Reply to reviewers
We appreciate the reviewers' comments; their detailed reading of the manuscript and many suggestions that have greatly improved the article. Our responses to the reviewers' comments are outlined below in regular font with reviewer's comments in bold font.

Reviewer 2

The analysis is quite comprehensive, and done carefully. The methods and technical details of the analysis seem appropriate.

But I don't think some interesting and important results are properly highlighted or summarized. The abstract states: "Our results showed that life disparity was high and strongly fluctuating over the time period. Life expectancy and life disparity moved independently from one another, particularly during periods of life expectancy stagnation." This is a fairly "plain" description of the results, missing some interesting patterns identifiable in the results.

In the results, e0 and e† do not look independent, but are negatively associated for 1988-1995 and 1996 onwards. (Since e0 was fairly stationary for 1960-1987, the association could not be strong in that period anyway.) The decomposition analysis indicates that much of the changes in e† are attributable to increases and decreases (recovery form increase) in middle-age (and younger old-age) mortality, particularly for males in the former USSR countries. This is an interesting result, which should be more highlighted. Also this makes a sharp contrast with typical patterns observed in "Western" countries, which went through two stages, increases in lifespan and decreases in dispersion up to around 1970, driven mainly by reduction in young-age mortality, and increases in lifespan and small increases in dispersion after around 1970, driven by the shift of high mortality to older ages. The West versus East differences are mentioned, but should be made clearer and summarized better.

One major reason why lifespan inequality is rarely tracked is because of the high negative correlation with life expectancy. There is of course no reason why that needs to be the case, and we found it striking that for nearly 30 years the two measures moved in the same direction (meaning toward a weakening of the longstanding negative correlation) more often than in opposite directions. To our knowledge this has never been shown empirically before, and we consider it a major finding from this analysis worthy of being highlighted. While it is true that the overall trends were flat, as you point out, the year-to-year differences were up to 2% in e0 and up to 5% in e†, so not always inconsequential. Nevertheless, it is an important point that the two metrics were more often changing in the direction expected from a negative correlation after 1988, when yearly mortality change was on average larger. So we have to be careful not to oversell the independence argument. As we see it, the main difference from before and after 1988 was that in the earlier periods age-specific mortality itself was moving in opposite directions for different age groups. Afterwards, through both periods of crises and recovery, age-specific trends tended to move in the same direction at all ages (with younger ages being the strongest drivers of both mortality increase and decrease), which explains why the e† and e0 relationship resumed being negatively correlated.

To make the above clear, we reframed all of this within the context of typical 'Western' patterns versus the anomalous Eastern age-specific mortality change, highlighting the different age-specific mortality trajectories as you suggested above. We made the following changes:

Changes to the Abstract:
…Generally life disparity was high and strongly fluctuating over the period. For nearly 30 of these years, life expectancy and life disparity moved independently from one another, largely because mortality trends ran in opposite directions over different ages. …Mortality patterns in CEE countries were heterogeneous and run counter to the common patterns observed in most developed countries.

Changes to the Discussion
The second paragraph refers to the negative correlation found in Western countries. In the third paragraph, we reframed our results in perspective with the Western pattern:

"Central and Eastern European countries run counter to this narrative. Although they too experienced the sharp declines in infectious disease mortality up to the mid-twentieth Century, mortality at mid-life stalled or even increased for most of the last half of the twentieth Century (McKee and Shkolnikov 2001),with no appreciable declines in cardiovascular mortality until very recently (Caselli et al. 2002, Grigoriev et al. 2014, Mesle 2004, Timonin et al. 2017). As our results made clear, mortality change at different ages was far from even, with the result that changes in lifespan variation did not correspond in intensity or even direction with changes observed in life expectancy."

In the Age-specific contributions section in the discussion we added:

"… Mortality compresses or expands, depending on the balance between these two processes. Our results for Central and Eastern Europe, which run counter the western narrative, are a product of different sensitivity of life expectancy and lifespan variation to mortality age-patterns. Typically, trends in lifespan variation are thought to be driven by changes in the ``younger age'' component of lifespan variation, with variation from the ``older age'' mortality component holding steady…"

In the Cause-of-death section in the discussion we added:

"Fluctuating alcohol-related mortality was an important component of the moving life disparity trends in the countries of the former Soviet Union, although it occurred to different degrees in each region, and manifested itself in different causes. Over young ages, a large role was found for the reduction of external cause mortality including traffic accidents in the Baltic countries throughout the period, and in Russia, Belarus and Ukraine from 2000 onwards. Since these causes often co-moved with mortality directly attributable to alcohol over these ages it is suggestive that healthier patterns of alcohol consumption were contributing to these reductions in life disparity. At older ages, between-country differences in mortality reduction seemed to be driven by the extent of mortality reduction from circulatory diseases. In addition, alcohol

consumption is not the only factor that explains mortality trajectories in the region, or the sole explanation for difference between life expectancy and lifespan variation levels with western European countries. Other factors, such as environmental pollution, medical care, smoking behaviors and diet have been important determinants of health outcomes in this region since at least 1970 (Bobak and Marmot 1996). Indeed, the strong declines in circulatory disease mortality in the Baltic countries (Jasilionis et al. 2011), and more recently Russia (Grigoriev et al. 2014) have been seen as hopeful signs that these countries are finally on a path toward the lower levels of cardiovascular mortality that have been achieved in the west."

Also, it will help readers if the 12 countries are distinctly split into two or three subgroups based on their differential patterns of time trend in e0 and e† and if the grouping is used consistency throughout the paper.

As reviewer 3 also suggested, as far as possible we grouped our discussion around three main groupings that experienced more similar trends: Central Europe + Bulgaria, the Baltic Countries, and other former Soviet Union countries (FSU). We hope that this patterning helps to anchor the trajectories geographically and has livened up some of the denser sections of the paper. In addition, we recreated all decomposition figures in concordance with the grouping by adding a specific label and background color in each country.

A minor comment. I felt that the term "fluctuation" was overused in this paper. For example, changes in e0 and e† due to the anti-alcohol campaigns and those around the USSR dissolution are systematic changes due to identifiable, solid reasons. They seem too strong and too clear to be called "fluctuations".

That's true. We tried as much as possible to avoid strong normative wording, but these mortality changes were objectively massive by any definition. To better convey this, we:

Introduction: "*Since the 'sharpest fluctuation' in age-specific mortality occurred over working ages…*" changed to "*Since the 'largest deviations' in age-specific mortality occurred over working ages*"

"*We complement the existing literature by focusing on the Central and Eastern European case, which shows atypical periods of mortality upheaval and substantial life expectancy fluctuation*" changed to "*We complement the existing literature by focusing on the Central and Eastern European case, which shows atypical periods of mortality upheaval and substantial life expectancy changes*"

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Data and Methods: "*Mortality fluctuated more strongly among men*" changed to "*Mortality change was larger and more abrupt among men*"

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Discussion

"*Changes in life disparity were, to a large extent, caused by fluctuation in mid-life mortality, with different net effects depending on the country and time period*" changed to "*Changes in life disparity were, to a large extent, caused by changes in mid-life mortality, with different net effects depending on the country and time period.*"

"*Gillespie et al (2014) showed that fluctuation in lifespan variation in Canada, Japan and the United States was almost entirely driven by younger ages.*" Changed to "*Gillespie et al (2014) showed that changes in lifespan variation in Canada, Japan and the United States was almost entirely driven by younger ages.*"

"*By contrast, in this study, we found highly fluctuating lifespan variation owed to fluctuation in both the younger and older age components.*" Changed to "*By contrast, in this study, we found high irregularity in lifespan variation owed to changes in both the younger and older age components.*"

"*As a result, the combination of mortality fluctuation over younger ages with growing mortality differentials at older adult ages can lead to widening between-country inequalities in life expectancy, alongside stable life disparity differences.*" Changed to "*As a result, the combination of mortality changes over younger ages with growing mortality differentials at older adult ages can lead to widening between-country inequalities in life expectancy, alongside stable life disparity differences.*"

"*Mortality associated to the most hazardous forms of alcohol consumption, such as alcohol liver disease or poisoning by exposure to alcohol, did not play a central role in the lifespan variation fluctuation.*" Changed to "*Mortality associated to the most hazardous forms of alcohol consumption, such as alcohol liver disease or poisoning by exposure to alcohol, did not play a central role in lifespan variation levels or trends.*"