# Demographic Research Submission #4457 R1

# ‘Visualizing fertility trends for 45 countries using composite lattice plots’

# Response to guest editors’ comments

We would like to thank the guest editors for letting us know that our paper has been conditionally accepted for publication in Demographic Research. We would also like to thank Sebastian Klüsener and the guest editors for providing additional constructive comments which we think have helped us to further improve and finalize our paper.

We have ordered the comments that we have received by number (CO#). We address them as follows:

**CO01: Uncommon definition of “sub-replacement fertility”**

**In lines 110-111 you state that the thin line denoting a CCFR of 1.5 is “sub-replacement fertility level”. In the text that follows you then seem to consider only levels around 1.5 as sub-replacement fertility levels. However, in the fertility literature any fertility below 2.05 is generally considered as sub-replacement fertility. Your uncommon definition of sub-replacement fertility would be very irritating for many readers. For example, on lines 367-368 you write: “Of the three population [editor: Japan, Taiwan, South Korea], South Korea appears more likely to sustain fertility at sub-replacement level.” With this you seem to imply that South Korea might be able to keep a level 1.5, while Taiwan and Japan are likely to stay at even lower levels. But for most readers this sentence would just be confusing. We strongly recommend you not to use “sub-replacement fertility level” as synonym for a level of 1.5. It would be better just to refer to it as a level of 1.5 children per woman. Please carefully change this throughout the text.**

We thank the guest editors for this comment. We have dropped the term “sub-replacement fertility level” and simply refer to “fertility level of 1.5 children per woman” in lines 113, 387-388 and throughout the text.

**CO02: Sudden new explanations in the “summary and conclusion section”**

**In a summary and conclusion section we would expect a summary and conclusion of the paper. However, in lines 396-429 you start a quite detailed discussion of possible determinants of fertility trends in East and West Germany and other countries for which plots have been presented in the results section. In this discussion you include arguments that have not been presented before. This does not fit well with a summary and conclusion section. Thus, please condense this section (lines 396-429) substantially so that only summarizing and concluding aspects remain. You might move parts of this section to the results section when the different countries are discussed. It would also not harm to leave out a number of mentioned aspects entirely.**

To address this comment, we have restructured the conclusions into two sections: Section 4.1 “Summary and discussion of the main results” and section 4.2 “Main contributions and further research directions”. In section 4.1 we include a brief summary of the key results and a discussion on how these are related to other interpretations offered in the literature. We use this section in a speculative way to highlight a range of factors that have been associated in the literature with the fertility trends that we have identified in the results section.

We have also revised, simplified and reduced the section mentioned in lines 417-433. We have kept the discussion of the main points as we think these are valuable and provide the readers with possible explanations for the descriptive trends revealed by our visualizations. In addition, in lines 278-279, we have added the following sentence “Some interpretations of the many results presented in this section are discussed in section 4.1” to further guide the reader.

**CO03: Small refinements of figures and of accompanying notes**

**The figures are already very nice, but as this is a special collection on visualization we would like to make sure that the figures are of very high quality. It is also important that they can be understood by readers who have not read the text. We added a number of comments to the figures and figure notes in the attached manuscript which will hopefully be of help in preparing the manuscript for publication. Particular attention should be given to how the ordering of the 45 countries in Figure 3 is described. In note c you write “Countries are ranked in descending order by CCFR in 2007 (last common year of observation)” This is a bit confusing as CCFR is given for cohorts and not for years. If the countries are indeed ordered by a level recorded in 2007, it is also surprising that Taiwan with its low fertility levels is ranking higher than, for example, Norway. This raises the question whether the countries are perhaps ordered using any cohort data recorded up until 2007. We believe it would be much better to order the countries in Figure 3 by some kind of reference cohort. If 2007 is the last common year of observation, the 1960 cohort might be a good reference point. Another possibility is to sum up all CCFRs recorded for cohorts of childbearing age in 2007 and use this as a point of reference to order the countries. If you prefer to keep the old ordering, please make sure that you explain correctly how you derived the order.**

We thank the guest editors for this comment. In order to address this issue, we have introduced the term “pseudo-cumulative cohort fertility rates (pseudo-CCFRs)” and changed the text throughout to reflect this. In lines 103-104 we have added the following text “we derive the cumulative ‘cohort’ fertility rates using ASFRs by period, and refer to these quantities as pseudo-cohort cumulative fertility rates (pseudo-CCFRs) for this reason” in order to clarify this term. In addition, in lines 275-276 we confirm that “Countries are ranked in descending order by pseudo-cumulative cohort fertility rates computed in 2007” and have added the following footnote after line 277: “An excel file containing the pseudo-cumulative cohort fertility rates computed for 2007 for each country is provided in the online appendix (see <https://github.com/JonMinton/comparative_fertility)>.”

[Jon – I had a go at addressing this point but feel free to rephrase or change.]

**Additional comments from the guest editors derived directly from the paper:**

**CO05: Line 27: Consider “might” instead of “can”.**

We have replaced the term “can” with the term “might”.

**CO06: Line 60: Repetition of the word “provides”.**

We have changed the expression “Our approach provides [etc.]” with “We present [etc.]”.

**CO07: Line 65: Repetition of the word “provide”.**

We have changed the word “provide” with the word “offer”.

**CO08: Line 79: Consider “are” instead of “is”.**

We have changed the expression “data is” with the expression “data are”.

**CO09: Lines 106-107: Repetition of the word “used”.**

We have replaced the statement “The R packages Lattice and LatticeExtra were used to produce the visualization (Sarkar 2008).” with the statement “The visualizations were produced with the R packages Lattice and LatticeExtra (Sarkar 2008).”

**CO10: Line 111: Is CCFR accumulated from age 15 onward or is there no lower threshold? The formula provides the impression as if there is no lower threshold. Just to check.**

[Jon to respond.]

[Jon – could you also check whether the text in lines 108-115 is correct? Thanks!]

**CO11: Line 114: It is very irritating that you define 1.5 as “sub-replacement fertility level” as any level below 2.05 is “sub-replacement fertility”. This has to be changed throughout the manuscript.**

We have dropped the term “sub-replacement fertility level” and simply refer to “fertility level of 1.50 children per woman” in line 114 and in other parts of the text.

**CO12: Lines 144-148 (figure 1a): Please no space before or after “/”**

In Figure 1a we now refer to “1.5 and/or 2.05 children per woman” instead of “1.5 and/or 2.05 children / woman”

Further comments on figure 1a:

Jon - I think in the previous version we had the term “children” instead of “babies” (3 instances on the graph). Can we revert these back to “children” for consistency with text?

Jon – have labels in x- and y-axis been enlarged

**CO13: Lines 158-167 (figure 1b):**

**Please make sure that capitalization in plot annotations follows a coherent rule “Replacement Fertility”.**

We have replaced “Replacement Fertility” with “Replacement fertility”.

**The x-axis title in this plot is much smaller than in the other plots.**

We have slightly enlarged the font of the x-axis title.

[Jon – could you confirm this?]

**Please change “Fertility rates” to “Annual age-specific fertility rates”**

We have replaced “Fertility rates” with “Age-specific fertility rates” for consistency with the term used in the text.

[Jon- do you think that we should include this on the top bar for each subsequent figure?]

Further comments on figure 1b:

Jon – this looks good.

I have three minor comments:

1. The blue label for panel (c ) looks a bit odd as it is a bit wider than the labels for panels (a) & (b). Perhaps we should enlarge these as well. I am happy to do the changes if you remind me which software do you use to insert the annotation items.

2. “Age specific fertility rates” on the top bar should perhaps be “Age-specific fertility rates” for consistency.

3. The arrow for “Tile colour indicates regions” points to the “ASFRs” bar instead of the “Germany, West” bar

**CO14: Lines 174-177: The fertility decline in the late 1960s was probably caused by several factors. Please reformulate to make clear that next to this factor also others might play a role.**

We have reformulated the sentence which now reads: “These include the fall in fertility rates at all ages seen in the late 1960s, coinciding with the diffusion of more effective contraceptive methods among other factors (as each vertical section through the figure is a cohort, a period effect will appear as a diagonal band moving bottom right to top left).”

**CO15: Line 189: I find this still quite speculative. If for whatever reason there is a trend change towards higher fertility among the later cohorts, this would not be visible in the contour plot (or only if you are talking about the immediately following cohort). The tendencies you are speculating about might be more visible if more contour lines of lower fertility levels are shown as well. I would rather skip this speculation.**

We have dropped the following text: “Though we cannot know with certainty, we can make some reasonable informal extrapolations of the contours for more recent cohorts by assuming the following: firstly, that so long as the contours are within ages ranging up to around 43 years, they can probably be assumed to continue linearly; secondly, if the contours trend upwards towards older ages (around 44 years and older), the total cumulative fertility of later cohorts is likely to become less than the level indicated by the contour, and so the contour is likely to move vertically upwards.”

**CO16: Line 191: Repetition of the word “shows”.**

We have replaced the word “shows” with the word “presents”.

**CO17: Lines 204-205: While reading, I first thought that “these changes” refers to what happened after 1989. But actually you are referring here to the whole period for which data are available. Please make this clearer in the text.**

The sentence has been revised and now reads: “By looking at the contours, we can see the effects that these changes in age-specific fertility, visualized over the whole period, had on completed cohort fertility rates.”

**CO18: Line 213 (figure 1c): Please choose a more meaningful title for this plot: e.g. Comparison of fertility trends in West and East Germany.**

We have changed the title of figure 1c accordingly.

**CO19: Lines 213-221 (figure 1c): On this second and all other plots you can put this information [cohort, not period, on x-axis] in a note.**

We have moved this information to note (a) “Cohort and not period is indicated on x-axis” in figures 1b-3.

**CO20: Lines 213-221 (figure 1c):**

**The comparison of Germany East and Germany West would be easier if also a clean plot without annotation is included for Germany, East. For that reason, I would prefer if the plot would contain three sub-plots: 1. Germany, East (with annotations), 2. Germany, East (clean), 3. Germany, West (clean)**

We thank the guest editors for this comment; we have modified figure 1c accordingly. To further clarify, we have revised the sentence in lines 191-192, which now reads: “Figure 1c presents the composite plots for both West and East Germany, with the plot for the latter presented in both annotated and non-annotated forms.”

**Capitalisation in axis titles should be coherent (“Age in years”, “Birth Year”). Please also provide the years (labels) on the x-axis in horizontal form.**

We have done the corrections as suggested.

**CO21: Lines 213-221 (figure 1c):**

**In case the contour lines are also derived from earlier years not shown in the plot, please add a note related to this.**

[Jon – I am not sure we have addressed this. Any suggestions?]

**Also the instruction notes are missing that explain what is actually displayed (ASFRs and cohort fertility contour lines). These could be copied from Figure 3.**

We have revised the following instructions notes from figure 3 and reported them in figures 1b, 1c and 2:

*“Note*: (a) Cohort and not period is indicated on x-axis. (b) The shades in the plots correspond to age-specific fertility rates (ASFRs), as indicated in the shaded scale bar on the top of the figure. (c) The thick solid contour line indicates pseudo cumulative cohort fertility rate (pseudo-CCFR)=2.05 children per woman (replacement fertility) and the thin solid contour line indicates pseudo-CCFR=1.50 children per woman. (d) The green color of the tiles containing the name of the countries indicates the macro-region of “Western Europe” (see also note (d) in figure 3).”

**Additional comments on Figure 1c**

Thank you for this Jon.

A couple of minor comments:

Is it possible to reduce the blank space both at the top and bottom of the figure so we can fit the notes?

Perhaps the label for y-axis “Age in years” should be lowered to be at the level of/within the mid panel or alternatively be repeated for the y-axis in each sub-panel (as you have done in figure 1b).

**CO22: Lines 233-235: I would combine this paragraph with the preceding one.**

We have now moved the following paragraph as suggested: “The USA ‘regained’ replacement fertility levels after a much longer period: cohorts born between 1950 and 1962 did not reach replacement fertility, but cohorts from 1963 onwards did.”

**CO23: Lines 243-251 (figure 2):**

**Please try to avoid the diagonal semitransparent polygon indicating the period of more rapid decline as it is not visible under the white area. Perhaps it is enough to take that white-shaded element and simply point the arrow in the area were most decline occurred.**

To address this comment, we have replaced the diagonal semitransparent polygon with a diagonal dashed black line, which we think is less intrusive.

**Please provide the years on the x-axis in horizontal form.**

The years on the x-axis are now provided in horizontal form.

**CO24: Lines 243-251 (figure 2):**

**In case the contour lines are also derived from earlier years not shown in the plot (for Norway and the US this is definitely the case), please add a note related to this.**

[Jon- could you address this?]

**Also the instruction notes are missing that explain what is actually displayed (ASFRs and cohort fertility contour lines). These could be copied from Figure 3.**

We have copied the instruction notes from figure 3, as suggested.

**CO25: Lines 253-254: I would either move this sentence to the preceding paragraph as it still deals with Norway. Or I would add “Norway” somewhere in this sentence to make clear that this sentence is about Norway.**

We have revised the sentence as follows: “Unlike in West Germany, in Norway there was not a pronounced fall in peak birth rates along with the increase in the age of peak birth rate; it has remained at or close to 0.15.”

**CO26: Lines 266-270: I would also assume this based on the trends, but I would not link it to the age 43 aspect, but rather to developments that one is already seeing among younger cohorts. If we would see massive trend changes at younger cohorts, we might expect the contour line to go down again, even though it has recently gone upwards.**

We have added the following sentence: “However, if we were observing missive trend changes at younger cohorts, we might expect the contour line to go down again, even though it has recently gone upwards.”

**CO27: Lines 275-276: Please also provide here information how you ordered the countries.**

We have added the following sentence and footnote: “Countries are ranked in descending order by pseudo cumulative cohort fertility rates computed in 20074.”

Footnote 4: “An excel file containing the pseudo cumulative cohort fertility rate computed for 2007 and for each country ranked in descended order is provided in the online appendix (see <https://github.com/JonMinton/comparative_fertility)>.”

[Jon – are you happy with this?]

**CO28: Line 292: I assume with “more elevated” you mean “more pronounced”. If this is the case, the use of “elevated” is a bit irritating at least for me as a non-native reader.**

We have replaced the term “elevated” with the term “pronounced”.

**CO29: Line 298: 1960.**

We have replaced the “1960s” with “1960”.

**CO30: Line 303: Repetition of word “further”.**

We have replaced the word “further” with the word “in more details”.

**CO31: Lines 307-308: Better slightly reformulate to state here what the colors in the plot actually represent and that the legend on top provides information which color refers to which level.**

We have modified note (b) in figures 1b-3 as follows: “The shades in the plots correspond to age-specific fertility rates (ASFRs), as indicated by the shaded scale bar on the top of the figure.”

[Jon-are you happy with this?]

**CO32: Line 312: Indeed 2007?**

We confirm that “countries are ranked in descending order by pseudo-CCFR in 2007 (last common year of observation)”, as indicated in note (d) to figure 3. To corroborate this, we have added the following footnote after line 277: “An excel file containing the pseudo-cumulative cohort fertility rates computed for 2007 for each country is provided in the online appendix (see <https://github.com/JonMinton/comparative_fertility)>.”

[Jon- are you happy with this?]

**CO33: Lines 311-312: I find it surprising that, for example Norway and Finland rank in this ranking quite low compared to countries such as Korea or Moldova. Visually, one might expect a different ranking. My feeling is that the countries are not ranked by CCFR in 2007 but by taking the average of what was observed until 2007. See decision letter for suggestions how the plots might be ordered better.**

[Jon – can you help with this please?]

**CO34: Line 325: In case the contour lines are also derived from earlier years not shown in the plot (which seems to be the case), please add a note related to this.**

[Jon – can you address this as well please? Similar to CO24]

**CO35: Lines 368-369: What is meant by “more sustainable sub-replacement fertility levels”?**

We have revised the sentence as follows: “By contrast, the cohort fertility level of 1.50 children per woman does not appear to decline further in Northern European countries [etc.]”.

**CO36: Lines 376-378: For that reason it is surprising that Spain is ranked before Norway in Figure 3.**

[Jon – any suggestions on how to address this?]

**CO37: Line 387: Populations.**

We have replaced “population” with “populations”, as suggested.

**CO38: Lines 387-388: See comment in the decision letter.**

We have revised the sentence as follows: “Of the three populations, South Korea appears more likely to sustain fertility of at least 1.50 children per woman.”

**CO39: Lines 406-407: Some countries have maintained replacement levels.**

We have revised the sentence as follows: “Our study shows that in a large number of countries fertility rates have dramatically fallen over time reaching levels of at least 1.50 children per woman.”

**CO40: Lines 417-433: Here you actually discuss many details that have not been previously discussed when you presented the figures on West and East Germany. I would either move elements of this text to the respective results section or drop them.**

In section 3.1. we describe the similarities and dissimilarities observed for the fertility trends in East and West Germany. We have re-structured the conclusions into two sections: Section 4.1. “Summary and discussion of the main results” and section 4.2 “Main contributions and further research developments”. We have revised and reduced the section presenting the discussion of the results for East and West Germany. Yet we believe that this discussion provides a valuable enrichment to the paper.

The section now reads: “Our study also shows that there is considerable variation around the general trend, both across and within geographic regions. For example, prior to the 1970s East and West Germany shared common trends in fertility decline and loss of replacement fertility for cohorts born before 1940. During the 1970s and 1980s, East Germany had a recovery in fertility while fertility continued to decline in West Germany, with a rapid convergence of fertility schedules after the collapse of the Berlin Wall. As reported in other studies (Frejka 2017; Sobotka, Skirbekk, and Philipov 2011), cohort fertility rates kept decreasing in East and West Germany and now appear to have stabilized below replacement level. Differences in fertility pathways between East and West Germany are largely attributed to disparities in social policies and socio-economic conditions following the German reunification (Konietzka and Kreyenfeld 2002), which may contribute to the amplification of pre-existing cultural discrepancies (Klüsener and Goldstein 2016).

**CO41: Lines 434-456: Also here the summary and conclusion should not provide new things that have not been discussed before, but rather summarize and conclude. Some of these aspects might be moved in the section when Figure 3 is discussed.**

See our response to previous comment (CO40). In addition, in order to further guide the reader we have added the following sentence in lines 278-279: “Some interpretations of the many results presented in this section are discussed in section 4.1.”

We have revised, simplified and reduced the section in lines 434-456. This now reads: “Another example is provided by East and South-East Asian countries, which have witnessed exceptional falls in fertility, following the rapid socioeconomic changes and expansion of education opportunities for women (Frejka, Jones, and Sardon 2010; Raymo et al. 2015). For these countries we observe diverging cohort fertility patterns, with Japan showing an earlier onset of cohort fertility decline compared to other countries in the region, and South Korea being the only country in the region to display sustained cohort fertility levels of at least 1.50 children per woman. Such intra-regional discrepancies may be attributed to different government interventions (e.g. Estévez-Abe and Naldini 2016; Gauthier 2016), persisting inequalities in the gender division of labor and slow-changing normative contexts (Hertog and Kan 2019; McDonald 2009).

Our study also shows that only few countries which ‘lose’ replacement fertility end up to regain it. Clear exceptions are USA and Norway, which display a certain degree of heterogeneity in their fertility pathways, reflecting contextual differences between geographic regions. Recovery patterns may be due to the influence of immigrant fertility in the USA (Choi 2014; Coleman 2006). In the case of Norway, sustained replacement fertility may also be explained by generous welfare provisions and widespread gender equality at the societal level (Kravdal 2016).”

**CO42: Lines 464-466: Further up you use the term cumulated CFR to make a distinction to CFRs.**

We have revised the sentence as follows: “The contour lines in our visualizations were based on pseudo-CCFRs calculated from period ASFRs, rather than CCFRs calculated from cohorts directly, and it would be useful to compare these period-based pseudo-CCFR estimates with real CCFRs.”

[Jon – are you happy with this? Can you check?]

**CO43: Line 484: Klüsener.**

We apologize for the spelling mistake. We have replaced “Klüsner” with “Klüsener”.