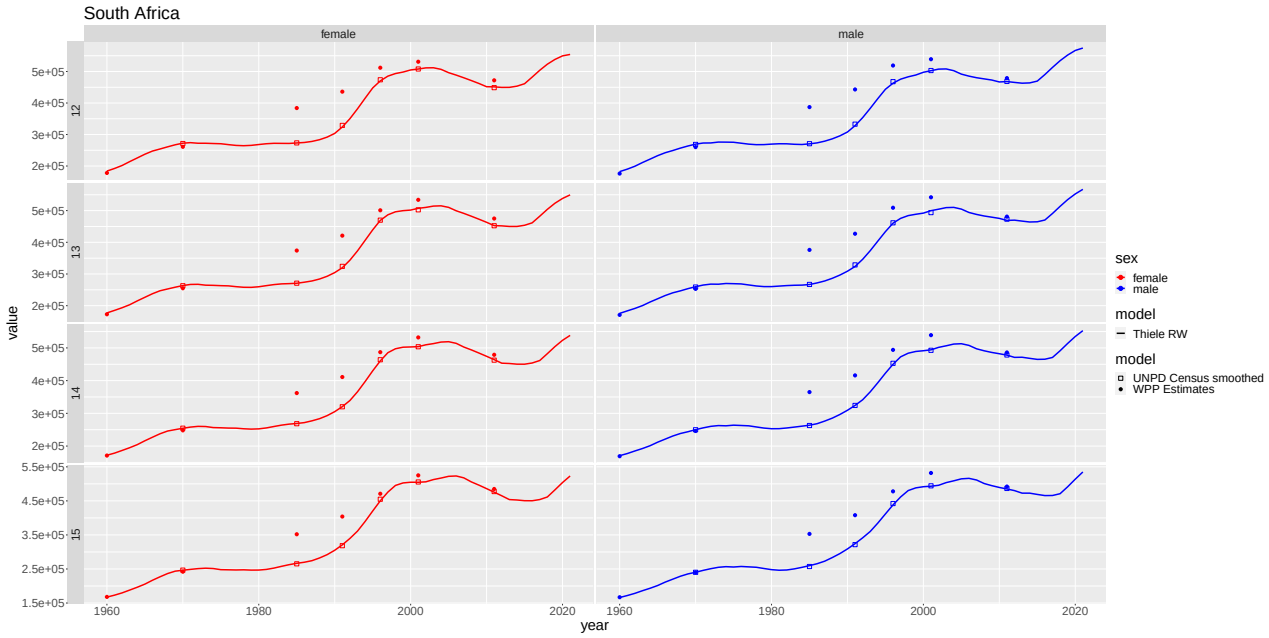

Figure 13: Population

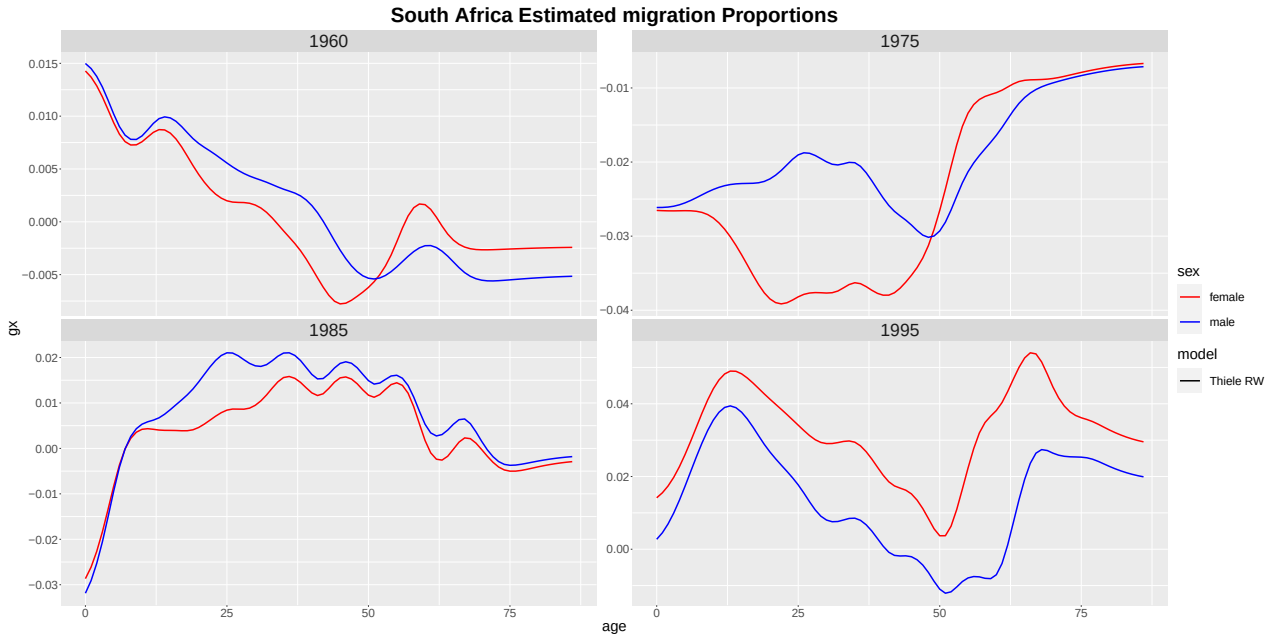

Figure 14: Migration

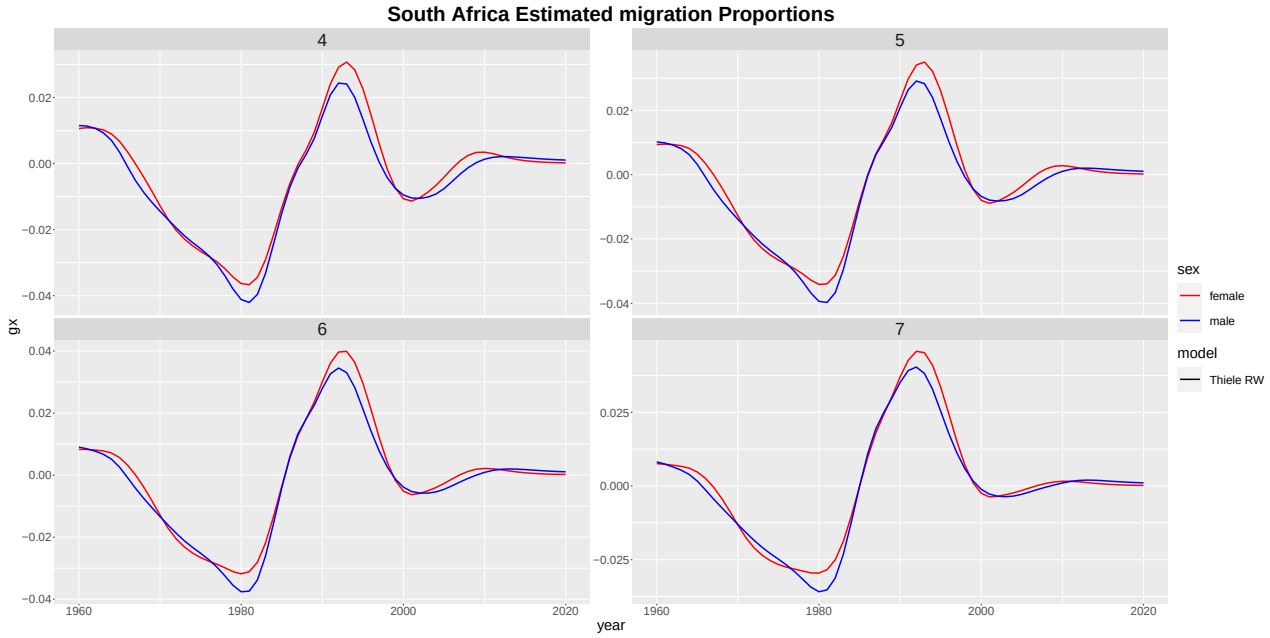

Figure 15: Migration

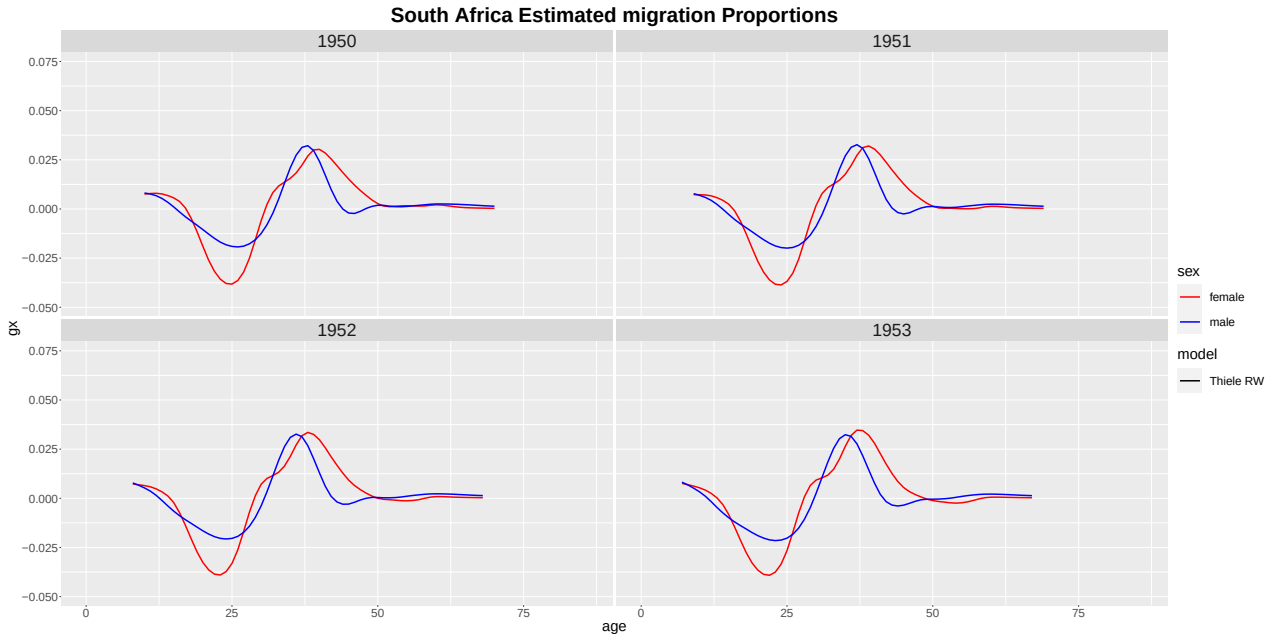

Figure 16: Migration

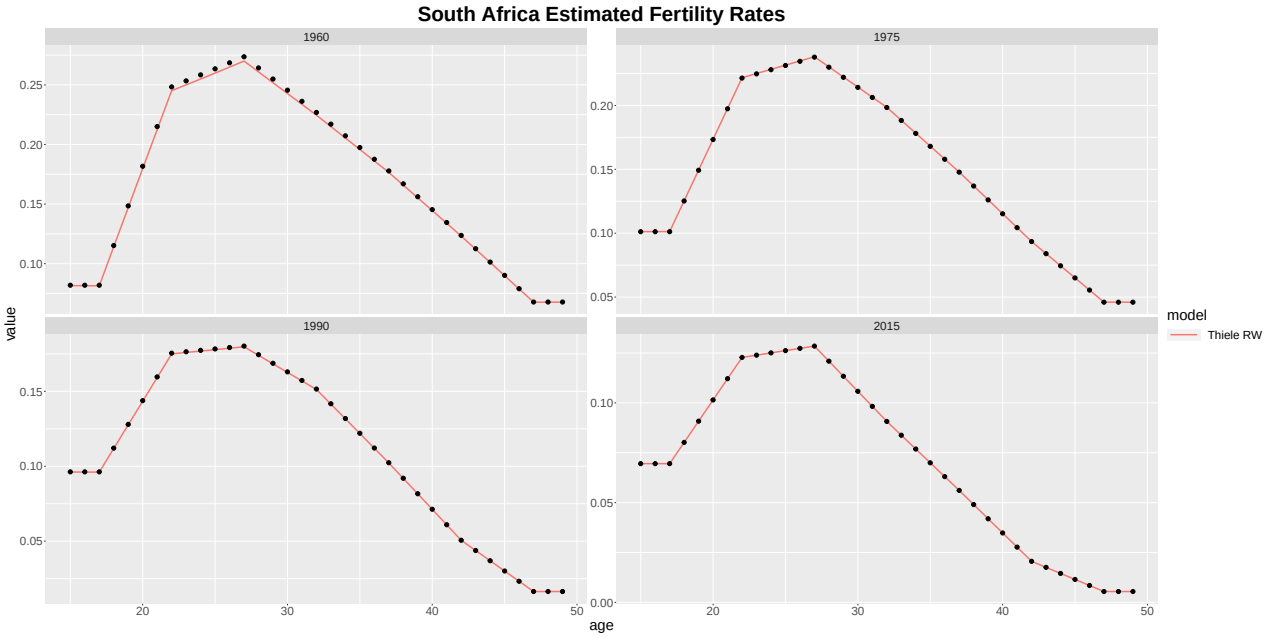

Figure 17: Fertility

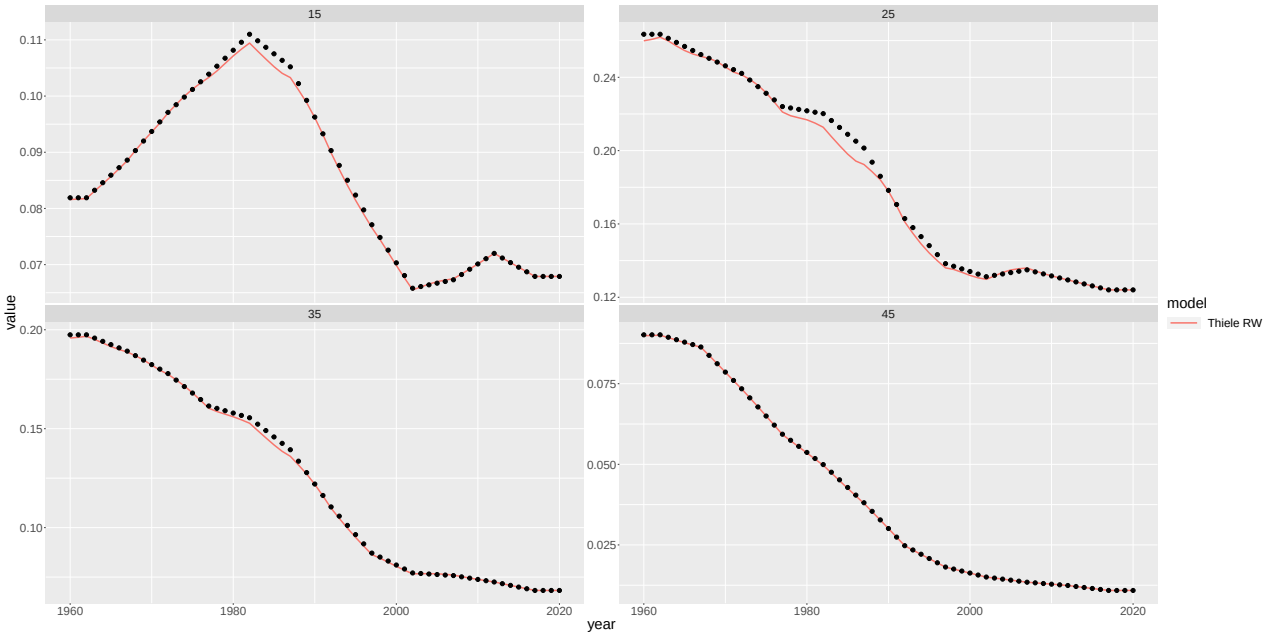

Figure 18: Fertility

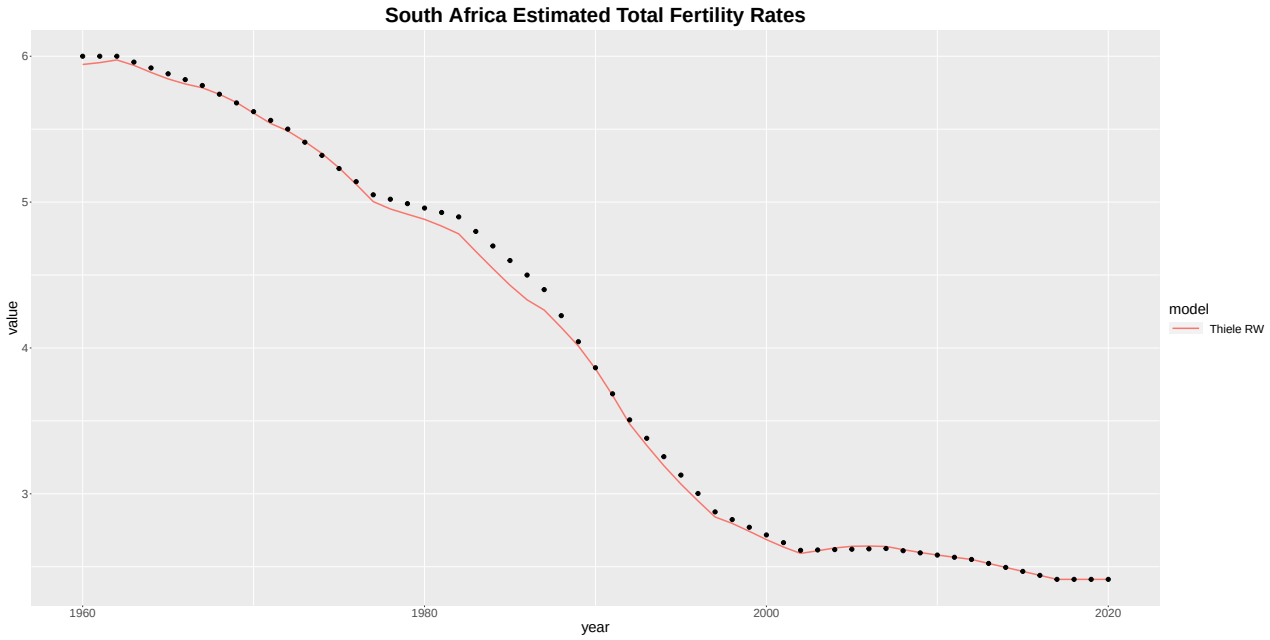

Figure 19: Total Fertility