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The significance of climate and solar variability on historical European grain prices

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Grain was the most important food source for a majority of the population in early modern Europe (*c*. 1500–1800). The price level and volatility had huge societal effects: high prices tended to increase mortality, decrease fertility as well as affect overall consumption patterns. To what extent climate variability influenced the long-term grain price evolution in early modern Europe has for a long time been a matter of debate. Recent advances in high-resolution palaeoclimatology and historical climatology have made it possible to reassess the grain price–climate relationship in time and space with unprecedented detail (Esper *et al*. 2017). We analyse the climate signal in 56 multi-centennial long series of annual prices of barley, oat, rye, and wheat across Europe. The grain price–climate relationship in regional clusters of grain price data is analysed using both tree-ring based temperature reconstructions, documentary-based temperature reconstructions, tree-ring based drought reconstructions, and early temperature and precipitation instrumental data, considering possible different climate responses in each grain type and different seasonal targets. In addition, we systematically investigate whether, and to what extent, the imprints of variations in solar forcing, including possible lag effects, can be detected in the grain prices.

We find a highly significant and persistent negative temperature–price relationship (i.e., cold = high prices and vice versa) across all of Europe and for all four grain types using both temperature reconstructions and instrumental temperature data. Excluding the Thirty Years' War (1618–1648) and the period following the French Revolution (1789), this relationship is as strong as r = –0.41 between the annual average of all the 56 included European grain price series and the reconstructed June–August temperature for the previous year. The correlations to drought and precipitation are, on the other hand, mainly insignificant and inconsistent in time and space. The evidence for the existence of the effect of solar forcing variations on early modern European grain prices is not strong, although we can detect statistically significant grain price–solar forcing relationships for certain regions. In conclusion, we find much stronger evidence than hitherto reported for long-term temperature imprints on historical grain prices in Europe, implying that

temperature variability and change have been a more important factor in European economic history, even in southern Europe, than commonly acknowledged.

Reference:

Esper J., *et al*., 2017. Environmental drivers of historical grain price variations in Europe. *Clim. Res*. 72: 39–52.