

International Perspectives on Aging

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To Sonia and Sage

Preface

The Transitions studies aging by analyzing the rates of non-communicable diseases across generations since the nineteenth century. It then examines the extent to which economic, epidemiologic, and political conditions in the childhood years of the generations had influenced the progress of aging. In recent decades, this issue of the role of childhood development has come to the fore as a vital one for grasping the sources of long-term wellbeing. The book, however, harnesses it mainly for examining another longstanding matter: what type of role does aging play in the long-term growth of per capita healthcare spending?

Examining the matter entails weaving together strands of research from biodemography, gerontology, health economics, economic history, epidemiology, macroeconomics, public health history, and from the modern debate on the prospects of aging. My hope is that scholars in each of the disciplines will benefit from the inter-weaving of ideas as much as I have benefitted from their work. I am not embarrassed to say that the book leaves some loose ends and unanswered questions. However, it is hard to imagine they will stay that way for long because the issue has become pressing in advanced economies, and is also critical to emerging ones, as their populations age more in the years ahead.

Without the support and guidance from Richard Steckel, Peter Howitt, and Paul Evans, advisors to my doctoral research more than a decade ago, the book may not have been possible. Based partly on the research, I was able to publish two related articles (Arora 2005, 2013), whose contents have been revised and reused in the book. It was apparent while writing the articles that the connections between the different topics involved would be clearer if they were presented together, in somewhat more detail, but doing so would also make the content book-length instead of article-length. And so it is to my wife, Sonia, and our son, Sage, I thank the most for their patience as the project ballooned.

Over the years, segments of the book were presented to various seminars at the Pan American Health Organization, where I benefited from comments by the participants, especially by Sir George Alleyne who encouraged the research very

early on. As the project inched forward, I gained from discussions with Bernard Harris, Rick Steckel, Peter Lindert, John Komlos, Simon Szreter, John Murray, Werner Troesken, Hoyt Bleakley, Claude Diebolt, Oded Galor, Shankha Chakraborty, Geoff Bump, and Paul Sharp. It has benefitted from suggestions by the participants of the Beta Workshop at the University of Strasbourg, of the conference on health and economic policy at the CES/ifo Institute, and of the seminar at the University of Oregon's economics department. I am grateful to David Blau, chairman of the economics department of the Ohio State University, for arranging access to the University Libraries. Thank you, Peter Lindert, for sharing the data on wealth and income inequality during the nineteenth century. Bernard Harris, thank you for answering my many questions and for guiding me to key sources of information and research. *The Changing Body*, by Sir Roderick Floud, Robert Fogel, Bernard Harris, and Sok Chul Hong (2011), has been an inspiration and an invaluable resource.

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References

- Arora, S. (2005). On epidemiologic and economic transitions: A historical view. In G. Lopez-Casasnovas, B. Rivera, L. Currias (Eds.), *Health and economic growth: Findings and policy implications* (pp. 197–238). Cambridge: MIT press.
- Arora, S. (2013). Understanding aging during the epidemiologic transition. *Research in Economic History*, 29, 1–69.
- Floud, R., Fogel, R. W., Harris, B., & Hong, S. C. (2011). *The changing body, health nutrition and human development in the western world since 1700* (NBER). New York: Cambridge University Press.

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