Nonfiction Book Proposal

Science/Social Issues/Current Affairs

100 Plus:
Getting Ready For the Coming Age of Longevity

By Sonia Arrison

With a foreword by Peter Thiel,
Co-Founder of PayPal, Facebook investor, and billionaire philanthropist

Proposal Contents

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I. Summary

Scientific advances have placed humanity on the cusp of an exciting longevity revolution. Better nutrition, sanitation, and medical technologies started the march towards longer lives, and now, with the sequencing of the human genome and the growing ability to reverse engineer the human body, a great revolution is upon us. Even the most conservative scientists now believe that lifespan, or rather, healthspan – the number of years that someone is alive *and* healthy – is about to significantly increase, making the thousands of centenarians alive today unremarkable in an era when this demographic is expected to increase exponentially in the next 50 years. The ability to grow a new heart in the lab or cure certain cancers using cloned stem cells are technologies in development, no longer in the realm of science fiction.

While this knowledge is growing rapidly, society is hardly prepared for the spike in longevity it has already experienced. In *100 Plus*, noted technology analyst Sonia Arrison explores how this coming era of longevity will change the way we live, work and play. There are lessons to be learned from the fact that humanity has doubled its lifespan in barely a century and Arrison asks how society can get ready for a second doubling that will happen even more quickly. Her answer is that nearly every aspect of our financial, family, religious, and environmental outlooks will need reshaping.

Longer health spans will mean more careers, more stages of life, and greater wealth. Individuals will have access to new fertility technologies at ever-later ages, which will have a dramatic effect on the organization of family. New thoughts of the potential for scientifically-created immortality will threaten organized religion, and only those that can successfully negotiate their place in the new world will thrive. Technological advances that change humanity's future also affect the environment. This will result in quantum leaps in resource management efficiency and a greater personalization of green issues.

100 Plus is the first book to give readers a comprehensive picture and understanding of how scientific inventions will extend life and create a new world for each of us to navigate. This indispensible text will serve as a guide for the thrilling journey of life beyond 100 years.

II. In-depth Overview

For as long as humans have been around, they have dreamt about living forever. Now, for the first time in history, science is bringing humanity closer to realizing that dream through advances that will increase the average lifespan by tens and, potentially, hundreds of years. That is the good news. The bad news is that, as a society, we aren't ready for it – yet.

100 Plus: Getting Ready for the Coming Age of Longevity starts a much-needed dialog about how the current scientific revolution will change our social and economic worlds. Many authors have already written about the multitude of head-spinning advances in science such as the sequencing of the human genome, stem cell work, cloning, genetic engineering, tissue regeneration, nanotechnology, robotics, and computer-human machine interfaces. Yet, no one has seriously addressed how all these fantastic advances will soon impact our daily lives.

Technology does not advance in a vacuum and the results are not benign news items that society can afford to ignore. Already, we witness the fact that millions of elderly people who never thought they would live so long are now struggling to provide for themselves. That is only the beginning of the changes that will take place. Even adding an extra 50 years to our lifespan will affect important areas of our lives that we must prepare for now before the future is thrust upon us and we find ourselves shocked and unable to manage a world we didn't think would ever exist.

Most people are unaware that human life expectancy has already doubled since 1900, and that is is about to be extended much more. Since the sequencing of the human genome in 2000, all areas of longevity science have made great strides. Even the most conservative scientists now believe that lifespan, or rather, healthspan – the number of years that someone is alive *and* healthy – is about to significantly increase. My excitement for the healthspan revolution culminated after writing about the biotech field for a number of years and then meeting Professor Cynthia Kenyon.

Anyone who has ever met Cynthia Kenyon, a molecular biologist at the University of California at San Francisco, is awestruck by the implications of her research. By suppressing a single gene in tiny worms called Caenorhabditis elegans, Dr. Kenyon has increased their normal life span up to six times, not

as crotchety old nematodes, but as young, vibrant, worms. Her discoveries show that a regulator gene, Daf-2 ,works to control an entire collection of genes that direct aging not only in worms, but in similar genetic pathways in flies, mice and, probably, humans. If humans were to have their lives extended in the same way as the worms, they would be living to 400 years old in bodies that looked like twenty-year-olds. This possibility is intensely intriguing, albeit still far from human application. However, there are scientists all over the world conducting related work with technologies that are quickly accelerating due to Moore's law and thus closer to market.

Growing a new liver from a patient's own cells, taking a pill to eradicate obesity, and using pharmaceuticals combined with nanotechnology techniques to radically increase each individual's healthspan are interventions just around the corner. Indeed, in January 2008, researchers at the University of Minnesota reported that, using a process called organ recellularization, they bio-engineered a brand new rat heart in the laboratory that actually started beating. Once perfected, their technique may be used someday to generate new hearts for human patients. Work such as this has lead scientists such as Dr. Robert Edwards, the British doctor who pioneered test-tube babies, to forecast that within decades stem-cell and other technologies will make it possible to grow replacements for virtually any part of the human body. Like replacing parts on an old car, humans could soon reach true vintage status.

Such advances make consideration of the social and political consequences ever more urgent. The human desire to live longer and healthier is strong, but the tension that results when longevity gains meet current societal structures can become problematic, raising a number of provocative questions that this book will address.

For example, if people live longer, will population necessarily grow, causing overcrowding and resource management problems? Procreation, often the reason for marriage, will soon have fewer time-restraints due to new technologies like ocyte cryopreservation, that allow a woman to have her eggs frozen for use at a later time. Will this result in women delaying childbirth even further or possibly putting it off indefinitely? What happens when a delay in family-creation is combined with long-lived

individuals who have healthy sex drives? Clearly, the nature of family life will change significantly, directly impacting every member of society.

Of course, the question that often arises is why one would want to live a long time in the first place. Respected public figures, such as Professor Leon Kass, former Chairman of the President's Council on Bioethics, argue that using technology to extend life is unnatural. It is true that society will have to be very careful about how it uses technology, but this book will argue that it would be disastrously Luddite and anti-human not to try to make ourselves live longer and healthier.

100 Plus will also address important and valid questions about the divide between rich and poor. Could it be possible we are on our way towards a world where a new class structure forms between those who are long-lived and short lived? While new technologies are almost always adopted by the rich first, the question will be whether they eventually reach everyone over time and to what extent longevity technologies can and should become widespread. Closely related to this is the ever-important question of how each individual will go about paying for their longer lives.

Savings rates are currently at an all time low and credit card debt is high. This is alarming, because as people's lives are extended they will need to be more financially stable. Indeed, longer lives have already caused problems for people who never expected to live so long and now find themselves unable to work. While addressing this issue, *100 Plus* will examine the likely possibility of a "longevity dividend," the result of productivity gains generated through better worker quality, higher education, and investment opportunities because of longer term health. Numerous scholars have shown that there are counter-intuitive reasons that longer lives could make society, and its members, wealthier. That would certainly be a happier ending than the one most people currently assume.

This book will also address the controversial issue of religion since much of the world's population believes that, in addition to a body and a brain, each human has a soul. Yet, if each person's lifespan is radically extended, with the possibility of near immortality on earth, tensions between God and longevity science will become much more strained than they are today. *100 Plus* will investigate what

this could mean for organized religions and individual spirituality. Will God become more or less important in a longer-lived world?

Finally, the longevity revolution will require informed political leadership, especially since it will usher in such important and varied changes to humanity's social and economic worlds. Thus far, there have been few political forays into the area of life extension, although there are some non-profit organizations, such as the Institute for the Future and the Singularity Institute, that urge greater political awareness. *100 Plus* will reflect on the coming changes and offer thoughts on how to prepare society for the increasing tension between longer lives and current social structures.

Over the next two decades, it is possible that the boomer generation will benefit from the beginning of the longevity revolution, but that will only happen if enough attention is paid to this important area of work. This is yet another reason for the urgency of *100 Plus*. Baby boomers are helping to drive progress and ultimately it will be Generation X that will be in charge when the biggest changes really take place. Unlike many of the "quirky" books on longevity, this book will act as a thoughtful, yet readable, guide through the journey of healthspan change.

100 Plus will be the first book to tackle the provocative tensions involved in the human quest to radically extend healthspan. Whether or not we realize it, science is changing more than cells and microchips – it is also set to change our sex lives, family structures, financial outlooks, religious views, and more. Greater healthspan will have a significant impact on both personal and global issues. It is time for the dialog to begin and *100 Plus* is the book that will start it.

III. Target Audience

100 Plus will appeal to the large general audience who enjoy reading about future trends, science, and politics. It will also be of great interest to sociologists interested in sexual and family issues as well as economists interested in how perceived time horizons impact financial decisions. Those who work with issues in aging will naturally be attracted to this book, including leaders of organizations such as the AARP, those who teach courses that examine aging and health-extension, the medical world, and the

growing number of "transhumanists." A broad range of baby boomers in particular will be interested, as they have reached a point in their lives where health extension is on their minds. Already, boomers have re-written the rules on what it means to be "old" – they don't think they are – and they plan to remain involved in shaping the society of the future.

Generation X is the generation with the greatest personal interest in how longevity issues resolve, and given their inclination to be more tech-savvy, they will appreciate how quickly technology will drive even greater changes to their world. This is the generation that is currently watching their grandparents die while simultaneously seeing their parents age. They care very much about speeding up cures for aging and see that the opportunity is ripe for these breakthroughs to happen.

IV. About the Author

Sonia Arrison is an author and analyst who has studied the impact of new technologies on society for the better part of a decade. A Senior Fellow at the California-based Pacific Research Institute (PRI) and a regular columnist for TechNewsWorld, she is author of numerous PRI studies on technology issues. A frequent media contributor and guest, her work has appeared in many publications including *CBS MarketWatch, CNN, Los Angeles Times, New York Times, Wall Street Journal*, and *USA Today*. She was also the host of a radio show called "digital dialogue" on the *Voice America network* and has been a repeat guest on *National Public Radio, Tech TV,* and *CNN's Headline News*.

Often asked for advice on technology issues, Sonia has given testimony and served as an expert witness for various government committees such as the Congressional Advisory Commission on Electronic Commerce and the California Commission on Internet Political Practices. She is an instructor for California's Command College and serves as an academic advisor for the new Singularity University (SU) at NASA Ames. She is also a member of the advisory board for the Acceleration Studies Foundation, the editorial board for the Institute for Humane Studies intellectual liberty guide, and the

Futurists board of the Lifeboat Foundation. In early 2009, she was elected to the board of directors of H+ (formerly the World Transhumanist Association) whose goal is promoting understanding, interest and participation in fields of emerging innovation that can radically benefit the human condition. She was also recently Chairwoman of Lead21, an organization dedicated to getting technology entrepreneurs more involved in politics.

Arrison is author of several major PRI studies including: "Canning Spam: An Economic Solution to Unwanted Email" and "Consumer Privacy: A Free Choice Approach." She is co-author of: "Wi-Fi Waste: The Disaster of Municipal Communications Networks" and "Upgrading America's Ballot Box: The Rise of E-voting."

Prior to joining PRI in 1999, Arrison focused on Canadian-U.S. political issues at the Donner Canadian Foundation. She also worked at the Fraser Institute in Vancouver, B.C., where she conducted research on broad social and economic issues. She received her BA from the University of Calgary and an MA from the University of British Columbia.

V. Competitive Titles

No other book does what *100 Plus* will accomplish. Other books have been written about the rise of anti-aging science and also about the angst that some feel towards the coming longevity revolution, but none of these works seriously exposes and discusses the political, social, and individual tensions between radical human longevity and current societal structures.

In *Chasing Life* (Warner Wellness, 2007), Sanjay Gupta focuses on how “practical immortality may now be within our grasp thanks to cutting edge scientific research and amazing medical breakthroughs that are coming at such astonishing speed that we can hardly keep up.” Dr. Gupta does a great job covering the science in an easy-to-understand way, but that is where he stops. He does not discuss how this science will collide with societal norms. *The Singularity Is Near: When Humans Transcend Biology* (Viking/Penguin, 2005) by Ray Kurzweil could similarly be considered competitive because it covers the technological advances that will lead the way to greater longevity, but it does not

discuss the social impacts and targets a more scientific audience. *100 Plus* will cover the scientific and technological advances in its second chapter, but it is different in that it looks at what happens next.

In *Ageless Nation: The Quest for Superlongevity and Physical Perfection* (New Horizon Press, 2007), Michael Zey discusses careers, business, marriage, and children in a world of super-longevity, but the book doesn't aim at a general audience and simply takes the science for granted. It is a "futuristic" book in the sense that Zey attempts to predict technological progress. *100 Plus* is different in that it looks at how the real science of today will extend healthspans and thus cause tensions in the most important areas of our lives.

In *How to Live forever or Die Trying*, (Simon & Schuster, 2007) Brian Appleyard addresses some philosophical aspects of extending lifespan and offers blog-like accounts of his encounters with people involved in attempts to extend life expectancy. *100 Plus* is different in that it covers a much broader range of issues including financial, religious, and social issues. *100 Plus* also deals with the subject matter more deeply and less off-the-cuff.

100 Plus stands alone in its broad coverage of the key social and political issues that increased healthspan will bring. It is written for a general audience, covers the science to explain why we will soon be living longer, and guides the reader through the important issues that arise from extended healthspans.

VI. Marketing and Promotion

I directed the technology studies department at the Pacific Research Institute for eight years, am well known in technology circles, and am an advisor to multiple groups that are closely involved with creating and analyzing new technology trends (Singularity University, H+, Accelerating Studies Foundation). This book will provide a platform for me to speak on a wide range of topics within the general framework of "the politics of longevity." New health discoveries, religious reactions to scientific advances, technological divides, and new family structures are all issues that continuously pop up in the news and will be covered in the book. I am an experienced speaker and am willing to talk in front of large audiences as well as attend more informal events like dinner party discussions. Longevity will

continue to be a hot topic for a number of years and even before writing the book I have been invited to speak on the subject by two state government departments and the Foresight Nanotech Institute.

Organizations that will be interested in having me speak include university clubs, political associations, think tanks, women's groups, futurist groups, and technology associations, to name a few. I have personal contacts in the AARP, Stanford University, UCSF, UCLA, think tanks such as AEI and the Cato Institute, TechNet, Lead21, both the Republican and Democratic parties, H+ (the World Transhumanist Association), the Singularity Institute, the Innerspace Foundation, the Foresight Nanotech Institute, the Milken Institute, the annual *TED* (Technology, Entertainment, Design) conference, and the venture capital world in general. I also teach a series of regular seminars for the California police academy on technology issues and it is my intention to use this book in the curriculum. I am currently working with Dr. Peter H. Diamandis of the X-Prize and inventor/author Ray Kurzweil to create the curriculum for the new Singularity University housed at NASA Ames, which "aims to assemble, educate and inspire a cadre of leaders who strive to understand and facilitate the development of exponentially advancing technologies and apply, focus and guide these tools to address humanity's grand challenges." Once my book is published, it will be considered for adoption in the course we are currently building on politics and ethics.

I will write opinion pieces for news outlets, as well as actively pitch radio and TV. I have extensive experience in doing this as part of my job at PRI, and am well known in media circles. Since I write a regular column for TechNewsWorld, I am also experienced in creating high quality copy quickly, which will help in getting pieces placed as I will be able to jump on the issues and react with speed. I regularly meet media people as part of my job and my volunteer activities. For instance, the Washington Post's technology writer recently attended a private event at my home that I hosted for Lead21, a group that I formerly chaired.

The blogging world is a place in which I am very active and I know many of the influential bloggers including Glenn Reynolds at Instapundit and the blogging teams at Huffington Post,

Betterhumans, the Longevity Meme, KurzweilAI.net, the Methuselah Foundation, TechLiberationFront, and VentureBeat.

Endorsements

I also have strong personal connections to influential people such as billionaire Peter Thiel (co-founder of Paypal and early Facebook investor) who has not only generated loads of media from donating millions to the longevity movement, but is also considering funding the first X-prize in longevity. Thiel has agreed to write the foreword for the book and can be counted on to help host various events to generate wide coverage. In terms of obtaining endorsements for the book, I can approach a wide range of impressive people depending on what the publisher thinks would be most helpful. Here are individuals who have already provided a blurb based on my sample chapter and detailed proposal:

> "With centenarians the fastest-growing demographic and ordinary lifespans growing, we're already facing the first stages of a longevity revolution. Both the problems and the prospects are likely to become more pronounced over the coming decade. Sonia Arrison, whose work I have known for years, is the perfect guide to this phenomenon, and to the social changes needed to cope with it."
>
> -- Glenn H. Reynolds, Beauchamp Brogan Distinguished Professor of Law, University of Tennessee, InstaPundit.com.

> "Over the last 15 years, lifespan extensions never thought possible have been produced in animals. While we still don't know when, if ever, eighty year old people will look forty, it is not too soon to start thinking about the consequences. In this engaging, thoughtful and informative book, respected thought leader Sonia Arrison explores the impact that slower aging may have on our families, our careers, our finances, our cultures, and our planet. This book will stimulate a new international discourse on the impact, good and bad, of slowing the rate at which we age."

-- Dr. Cynthia Kenyon, director of the Hillblom Center for the Biology of Aging at UCSF

"Bit by bit, modern science is unlocking the keys to aging and opening up the possibility of lives decades longer than we expect, with major implications for society as a whole. Analyst Sonia Arrison, a Senior Fellow at the Pacific Research Institute, makes a great guide on a tour through the science and more importantly the consequences for us all. *100 Plus* is essential reading for those interested in their future."

-- Ramez Naam, co-developer of Microsoft Internet Explorer and Microsoft Outlook and author of *More Than Human* (Broadway/Random House, 2005)

In addition to these three solid endorsements, there are many other individuals I will approach for blurbs including:

- Tyler Cowan, professor of economics at George Mason University and at the Center for the Study of Public Choice
- Aubrey deGrey, chairman and chief science officer of The Methuselah Foundation and editor-in-chief of the academic journal *Rejuvenation Research*.
- Clark Judge, Managing Director of the White House Writers Group and former Speechwriter and Special Assistant to both President Ronald Reagan and Vice President George Bush.
- Any of the fantastic and well-known folks involved with the Singularity University.

Serialization

Each chapter of the book lends itself to excerpting in magazines and journals. For instance, the part of the book that focuses on the longevity divide would make a good piece for *Wired Magazine*, *Atlantic Monthly*, or *MIT's magazine*. Parts of the book that cover the changing face of family and female sexuality would make for a good excerpt for *O Magazine* or *Redbook*. The financial implications chapter

could easily be worked into a piece for *Fortune* or *Forbes*. Nick Schulz, my former editor at TechCentralStation and current editor of AEI's magazine, *The American*, has already expressed interest in publishing excerpts whenever I am ready to start marketing the book.

I will also retain a publicist and augment the publisher's efforts to organize speaking events at places like the Commonwealth Club and Borders Books in places I already frequent such as San Francisco, New York, Los Angeles, London, Toronto and Istanbul. Originally from Canada, I still have a large business and political network in that country and I am also strongly connected with a group of international think tanks through an organization called the Atlas Foundation. I expect that the book will receive a lot of impassioned feedback, so the idea of doing a second, shorter book to respond may be a good idea (like Sam Harris did with *Letter to a Christian Nation*).

VII. Detailed Table of Contents

Chapter 1 – Humankind's Long Quest for Immortality

For as long as humans have been around, they have dreamt about living forever. Now, for the first time in history, science is bringing humanity incredibly close to realizing that dream through advances that could potentially add hundreds of years to the average lifespan. This pivotal moment in time is not the result of random chance. Instead, it follows directly from a vast culture of human desire

and action directed towards the proverbial fountain of youth. This introductory chapter will serve as an overview of humankind's quest for immortality, setting the stage for a larger discussion about how long science will extend our lives and how that in turn will change our social, financial, and political worlds.

Humanity's obsession with everlasting life has left a trail of fascinating stories and ideas. One of the most famous is that of Spanish explorer Ponce de Leon who accidentally discovered Florida in 1513 while searching for a mythical fountain that would restore youth to those who touched it. Alexander the Great searched long and hard for a similar fountain; George Bernard Shaw imagined that longer lives could be achieved through focused thought; Nobel Prize winning Russian scientist Elie Metchnikoff thought Bulgarian Yoghurt would do the trick; and American Physician Robert Ettinger invented cryonics so people could be preserved for when immortality methods finally arrive. Even the Bible contains stories about rivers of immortality and long-lived people like Methuselah who supposedly lived to be 969 years.

Of course, no one has yet achieved physical immortality, but the hunt for it continues to this day. Thanks to greater computing power and scientific techniques such as genetic engineering, stem cell research, and nanotechnology, the dream could soon become a reality. That is what the next chapter will examine.

Chapter 2 – How Science & Technology will Radically Increase Lifespan

Since 1900, average human life expectancy has nearly doubled. Indeed, the data show that each year, life span increases at an average rate of 3 months per year (2.5 years per decade) for women and 2.5 months per year (2 years per decade) for men. In the United States, life expectancy at the turn of the twentieth century was about 45 years; now it is closer to 78 years (with variations for men and women). What appears to be a massive 33 year gain was mostly the result of a dramatic lowering of infant mortality combined with better methods to fight infectious diseases and a better knowledge of nutrition. During this time, gains in longevity also occurred through battling diseases affecting older people, but

those gains were quite small in comparison. This led to theories that human lifespan has a hard ceiling, but now the evidence is proving otherwise.

Many don't yet realize it, but a longevity revolution has begun as scientists are finally acquiring the tools to effectively fight chronic disease and perhaps aging itself. The discovery of DNA in 1953 kick-started the current revolution, with the most recent advance being the sequencing of the human genome.

The genome is like a source code for humans, now that scientists have it, it is possible to re-engineer subjects through gene and other therapies to extend life or repair damage. Growing a new liver from a patient's own cells, taking a pill to eradicate obesity, and using pharmaceuticals and gene therapy to radically increase each individual's health span (as opposed to life-span, which could mean a long life in a frail state) are interventions just around the corner.

Greatly improved cancer treatments are on the horizon as well. Already, University of Michigan scientists have figured out how to use nanotechnology to deliver chemotherapy drugs directly into cancer cells, sparing the healthy cells that regular chemotherapy ravages. There are also new bio-engineering projects in the works, such as Aubrey de Grey's "Strategies for Engineered Negligible Senescence" (SENS) in which he describes how the aging process might be reversed through seven possible interventions.

How much longer will this research extend people's lives? Advances in bioscience have accelerated, and according to even the most conservative scientists, the sector will extend normal human lifespans by at least 20 years, and potentially hundreds of years. This chapter will examine new technologies that are likely to extend our lives through interviews with renowned scientists such as UCSF's Dr. Cynthia Kenyon and Advanced Cell Technology's Dr. Michael West, as well as controversial biogerontologist Aubrey de Grey. This discussion will help shed light on the time frames in which we might expect to see revolutionary treatments that radically extend human healthspan, thus creating significant tensions within key areas of our life. These tensions are the focus of the rest of the book.

Chapter 3 – Population Concerns and the Environment

As chapter one explains, living longer is a deeply ingrained human aspiration. Yet, not all human desires have positive outcomes. Perhaps the biggest tension related to radical longevity is the health of the earth.

Many authors have addressed the problems associated with population and the environment. For instance, in the 1960s, author Paul Ehrlich stirred up fear of an impending global crisis in his book the *Population Bomb,* and in 2000 Sun Microsystems' co-founder Bill Joy warned of the possible annihilation of life on earth through nanotechnology misuse or mistakes. While each man's prognosis is extreme, at the root of their arguments is a reasonable worry. It is true, for example, that if fewer people die and birth rates stay constant, population will grow, theoretically causing overcrowding and resource management problems. It is also true that in our quest to extend longevity, technology could get out of our control.

However, global population growth rates have been declining from a peak of 2.07 percent in 1965-1970 to 1.2 percent in 2006 and the trend is likely to continue. It turns out that one of the most surprising demographic trends over the past 20 years is how quickly fertility declined in many of the less developed nations. As a result, more than 20 countries are projected to see a *decrease* in their total population over the next few decades, and by 2010 there will be few if any countries where fertility has not declined. So, while longevity science will shrink death rates, birth rates are expected to fall in tandem, a trend that will be amplified as many nations continue to develop and become wealthier. That still leaves the question of the environment, which is already a big concern today.

How will specific longevity technologies affect the environment? New particles developed for consumer products, nano-medicine, and the creation of artificial life forms do have the potential to generate unexpected circumstances. However, the evidence thus far gives one confidence that it is possible to avoid huge undesirable consequences. For instance, Dr. Craig Venter, CEO of the first private company to sequence the human genome, is working on creating an artificial life form that will help clean the environment. In the field of nanotechnology, many products are modeled on naturally occurring

processes in the first place. Groups like the Foresight Nanotech Institute are leading self-regulatory initiatives to keep the science safe. Since people will be living longer, there is also a strong argument to be made that the world will become more politically green. Pollution will no longer be seen as a problem one is leaving to their children or grandchildren, but rather an issue that will have a more personal impact. Self-interest will drive an increase in investment in green technologies across the board, similar to what is now occurring in the energy sector.

For this chapter, I will present easily accessible population facts and theory to show the likelihood of continued decline in fertility rates. I will also interview top writers on the environment such as Bjorn Lomborg, Nanotech experts such as Christine Peterson, CEO of the Foresight Nanotech Institute, as well as scientists working on green tech such as Dr. Norman Arrison, and Dr. Hamilton Smith, group leader of synthetic biology at the Venter Institute. After addressing the key environmental and population issues, I will next turn to the related topic of procreation and family.

Chapter 4 – The Changing Face of Family

In a world where humans are living significantly longer, old social norms and arrangements will clash with new realities. Family choices, such as marriage and childbirth will be influenced by the fact that staying together until “death do us part” will prove difficult over hundreds of years, and also because childbearing, which is often the reason for marriage in the first place, will have fewer time-restraints. Yet, the fact remains that humans are evolutionarily wired to pair-up.

Well-known anthropologist and author Dr. Helen Fisher has shown that humans are physiologically wired to ensure that a relationship lasts long enough for pairs to rear one child through infancy, about four years. After that, the biological imperative sends each parent to find a new partner and start all over again. Dr. Fisher argues that additional offspring help to keep pairs together longer, again in four-year lots. Since a large percentage of families in the West typically have two children, this explains the "seven-year itch" phenomenon. Of course, people can and do stay together longer, but many argue

that such an arrangement is difficult or subject to adultery. Longer lives will significantly add to this tension.

Serial marriages will become the norm, in some cases resulting in large extended families with complicated relationship structures. For instance, one could easily imagine a case where a person has grandchildren older than their new spouse. Yet this is only the beginning of changes to the family in Western nations. Longer lives will usher in the call for brand new social structures ranging from the mild idea of "co-habitation contracts," which replace formal marriage and expire at a set time, to the advocacy of polyamorous marriages, otherwise known as group marriage. Chicago Law School professor Elizabeth Emens has written a number of papers arguing for the legal right to polyamorous marriage while others such as author F.M. Esfandiary have argued for creating new arrangements to promote "responsible singleness." Today these ideas seem strange, but radical life extension may motivate people to consider them, especially when one considers that sex drive at older ages will be just as healthy as the rest of one's body.

New found vigor at older ages has already led some authors, such as sociologist William Sadler, to announce a new phase of life called the "third age." Just as adolescence is a relatively new stage of life resulting from the delay in responsibility for younger people, the third age is a new stage of life due to increases in health span. Continued increases in health span will create at least one more life stage after adolescence where individuals take much longer time periods to pursue their career and other interests before having children.

Technologies like birth-control pills have already given women the freedom to pursue careers and bear children later in life. Now, greater longevity combined with technologies like ocyte cryopreservation, that allow a woman to have her eggs frozen for use at a later time, may result in women delaying childbirth even further or possibly putting it off indefinitely.

Through interviewing and reviewing the work of anthropologists, legal experts, and sociologists such as Dr. Helen Fisher, Elizabeth Emens, and Dr. William Sadler, this chapter will explain how greater longevity combined with increasingly better reproductive technologies will clash with traditional ideas of

marriage, childbirth, and family structures. Given that this is only the beginning of the potential problems that humans will face with greatly extended healthspans, the following chapter will address the next obvious question of whether it is even worth living longer at all.

Chapter 5 – The Longevity Divide: Does Living Longer Mean Living Better?

It might seem strange to consult actress Suzanne Somers and country singer Naomi Judd for ideas on longevity issues, but each of these celebrities has written a book on the topic and each symbolizes opposite sides of an important debate. In *Ageless: the Naked Truth about Bioidentical Hormones*, Somers tells her readers that "I believe it is possible to experience aging without illness," making her a prominent supporter of increased longevity. On the other side is Judd, with her book *Naomi's Guide to Aging Gratefully*. She tells her readers to accept aging because it's "one of those things you just can't control." It is best for everyone, she says, when we "choose to be at peace with ourselves exactly as we are."

The divide between these stars is not an insignificant celebrity spat. Instead, it is the Hollywood-ization of one of the most important questions of our time. Is it a good thing to attempt to slow down or reverse the aging process? This chapter will examine some common objections to extending human life spans such as the worry about boredom, longer working years, the unnatural feeling of super-longevity, and divides between rich and poor.

Respected public figures, such as Professor Leon Kass, former Chairman of the President's Council on Bioethics, argue that using technology to extend life is unnatural. It is true that society will have to be very careful about how it uses technology, but this book will argue that it would be disastrously Luddite and anti-human not to try to make ourselves healthier.

While new technologies are almost always adopted by the rich first, over time they eventually reach everyone, and the historical record seems to show that distribution of new technology is speeding up, not slowing down. In their book *Myths of Rich and Poor*, Michael Cox and Richard Alm note that it took 46 years for a quarter of the population to get electricity and 35 years for the telephone to get that far. Move forward to more recent history, and we can see that it only took 16 years for a quarter of

American households to get a personal computer and seven years for Internet access, a promising trend for those who wish to see the widespread use of longevity technologies.

Large increases in longevity will raise important personal, political and ethical questions and this chapter will draw upon longevity experts like Ray Kurzweil, as well as political, philosophical, and historical literature to answer these concerns. Of course, even if it is desirable to live longer, the next question is how individuals and society as a whole can afford it, the subject of the next chapter.

Chapter 6 – The Financial Implications of Longevity

The generation that "wouldn't trust anyone over 30" never planned on a 30-year retirement.

Those are words from an advertisement by Allstate, an insurance company offering retirement savings accounts. It's a cute twist on the serious financial tensions facing America's baby boomers, as well as the generation before them, and potentially generations to come. Many older people are currently having trouble when they find themselves in situations where they may be healthy, but unemployable because of their age. With a status quo like that, it is legitimate to ask whether one could even afford to live longer if it were possible.

To make matters worse, savings rates are currently at their lowest level since the Great Depression and some insurance companies that sold long-term-care policies didn't anticipate even the current growth in longevity and are now in trouble. Longer and healthier lives combined with an impending collapse of the social security system and a deficiency in private savings and insurance add up to a serious collision between finances and longevity. However, this tension is not a good reason to advocate death. In fact, radically longer lives may actually generate more wealth for both individuals and society.

While it is widely known that increased health is the result of greater wealth, few are aware that health also *creates* wealth. Economists at Yale and other universities have recently identified a "longevity dividend" which is the result of productivity gains generated through better worker quality,

higher education, and investment opportunities because of longer term health. It might seem counter-intuitive to some, but longer lives will make society wealthier.

As science discovers how to decelerate aging and cut disease rates through gene, nano, and pharmacological methods, it will be possible to raise the age for social security benefits, reduce health care costs, and shift the focus for older populations away from nursing homes and towards greater education and employment opportunities. Just as antibiotics and vaccinations drastically reduced the social and financial costs of many highly contagious diseases, anti-aging solutions will do the same for chronic diseases, thereby driving productivity gains to make society and individuals wealthier. This is particularly true when one also considers that healthy populations tend to be more cognitively aware, and a new industry devoted entirely to "brain fitness" has sprouted up with amazing results.

Of course, a longer-lived workforce will require industry to answer pressing questions such as whether younger people will find it more difficult to land jobs in a world where older people don't retire as early. There is also the question of how much anti-aging technologies will cost and what kind of discrimination could result for those with no access. Longer periods to invest personal wealth will likely exacerbate the divide between rich and poor because of compound interest.

For this chapter, I will interview experts on economics and health including William Nordhaus at Yale University and Kevin Murphy at the University of Chicago. I will also consult with finance and longevity experts such as Adriane Berg as well as economists such as Tyler Cowan at George Mason University and Larry Summers at Harvard. Now that most of the everyday tensions have been addressed, there remains the important question of the soul.

Chapter 7 – Afterlife vs. a Longer Life: Religion in the Age of Longevity

Francis Collins, one of the geneticists who sequenced the Human Genome, created a storm with his book "The Language of God." In it, he argued that religion and science can and do coexist peacefully, and that each actually complements the other. His claim may sound plausible now, but when people

begin to delay death by hundreds of years, the tension between science and religious belief could be enormous.

The idea of an afterlife is important for many of the world's religions. Christians and Jews believe in Heaven and Hell. Muslims similarly believe in Jannah and Jahannam. For many, the tradeoff between eternal happiness and damnation influences how they conduct their activities here in the present day. But will that still be the case when the journey to the afterlife faces substantial delays and science presents humanity with the possibility of actually concurring death?

Fear of death is an extremely powerful force, so much so that psychologists have even found that weak suggestions of death, such as standing near a cemetery, can measurably change our thinking. When it comes to religion, this fear has been a massive source of power. Will religious institutions see the scientific delay of death as a threat to their power? If so, how will they react?

The Catholic Church has no official position on life extension, but given that the Pope announced seven new deadly sins in March 2008, one of which is "allowing genetic manipulations which alter DNA," opposition to longevity science seems certain. Other religions like Hinduism and Buddhism, on the other hand, seem well positioned to embrace radically longer lifespans. For instance, religious Studies professor Derek Maher at East Carolina University has argued that in a world of super-longevity, Buddhism, which is already open to the concept of longer lives, could change its orientation from one where death is the everyday reason for spiritual practice to one where other reasons come into play.

Of course, each religion has its own traditions and history, and Professor Calvin Mercer, Director of Religious Studies Program at East Carolina is currently assembling an academic book with a variety of scholars on each major religion explaining whether radical life extension can fit within each paradigm. He has agreed to allow this author to interview all the scholars involved in his project in order to help translate their academic prose to a general audience and further clarify what role religion will have in a longer-lived world. I will also talk with various religious leaders, including Reverend William Swing who is currently heading up an interfaith partnership program called the United Religions Initiative.

Given that increased heathspans are going to dramatically change the dynamics of society and put great stress on the current structures we have in place, good leadership, the subject of the next chapter, will be of utmost importance.

Chapter 8 – Leadership for a Longer-Lived World

The longevity revolution will require informed leadership, especially since it will usher in such important and varied changes to humanity's social and economic worlds. Thus far, there have been few political forays into the area of life extension, although there are some non-profit organizations, such as the Institute for the Future and the Singularity Institute, that urge greater political awareness. This chapter will reflect on the coming changes mentioned in previous chapters and offer a framework for solving the most important issues for political leaders in a longer-lived world.

For instance, if there is a big divide in access to longevity technologies between the rich and the poor, should government institute programs to provide longevity technologies? In the shorter term, should public leaders make anti-aging research a bigger national priority? Former National Institute on Aging director Dr. Robert Butler thinks so, but he makes his argument in the shadow of failed programs like Richard Nixon's "war on cancer" in 1971 and increasing impatience with the FDA's process for regulating medicine. Also, given that politicians generally serve for short terms, their incentives to think about the long-term issues are small, perhaps making external influences, such as the Clinton Global Initiative or The Bill and Melinda Gates Foundation, much more important in leading the way.

The alternative to a top-down strategy for change is a hands off approach that incentivizes innovation in science and technology. This bucket of political goods includes property rights, free speech, lighter regulation and smaller tax loads. The reason these are important in the context of longevity is that freedom brings prosperity, and the countries with the longest lives are the richest ones. Many authors have recognized the link between wealth and longevity including Indur M. Goklany in his book *The Improving State of the World: Why We're Living Longer, Healthier, More Comfortable Lives on a Cleaner Planet.*

This chapter builds on my background in political analysis, which spans more than a decade. In detailing the ways in which we can help transition and manage society in an age of greater longevity, I plan to interview a wide range of influential thinkers such as Ed Crane, president of the Cato Institute, as well as politicians such as Donna Shalala, former Secretary of Health and Human Services under President Clinton. I will also interview representatives from the Clinton Global Initiative, such as Ellen Levy, as well as Geoffrey Lamb at the Bill and Melinda Gates Foundation.

VIII. Sample Chapter

Chapter 6 – The Financial Implications of Longevity

Virginia Raskin is a star real estate agent in Sacramento, California, selling million dollar homes, taking calls from clients at all hours, and processing piles of paperwork. You might expect a person with such high energy to be middle aged or younger, but the surprising fact about Ms. Raskin is that she's 92 and this is her second career, following a career in nursing.[i] Such stories make the news because most of us hope, either secretly or otherwise, that we will also be full of energy in our older years. Fortunately, because of advances in science, we are marching towards a world where there will be more people like Virginia Raskin and fewer people retiring to nursing homes in their 90's.

Money makes the world go around, and living longer means spending money longer. This begs the question then: if the average person could expect to live 150 or even 200 years, how would that change our economic lives? Or, put a slightly different way, how will doubling our *economically active* lifespan alter our financial world?

There are many elements that define one's economic life including education, experience, savings, ambition, retirement plans, and balancing work with other goals. A country's human capital and wealth are generated from the combination of its citizen's choices surrounding these elements. This chapter examines the changes that longer lives will create in each of these important areas.

The prospect of living longer makes some people recoil in horror as they look at today's situation where many of the world's elderly had not expected to live so long and haven't planned for it, leading to financial ruin and poverty. Daily, it seems, there is a news story about an elderly person being denied health or insurance benefits or of adults in their 50s and 60s desperately trying to care for their much older parents. To make matters worse, even if older people are not living in poverty and with poor health, most of them are drawing from the nation's social security system which, if left unaltered, will take in less money than it pays out by 2018. This is the crisis that has already been identified by numerous scholars.

Due to demographics and a lack of financial foresight, most countries will be facing severe financial challenges due to increased longevity. Many legislators, academics, and social activists are currently working to fix this problem. Yet, what most are not thinking about is what happens when our world of accelerating science and technology presents us with the ability to increase our *healthspan*, the number of years we are alive *and* healthy.

The difference between the current aging crisis and the biologically enhanced future is that when people are living on average to 150 years, they will be much healthier and in much better physical condition. This time around, when we double our lifespan, we will really be doubling our *healthspan*. In the future we are considering, a 90 year old will feel like a 45 year old. While only lucky people like Virginia Raskin get to experience something approximating that today, in the world of tomorrow it will be commonplace. This good news does not mean that we can afford to be complacent, however.

A doubling of healthspan will bring major changes, creating new tensions that society needs to address – and the sooner the better. If today's aging crisis has taught us anything, it is that we need to start planning for longer lives earlier, especially when the science is moving so fast. If we don't, we will be scrambling to re-organize society in order to fit our new realities, and reorganizing societal structures is not something that can be done instantly. Even if everyone agreed on exactly which way to proceed after we found ourselves living longer, there would still be a problem because decisions that are made today often don't wind up having consequences until much later.

How the value of time changes with longer lives

Regular surveys over the last 34 years show that American adults feel rushed either all the time or some of the time. Perhaps surprisingly, even with the graying of the nation and retirements increasing, this pattern hasn't changed. For example, in 1971, 73% of all Americans reported feeling either "always" or "sometimes rushed." In 2005, the numbers were similar with 76% saying they were "always" or "sometimes" rushed. This feeling of time pressure results in articles with titles like "Too Busy to Notice You're Too Busy," that might make us smile. On a more serious level, however, our feeling of busyness

is inherently linked with both economic growth and how much time we have. These two factors also happen to be significantly affected by lifespan.

In 1965, Nobel Prize winning economist Gary Becker wrote a paper titled "A Theory of the Allocation of Time." In it, he argued that the cost of time should be considered when analyzing the cost of anything, but also that the cost of time *changes* based on the nature of a commodity and the time period. For instance, the cost of time is less for activities like sleeping and eating as compared with going to the theater because sleeping and eating contribute to one's productive effort. That is, you can't really do anything else if you're weak from sleep or food deprivation. In addition, he argued that "the cost of time is often less on weekends and in the evenings because many firms are closed then."[ii] The idea that the cost of time can change depending on the circumstances has great implications for a world in which people gain more time, a world where humans expand their lifespans by a factor of two.

Of course, Becker wasn't the only one to realize that the price of time changes. In an insightful little book titled "The Harried Leisure Class," Swedish economist Staffan Linder explains why, even with the great economic growth western nations have experienced, individuals don't seem to have more leisure time. In fact, as the polling data above attest, most of us seem rather harried. It turns out that economic growth also changes how we spend our time. As wages go up (and time stays fixed), it becomes more expensive to do things away from work. Consuming things like movies or books takes time that we might have otherwise spent working, so increasing wages makes our non-work time more expensive.[iii]

The worlds that both Becker and Linder were examining had fixed amounts of time. There are only 24 hours in a day and life expectancy in 1965 was about 70 years. Of course, out of the 24 hours, if we assume 8 are spent sleeping, that only leaves 16 for work and non-work consumption. So, if we multiply 16 by 365 days in a year by 70 years, that means the average person in 1965 had 408,800 hours during their lives in which to do things. But what if one of the variables in the equation changes? What if the average life expectancy increases? If average life expectancy increased to 150, the number of hours that a person would have to spend would equal 876,000 hours. That is a big increase in the supply of time and therefore should have an impact on the value of time and, thus, on how harried people feel. Of

course, since we have seen that an increase in economic growth can change how time is valued, we will also need to examine the extent to which economic growth might change as a result of greater longevity.

Human Capital

The opening ceremony of the 2008 Beijing Olympics was a glitzy demonstration of human capital. Designers, composers, technicians, dancers, cultural consultants, and even weather modification experts, came together to make the 4 hour event a spectacular success. Human capital is a key ingredient in the recipe for economic success. It is enhanced through education and experience, resulting in knowledge, skills, and values that lead to economic gain. Indeed, some economists have gone so far as to argue that human capital is the "ultimate resource."

The economist Julian Simon was famous for arguing that "the ultimate resource is people – especially skilled, spirited, and hopeful young people endowed with liberty – who will exert their wills and imaginations for their own benefit, and so inevitably they will benefit the rest of us as well."[iv] You will notice that he specifically mentioned young people. One of the reasons for this is that young people are generally *healthy*, and have the energy to pick up big projects and run with them. They are also often doing things for the first time, which potentially gives them a different perspective from those who have been in a certain field for a while.

So how will longer healthspans change our stock of human capital? First, and perhaps most importantly, healthy humans directly implies better, more productive human capital. This is perhaps an obvious conclusion, but it wasn't until relatively recently that researchers began investigating whether health actually creates wealth.

It has always been known that there is a positive correlation between health and wealth, but it was most commonly thought that it is wealth that creates health. While it is certainly true that wealthier people can afford to take better care of themselves, it is now known that health also begets wealth. Put another way, it is also true that poor health causes a decline in economic production and, therefore, poverty.

In their paper titled the "Health and Wealth of Nations," Harvard economist David Bloom and Queen's University economist David Canning explain that, based on the available research, if there are "two countries that are identical in all respects, except that one has a 5 year advantage in life expectancy," then the "real income per capita in the healthier country will grow 0.3-0.5% per year faster than in its less healthy counterpart."[v] While these percentages might look small to the non-expert, they are actually quite significant, especially when one considers that "from 1965 to 1990, countries experienced an average per capita income growth of only 2% per year. When countries only have an average growth of 2%, an advantage of 0.5% is quite the boost.

Now, those numbers are based only on a 5 year longevity advantage. What if a country had a 75 year advantage? If we assume that every 5 year healthspan extension creates a 0.5% increase in growth, we would be looking at a 7.5% growth advantage for a country like the United States if it were to double the healthspan of its residents.[vi] That is a huge amount of wealth creation which ultimately leads to social benefits, and one of the reasons why there is a movement among some academics and activists to urge Congress to spend more on anti-aging research in order to create what they call a "longevity dividend." [vii]

Not only have economists estimated the benefits to humanity if healthspan were to be extended, but they have also shown very clearly that we have already made significant economic gains. It turns out that improvements in health were a major contributor to economic welfare over the 20th century.

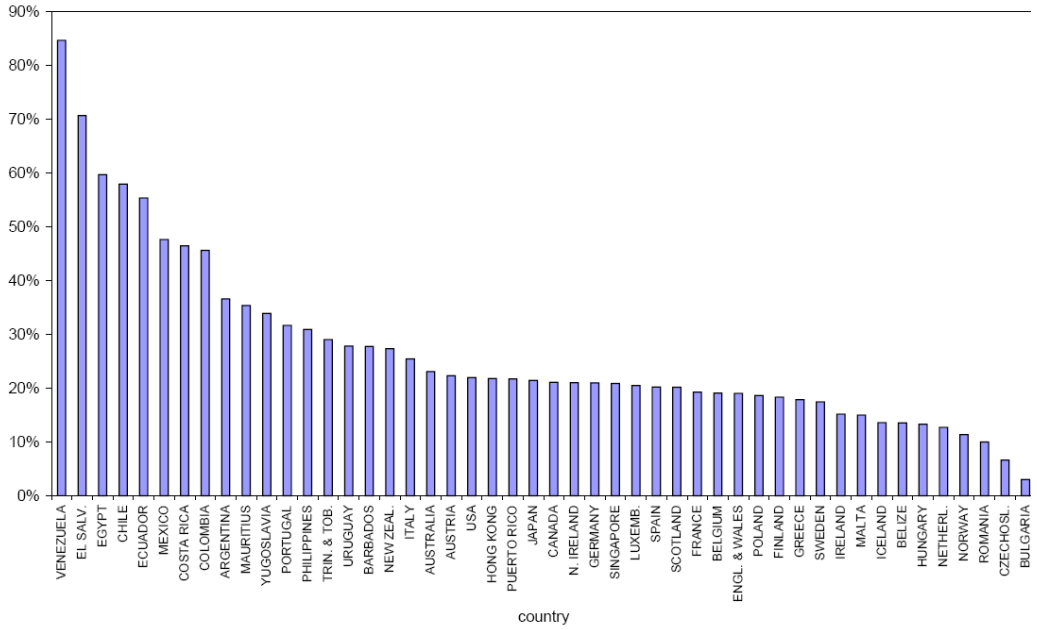
In 2006, the economists Kevin Murphy (U Chicago) and Robert Topel (National Bureau of Economic Research) painstaking calculated that, for Americans, "gains in life expectancy over the century were worth over $1.2 million per person to the current population."[viii] They also found that "from 1970 to 2000, gains in life expectancy added about $3.2 trillion *per year* to national wealth." These enormous numbers represent a spectacular accomplishment in terms of benefits. Indeed, it could be said that longevity gains are really the best thing humans have ever accomplished.

To reiterate, because of longevity gains, Americans gained a value of $1.2 million **per person** over the 20th century and $3.2 trillion **per year** in national wealth over a 30 year time span. This

explosion of wealth creation contributes a significant amount to the happiness and wellbeing of Americans, although they are not the only ones gaining from longer lives.

Around the world, researchers have shown that longevity gains have caused an increase in economic welfare across the board, and the countries with the biggest gains have been the less developed nations.[ix] Longevity gains have worked towards bridging inequality between developed and less developed countries. For example, a study published by the National Bureau of Economic Research showed that for the time period between 1965 and 1995, the welfare gain from longevity was 27 percent of GDP for Mexicans born in 1995 and only 5 percent for Americans born the same year. Of course, developing countries are starting from a lower GDP to begin with, so the raw numbers are larger for America, but the point is that longevity is helping people in countries everywhere and the percentage gains are bigger in the countries that are starting from a lower point. As you can see from the chart below, Venezuela, El Salvador, and Egypt have been the biggest beneficiaries on a percentage basis.

Figure 8: Share of Welfare Improvements due to Longevity Gains

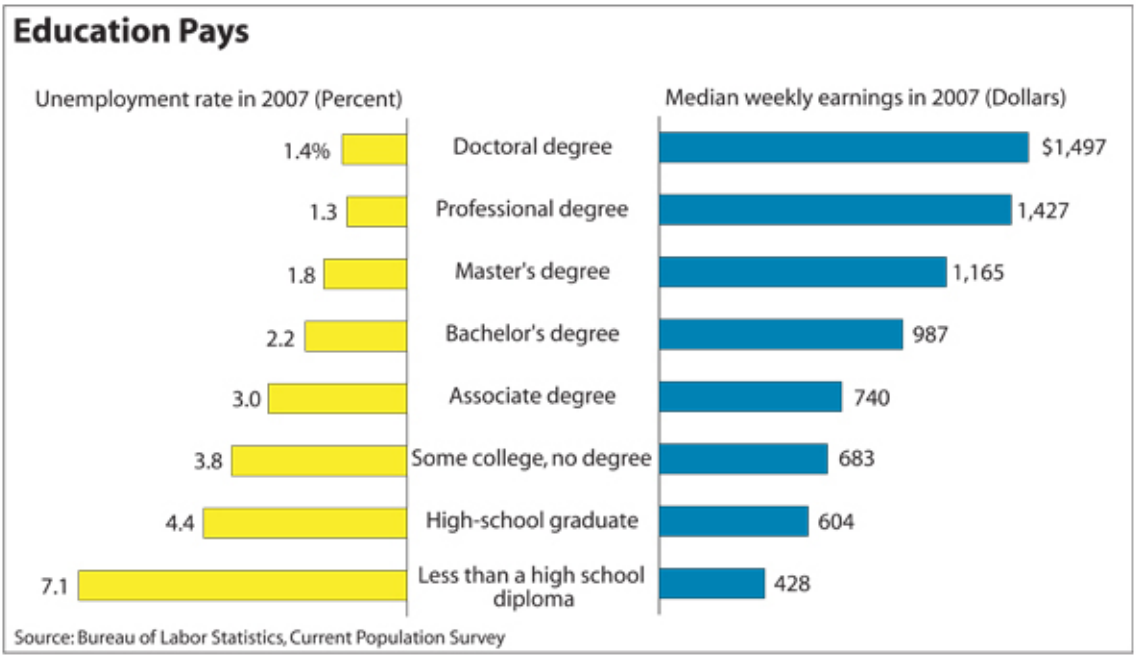


Source: Gary Becker, Tomas J. Philipson, and Rodrigo R. Soares, "The Quantity and Quality of Life and the Evolution of World Inequality," National Bureau of Economic Research, paper No. 9765, June 2003.

It is also worth noting here that developed countries tend to pay more for creating the technologies that lead to longevity than the developing countries do, so the benefit to the developing countries is even higher. In 1995, for instance, the United States and Sweden spent about $4000 per capita on health expenditures whereas countries like Mexico and Poland spent around $100 to $200 per capita.[x]

The Role of Education

Clearly, longer-lived individuals add to the economic welfare of any country by virtue of being around longer to work, but living longer also allows for more time to get educated. This is important because education increases the *quality* of human capital, which matters quite a bit when it comes to the financial well being of both individuals and nations. Here are data from the US department of labor showing how education pays off on a personal level, benefitting the individual in terms of higher wages and lower unemployment.



These results on the individual level also track on the national and international levels. If one person can make a lot more money from getting a higher education, then just imagine what can happen when a large group of people expand their opportunities. In a paper funded by the National Science Foundation, the economists Rodolfo Manuelli and Ananth Seshadri from the University of Wisconsin-Madison demonstrated that a good deal of the differences in the economic output of countries are due to differences in human capital, a big portion of which is formed through education.

"To be precise," they write, "the typical individual in a poor country not only chooses to acquire fewer years of schooling, he also acquires less human capital per year of schooling."[xi] The finding that education, and the quality of that education, matters in terms of economic output is not surprising and is one of the reasons why a high-performing school system is key to economic growth.

Assuming that longer lives drive people to get more education, the quality of human capital will grow in tandem with increases in healthspan. Such an assumption makes sense, because throughout history longer lives are correlated with greater education. For instance, in 1900, only 10 percent of teenagers were enrolled in high school, in 1940, 70 percent of teenagers were enrolled in high school, and in 2000, 95 percent of teenagers were enrolled in high school.[xii] Indeed, in our future technological-centric countries, work-force participation will *require* a higher level of education and experience, spurring greater demand for training.

Howard Gardner, in *Five Minds for the Future* describes work-force demands in the future technological economy.[xiii] He describes a world in which the market demands newly skilled employees, particularly when it comes to synthesis and innovation, mastery of computers, and expertise in a discipline. In addition, Gardner argues that certain inter-personal skills such as respectfulness and ethics will become increasingly valued in a global economy with many diverse cultures. Following from this, it is clear that in a world of longer healthspans, intergenerational management skills will also be highly valued. Already, older boomer generation managers complain about not understanding new employees from Generation Y (born after 1980). According to Jordan Kaplan, an associate managerial science professor at Long Island University-Brooklyn in New York, Generation Y has "grown up questioning

their parents, and now they're questioning their employers. They don't know how to shut up, which is great, but that's aggravating to the 50-year-old manager who says, 'Do it and do it now.' "[xiv] Indeed, this iPod toting, instant messaging, Jonas Brother listening generation is not always impressed with boomers, particularly when it comes to technology.

Data from Ernst & Young show that while 45% of boomers say they're comfortable using technology, only 9% of individuals in Generation Y think that boomers are good at using technology. This can translate into communication problems when over eighty percent of Gen Y'ers use technology to avoid difficult conversations and boomers prefer discussing difficult things in person or over the phone.[xv] Such cultural divides among the generations will only widen as the age gap grows. Like the transition to stable agrarian societies, the transition to a longer-lived technological society requires a higher degree of cooperation with people near and far, old and young, who differ widely in their group cultures and language.

How is investment in education changed by these forces? Data from Australian universities show that enrolment statistics are becoming increasingly age-integrated, and are now widely defined as life-long.[xvi] While empirically these findings suggest that learning is trending towards more investment throughout one's life, the findings do not support the idea that there will a decreasing amount of intensive training periods at the beginning of life. In fact, since people will have longer healthspans, there will likely be an increase in the amount of time one spends in training at the beginning of their lives as well as throughout their lives. This begs the question of whether the nature of education will change as our lives lengthen and we become more technologically sophisticated.

Assuming that education mirrors the needs of the market, education will expand to offer higher levels of instruction to meet the demands of highly disciplined specialists. In a recent book, titled *Disrupting Class*, Clayton Christensen and his co-authors make a persuasive case that the future of education will become more tailored to individuals learning styles and levels. Whereas one student might learn from rote memorization, another might be better off learning by manipulating visual cues. Christensen sees better computers and software as the platform for providing this individualized training.

Computer-based learning, he says, "will keep improving, as all successful disruptions do. It will become more enjoyable and take full advantage of the online medium by layering in enhanced video, audio, and interactive elements."[xvii] As virtual reality experiences become possible, this will take these new educational levels to a whole new level. One can imagine a day where an executive comes home from work, has dinner, and then spends an hour in his virtual learning environment instead of watching TV. This will happen partly because the learning experience will be more enjoyable and partly because continuous learning will be required to stay competitive.

Already, such programs would be extremely useful as workers from sectors such as the automobile and manufacturing industries face layoffs and will need re-training. Workers such as Darin Gilley, who was laid off from a plant that made seats for Chrysler vehicles, are clearly upset about changing times and it will be imperative that society finds ways to help re-integrate workers in transition. Gilley told the New York Times that things got so bad that one of his friends and his wife lost their house. "It was foreclosed on. They had to send back their truck. And they've got two kids, younger than mine. The kids don't stop growing just because you've lost your job."[xviii] Christensen's view of where technology is heading should be able to help with such problems that will only multiply in a world of longer-lived individuals.

Extreme Experience

In September 2008, BusinessWeek magazine published a story featuring twenty-five influential business leaders who also happen to be over the age of seventy-five. The list includes Osamu Suzuki, who at 78 years, "still calls the shots" at Suzuki Motor, Harold Burson, who at 87 still offers cutting edge advice to clients at public-relations firm Buson-Marsteller, and Sumner Redstone, who at 85 is Chairman of CBS and Viacom and recently sued Google and publicly criticized Tom Cruise.[xix] As the magazine notes, the people they profile are not average CEOs and Chairmen, yet the unspoken premise is that one day they could be. Lifespan has grown linearly at an average rate of 3 months per year (2.5 years per decade) for women and 2.5 months per year (2 years per decade) for men and, as mentioned previously, it

is about to grow exponentially. When that happens, and healthspan is extended, it will be possible to have 130 year olds and over at the helm of companies. What will this mean for the job market? How can younger individuals hope to move up the ladder when, instead of being around for a potential sixty years or so, business leaders might be around for one hundred or more years?

There are different ways to approach this question, the first of which is to acknowledge that just because these leaders have experience doesn't necessarily mean that they will always win in the marketplace. Make no mistake: experience is an important part of human capital, but it is not the sum. Other attributes like creativity, motivation, flexibility, intelligence, and talent come into play as well. Indeed, the BusinessWeek story pointed out that a "calculation shows that most of the seniors on our list who run public companies failed to beat their respective indexes over the past five years."[xx] Experience is clearly an asset, but it didn't mean that these select and very experienced executives were able to beat the stock market.

Another way to look at the question of whether experience will necessarily create barriers to younger people seeking higher positions is to consider what kind of businesses are likely to employ people. In the United States, about half of all workers are employed by small business. Small businesses are obviously easier to start than big businesses, and small businesses can turn into big businesses. Particularly in a world where technology will continue to help level playing fields, businesses that shun smart, young people will face competitive disadvantages. And there are many examples of very young people starting small companies that grew into larger, very successful companies. For example, Steve Jobs and Steve Wozniak started Apple in their early 20s – the same age as Bill Gates and Paul Allen when they started Microsoft, and Sergey Brin and Larry Page launched Google in their mid-20s.

That said, one of the advantages that goes along with experience, aside from historical knowledge and large rolodexes, is that people also tend to become more patient as they age. In 2006, researchers from Harvard showed that patience increases across the lifespan.[xxi] They showed that, with age, people tend to stop discounting the future and learn to become more future-oriented (until, of course, those people hit the point where they think they have no future left). If, as we expect, people will die at older

ages, there will be an increased number of workers who are educated, experienced and patient individuals. This patience may allow steadfastness in the accomplishment of goals, more harmony in personal relationships, and clearer foresight when approaching problems. Such mature behavior will allow for an increased ability to put off present pleasure for future gains and hopefully cultivate leaders who deal reasonably and fairly with generations other than their own. The key to avoiding problems for young people is to start a dialog about why younger people are valuable, so that the issue is on the social agenda before it becomes a problem.

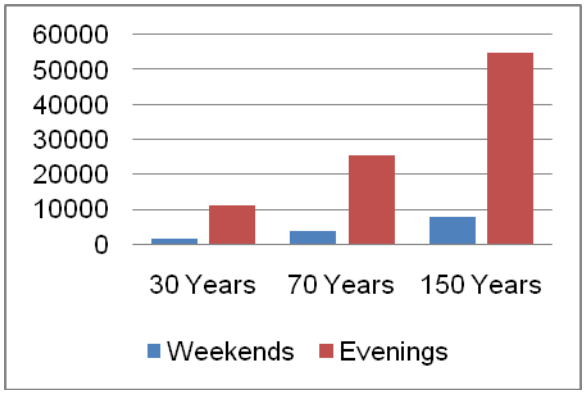
Going Long on Ambition

The degree to which longevity will change the economic order also depends somewhat on how much of an effect an increased healthspan has on the conditions of human ambition. A strong source of motivation, ambition affects individuals and societies on a large scale. Longer healthspans mean that individuals no longer have to curtail life plans so that they accomplish only what can be accomplished in the formerly-expected life-span of around 75 years. That is, an individual's aspirations will no longer be limited to achieving what one expects to achieve in less than 100 years. For instance, when Donald Boudreaux, Chairman of the Department of Economics at George Mason University, was asked about his current lifespan and career plans, the 50 year old said "I won't [have time to do work that will] win a Nobel Prize, so I am focusing on communicating economics to the public."[xxii] But what if Dr. Boudreaux had more time? He may still not win a Nobel Prize, but he might try new projects that he thinks could lead him there and that activity would be good for society. Consider that in the future, an equivalent human to Albert Einstein could walk the earth for 150 years, making so many contributions to society that for at least the initial social acclimation to increased longevity, these individuals would seem god-like. Of course, once society becomes acclimatized to longer working years, one might think that Albert Einstein was significant, but qualify that he was accomplished considering that he lived for less than 100 years. It might be tempting here to think that longer lives could harm ambition because they would allow more time to procrastinate. Perhaps some will look at it that way, but since longer lives do not mean immortal

lives, individuals will know that their time is limited and that their lives could unfortunately come to an end through an accident or other misfortune. This knowledge should tilt things in favor of enhanced ambition and, for some, that will mean having multiple careers. Today, if someone dreams of being both a lawyer and a doctor, it is unlikely that they will do both. However, in a world with longer healthspans, a person could very well have two distinct careers that each require a significant amount of education.

There have always been certain individuals who work their whole lives and never retire. They do so not because they need money, but because they are ambitious and enjoy building wealth, power and knowledge. In a world where some of these individuals live to be 150 years old, the corporate empires they build could be bigger than anything we've ever seen.

Of course, not everyone likes their job, and the mere idea of doubling the amount of time that one will need to slog away frightens some. "Let's face it," says Chris Hackler, Director of Medical Humanities at the University of Arkansas, "most people's jobs aren't all that fascinating."[xxiii] It's true that not everyone loves their job, but how many of them would wish that they only had a life expectancy of someone born in 1900 (around 30 years)? If one lived only 30 years as compared with the current average of around 70 years, that person would only get to enjoy 1560 weekends and 10,950 evenings during which they might go to concerts or enjoy time with family. In contrast, living to 70 years old allows for 3640 weekends and 25,550 evenings, and if one were to live to 150, available weekends and evenings would be 7800 and 54,750 respectively (see chart below).



In theory, an individual might say that he or she is willing to give up the extra time to prevent boredom at work, but in practice, unless one is severely depressed, the idea is always rejected. Also, as already discussed, having more time means greater opportunities for the education that leads to more stimulating jobs. We have also already established that individual and societal wealth grows with longer lives, so people with longer healthspans will be better off at home *and* at work.

The Nature of Work and Redefining Retirement

Since longer lives make us richer, will that mean people will work less? That is, to address an earlier question, will we become less harried? The answer depends on a number of factors, including how much our extra years and corresponding wealth creation affect our preferences for trading between work and leisure activities. For years, leisure experts and futurists have been predicting that as the economy grows, work will start to fade away. For instance, Herman Kahn and Anthony I. Weinter predicted that, by the year 2000, people would only work 7.5 hours a day, four days a week, and enjoy 13 weeks of vacation.[xxiv] Yet, as of this writing, there's been no gigantic all-around surge in America's golf-course visiting, cocktail sipping, leisure class.

Perhaps that's because many workers now spend more time *at work* doing leisure activities such as surfing the Internet, conducting personal business, running errands, and socializing with co-workers. This growing interconnection between work and personal time may also help to explain why some workers today are not interested in retiring. For instance, 84 year old Jean Hines of Sullivan, St Louis says that she continues her job at an airplane parts manufacturing plant because she "can't just sit at home." The work seems to give her more purpose than she might have had otherwise.[xxv]

Of course, a more convincing reason for the persistence of work, despite increased wealth, is capital accumulation. We have already seen that longer lives increase the population's pool of experience, so now we need to consider how that will affect wages. An ever-increasing lot of human capital will increase the wages of those that are very experienced. As the worker's wage increases, he or she will find it difficult or perhaps even undesirable to have too much leisure time *at any given time* for

fear of losing both capital and additional experience in the work force (such as leaving the workforce for a long period of time to bear and raise children, or to attend college). However, there could also be a point at which the worker's experience makes them too expensive and the employer begins to favor younger people. At that point, workers will start to see a need for new education in order to embark on a new career. When that point happens will be up to the market. Nevertheless, workers generally find efficiency from remaining in the work force longer, so as to accrue experience years, so it is likely that they will try to incorporate more leisure and education *into* those years, so that there is a smoothing of the lifetime activities. That is, one may pursue a career in finance for 75 years, while at the same time taking more frequent vacations, working less hours a day, and pursuing additional education throughout the prime earning years. The main tensions involved here will primarily be in figuring out how to move society from a culture where we are used to doing one thing at a time for potentially long periods to one in which we have more variety for shorter periods of time. We are already seeing the beginnings of a cultural shift in this direction with the so-called "attention deficit disorder" syndrome bought on by the Internet. Such a lifestyle change has implications for the definition of retirement.

It's already common knowledge that most of us don't expect a retirement that starts at 65. In the longevity-enhanced society, going out to the pasture to rest at 65 gets boring if one lives to be 150 or even 200 years old. Instead, as discussed above, additional life years will be used for secondary and tertiary life goals. For example, those who struggled between a career path in finance or starting their own business could choose both dreams and "retirement" might be redefined to mean the expensive chunk of time that someone takes out of regular working life in order to train extensively for a new career. Consider that one might select to have 60 years in the business world, 60 years as a doctor, and 30 years accumulating human capital through education. Because of the ability to obtain secondary and tertiary life goals, retirement as we know it now will be put-off until serious disability, and work-hours will decline only as a result of health decreases in the latter half of a 150 year life-span. In some ways, this shift will be a throwback to agrarian societies where retirement didn't really exist. Back then, one worked the fields until they just couldn't anymore. The difference, of course, is that in the future people will be

much wealthier than those in agrarian societies and will likely not be doing manual labor. Indeed, retirement itself is a relatively new concept that was only officially made into American law after President Franklin D. Roosevelt proposed the Social Security Act of 1935. Interestingly, President Roosevelt proposed the act as a more moderate version of a popular program that Californian Francis Townsend was proposing which would have made retirement mandatory at age 60 and offered generous pensions of up to $200 a month, an amount equivalent at the time to a full salary for a middle-income worker.[xxvi]

Savings and Investment

No matter how the balance between work and leisure is resolved, there will remain a period of human life when individual income will be dependent on capital already accumulated either by the individual or by society as a whole. One interesting finding is that, within the US, many who already live to around 100 have both planned financially for their retirement and have continued to accumulate capital post-retirement.[xxvii] A study conducted by Thomas Perls, assistant professor at Harvard Medical School, and his colleague Lara Terry, showed that their sample of centenarians "had lived 30 years beyond what they expected to live, and they still had a little extra."[xxviii]

However, not everyone is so good at planning and, at the moment, there is consensus that people tend to save too little. Indeed, evidence from across the OECD suggests that people tend to feel they have saved too little for their retirement.[xxix] Why is this the case and how will longer lives change an individual's propensity to save?

Research based in economics and psychology can help us understand why people save or not. Irving Fisher, who was arguably America's first celebrity economist, argued that there are six personal characteristics that influence savings. They are: whether the individual is short or long sighted, one's level of self-control, habits of thrift, expectation of length of life, desire to leave money after one's death, and how much a person is influenced by social pressure to spend, such as the idea of keeping up with the Joneses.[xxx] Obviously there are a lot of factors in this basket of traits, but at least three of Fisher' six

characteristics may be influenced by longer lives. These are the expectation of length of life, the degree of short sightedness, and the desire to leave money after one's death.

In a world where human healthspan increases to around 150 years, it is clear that the expectation of length of life will grow. Longer lives mean that there is a longer period of time to be around, and this will increase each individual's amount of uncertainty. Greater uncertainty typically generates higher savings, as people begin to put money away just in case things don't work out as planned. Of course, many things can affect the population's degree of certainty. For instance, governments that promise wage increases or new social benefits may help take away uncertainty and affect the savings rate. In general, however, if all things are kept equal, a longer life should prompt greater savings due to the greater length of time that one will have to save as well as the increased uncertainty of a longer life (and this is not even considering the effects of compound interest yet). Fisher's other two characteristics, the degree of short or long sightedness and desire to leave money after one's death are more difficult to use as predictors, but there are some things we can say about how they may affect savings.

Nobel Prize winning economist Milton Friedman analyzed consumption data and found that people tend to have time horizons of three to four years.[xxxi] Of course, planning for retirement or saving for other long-term needs requires thinking farther ahead than four years, so both economists and psychologists maintain that the vividness of a future image is important in determining whether people follow through with savings or not. Put another way, it is easy to imagine how that new pair of shoes will look on you tomorrow if you buy them today, but it is harder to imagine how saving now will allow you to go back to school with the same standard of living in ten years. However, in a world where people are increasingly living longer, it should be easier to imagine living a very long time (especially when one can see actual people living longer) and imagining things that one would want to save for over the decades. Indeed, one day, banks and other financial institutions might take a greater interest in advertising to consumers about how saving now will create many more opportunities later.[xxxii] This type of advertising and potential cultural shift in thinking about the future may influence Fisher's category of short vs. long sightedness. If individuals can see other people living their dreams through savings, as well as being told

about it through various media outlets, it is possible that longer lives will increase people's propensity towards being longsighted. One of the technologies being developed today that might make such advocacy easier is automated financial goal planning software. Companies like Mint, an online personal finance tool, helps users find personalized ways to save money and could one day better help users track and reach long term financial goals. Will Wade, one of Mint's users, says he is already benefitting from such help. "My wife and I started using Mint right after we got back from our honeymoon," he said. "We were both still in college at that time and we knew watching our income would be very important. Mint allowed us to see not just where our money was going, but also to understand where our money needed to go."[xxxiii] Such personalized help from computer programs is only the beginning of where banks can make inroads with a population that is both about to live longer and is notorious for not saving enough for their current lifespans.

The last of Fisher's savings characteristics that could be influenced by longer lives is bequests, or the desire to leave money for loved ones or for society in general after one is gone. Understandably, a common conclusion on the future of bequests is that older people are now spending most of the money that otherwise would have been left as an inheritance in times gone by. Today, with increased health care costs at the end of life, and with many older people healthy enough to spend their time travelling and shopping, many children expect to see their inheritance shrink or disappear altogether. Indeed, according to a 2006 study by the AARP, the median American inheritance is $49,000, barely enough to pay for one year at a private college.[xxxiv] However, that is the situation today. It could continue, but it could also be the case that other factors will come into play, such as potentially less expensive health care (we will discuss this in a moment) and compound interest combined with larger family structures that shift motivations.

There will always be a certain percentage of the population that doesn't save, but as noted earlier, longer lives should tend to increase, not decrease, personal savings. If that is the case, savings will be invested and will be earning interest over a longer period of time than ever before. Since compounding works by adding accumulated interest back to the principal, interest is continually earned on top of

whatever principle there was plus the interest that the individual already made from each moment on. This means that money grows at a much faster rate than if one were to just stuff bills in one's mattress. Indeed, compounding works so well that Albert Einstein called it the "eighth wonder of the world."

An example below helps to show that *how long* someone saves matters just as much as how much is saved. In the example, the following assumptions have been made: 1) the individual will retire at 65 as many do today; and 2) annual net interest is constant at 5% (i.e., this is above any inflation). With these assumptions, four scenarios are tested:

1) The person saved $100,000 at 30;

2) The person saved $100,000 at 35;

3) The person saved $100,000 at 40;

4) The person saved $100,000 at 50.

For simplicity, it is assumed that no subsequent net savings are made. The relationship between savings and compound interest of 5% are reflected in the below chart:

$100,000 is saved at age	**Value of investment at age 65**	**Additional value in last 10 years**
30	$551,602	$212,966
35	$432,194	$166,864
40	$338,635	$130,743
50	$207,893	$80,265

Thus, we can see that 35 years of compound interest has the effect of increasing the value of the $100,000 in savings by 451.6% to over half a million dollars (and of this, almost 50% is added in the last 10 years before retirement). On the other hand, saving over a period of 15 years only has the effect of doubling the

initial amount. Clearly, time does matter quite a bit when it comes to savings, which of course brings up the question of what happens if we are able to double our lifespan. If we had longer amounts of time, we would probably keep adding to our savings, but even if we didn't, compound interest would keep growing savings. The same chart appears below, but with a column that makes room for someone who retires at 130 years old.

$100,000 is saved at age	Value of investment at age 65	Value of investment at age 130
30	$551,602	$13,150,126
35	$432,194	$10,303,468
40	$338,635	$8,073,037
50	$207,893	$4,956,144

Clearly, older people who started saving at a younger age will benefit the most from compound interest, and since people in a longer-lived world will be incentivized to save more, that means older people will have more money than they do today.

Of course, large sums of money don't negate the fact that there will be costs. Health care costs are usually highest near the end of life, and large sums are often spent trying to fight the inevitable. Indeed, as New York Times writer Bob Morris pointed out in an article on inheritance, he and many others worry that health costs will consume what they eventually receive from their parents.

"Much as I hate to admit it," Morris wrote, "there were plenty of moments during the last year when I was consumed with an invisible ledger in my brain: my inheritance versus [my father's] health costs. Fifteen hundred dollars a week on this. Six thousand a month on that. It could all add up to leaving nothing."[xxxv] Will this trend continue? Will all the new technologies just wind up adding more and more expenses at the end of life that will eat up even the greater savings that people with radically extended lives will accumulate? Not necessarily. Consider that when someone is able to replace a heart instead of simply taking drugs to fix symptoms of a sick heart, there will be fewer trips to the emergency room

afterward, saving money. Likewise, if technology leads to a greater compression of mortality, people can expect to be healthy for longer, with shorter periods of sickness that call for expensive techniques to keep them alive.

Conclusions

One of the questions raised at the beginning of this chapter was whether individuals will feel less "harried" as they gain more time due to longevity. Factors that influence the answer to this question include amount of time gained, levels of economic growth, and preferences in the tradeoff between money (productivity) and leisure. Given that time will grow, but productivity will as well, the likely outcome for a country like the United States that highly values productivity is that people may become only slightly less harried. Talk show hosts, women's magazines, and celebrity trainers can rest assured that there will always be a large market of people interested in hearing about Dr. Oz's "maximize your time workout." Greater wealth generation will give individuals more resources with which to occupy their increased time and they are likely to fill up their calendars as they do today. The upside however, is that more time and greater wealth translates into more experiences that can contribute to individual growth and self-actualization. The possibilities are endless.

With more weekends in one's life, there can be more short get-a-ways to wine country or more chances to see one's favorite team play soccer. For those who like to shop, the combination of greater time and wealth is obvious. There will also be new possibilities such as space travel or real-seeming virtual reality worlds. And of course, some of our additional experiences will certainly be created through formal education, which can be expected to increase over one's lifespan since continuous learning will be required even more than it is today to stay competitive in the marketplace.

Taking time off work to get re-educated will be the new definition of retirement. When people can stay healthy and vibrant for longer periods and reduce their disability time before their death, retirement as we know it today won't exist. Individuals will not look forward to going out to pasture to

rest, but will instead look forward to taking some time off in order to start a new career or pursue other life interests.

Death will still be a fact of life in a longer-lived world, and ambition to leave one's mark will not disappear. Indeed, longer lifespans give the super-ambitious even more time to create and grow their empires. Jack Welch is no longer CEO of General Electric, but he still enjoys giving advice through his website and BusinessWeek magazine column – just imagine what he would do if he thought he had an extra 50 healthy years ahead of him.

Having so many vibrant older people around poses a potential problem for the job prospects of younger people, but it is not an insurmountable issue. Society has an interest in intergenerational harmony and corporations will have limits on how much they are willing to pay for experience. It could be the case that younger people, who will be paid less, may be a better bargain for employers who are looking to streamline their business costs. That said, there will be intergenerational tensions simply because of cultural differences. Any boomer who has tried to manage someone from generation Y knows that, even now, the challenges can be great.

National savings rates have recently been quite low, but longer lives may change that trend. The increased uncertainly associated with longer lives should spur more people to get serious about saving. New technologies like online financial management tool Mint can help individuals learn to better manage their funds. For those who are diligent, compound interest will have an even bigger impact on their bottom line, as more time means greater wealth generation opportunities.

That is the quick summary of what will happen to our financial lives with the onset of longer healthspans. Next up, we consider what happens to our souls and those who purport to care for them.

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